Centennial Coal

CENTENNIAL COAL
MYUNA COLLIERY
ANNUAL REVIEW

March 2017

Centennial Coal
Environment Matters

Table 1 Annual Review Title Block

Name of operation	Myuna Colliery
Name of operator	Centennial Myuna Pty. Ltd.
Development consent / project approval #	PA10_0080 MOD1 SH110-148
Name of holder of development consent / project approval	Centennial Myuna Pty. Ltd.
Mining lease #	ML1632 ML1370 MPL334
Name of holder of mining lease	Centennial Myuna Pty. Ltd.
Water licence #	20BL172565 20BL173259
Name of holder of water licence	Centennial Fassifern Pty. Ltd.
MOP/RMP start date	1st January 2016
MOP/RMP end date	30th November 2022
Annual Review start date	1st January 2016
Annual Review end date	31st December 2016

I, Mick Cairney, certify that this audit report is a true and accurate record of the compliance status of Myuna Colliery for the period 1st January 2016 to 31st December 2016 and that I am authorised to make this statement on behalf of Centennial Myuna Pty. Ltd.

Note:

a) *The Annual Review is an 'environmental audit' for the purposes of section 122B(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	Mick Cairney
Title of authorised reporting officer	Executive General Manager Operations
Signature of authorised reporting officer	
Date	27.3.2017

Contents

1. STATEMENT OF COMPLIANCE

Table 2: Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
Project Approval 10_0080 MOD1	NO
Development consent SH110/148	YES
Mining Lease 1632	NO
Mining Lease 1370	YES
Mining Purposes Lease 334	YES
Exploration Lease 4444	YES
Exploration Lease 6640	YES
Bore Licence 20BL172565	NO
Bore Licence 20BL173259	YES
Environment Protection Licence 366	NO
Section 151 Point Wolstoncroft SCA	YES
Section 151 Pulbah Island SCA	YES
Section 151 Wangi Point SCA	YES

Table 3: Non-Compliances

Relevant Approval	Condition #	Condition summary	Compliance Status	Comment	Page # addressed in Annual Review
PA10_0080	Sch 3 Condition 11	Noise limit	Low	Exceedance of noise criteria limit at R4 and R6.	Section 11
PA10_0080	Sch 3 Condition 13	Noise Management Plan	Administrative	The collection of real time noise data for modelling purposes to facilitate compliance with PA10_0080 was not detailed in the Noise Management Plan.	Section 10.1
PA10_0080	Sch 3 Condition 21	Surface water discharge	Low	Exceedance of EPL366 TSS concentration limit at LDPB.	Section 11

EPL366	L5	Noise Limit	Low	Exceedance of noise criteria limit at R4 and R6.	Section 11
EPL366	L2	Water concentration limit	Low	Exceedance of TSS concentration limit at LDPB.	Section 11
ML1632	Condition 12	Prevention of soil erosion and pollution	Low	No sediment or erosion controls installed beneath the LDP A outflow.	Section 10.1
20BL172565	Condition 2	Authorisation for extraction of surface or ground waters from central coast-hunter porous rock groundwater source.	Administrative	There is no verification of impact to alluvial groundwater.	Section 10.2
20BL172565	Condition 3	Groundwater Management Plan	Administrative	Implementation of the Groundwater Management Plan was found to be non compliant.	Section 10.2
20BL172565	Condition 4	Annual Groundwater Management Report	Administrative	The Annual report does not include all extraction data.	Section 10.2
20BL172565	Condition 8	Installation of approved appliance to measure groundwater extraction	Administrative	Flow meter not approved by DPI Water	Section 10.2

Note: Compliance Status Key for Table 3

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 (e.g. submitting a report to government later than required under approval conditions)

2. INTRODUCTION

Myuna Colliery is an underground coal mine owned and operated by Centennial Myuna Pty Limited. Myuna is located 25 km south west of Newcastle NSW in the Lake Macquarie and Wyong Local Government Areas.

Lake Macquarie City Council (LMCC) granted Development Consent SH110_148 for the development and operation of the Myuna and Cooranbong Collieries in 1977. The Development Consent was granted pursuant to the provisions of the now repealed Local Government Act 1919. The Development Consent remains in force and authorises the extraction of coal within the Development Consent Mining Area.

The Development of Myuna Colliery began in 1979 and underground mining using bord and pillar mining methods commenced in 1982. Centennial Coal Company Ltd acquired Myuna Colliery in 2002, and has operated the mine since this time.

On 18 January 2012, the then Minister of Planning and Infrastructure granted Project Approval (PA) 10_0080 to Centennial Myuna. A modification to PA10_0080 was approved 1st February 2015.

PA 10_0080 (MOD1) authorises the continued mining in areas outside the existing Development Consent SH110_148 mining area and within the boundary of existing mining leases held by Centennial Myuna. PA 10_0080 MOD1 authorises:

- the use of bord and pillar methods in the Wallarah, Great Northern and Fassifern coal seams;
- the continued use of ancillary infrastructure until 31st December 2032;
- The extraction of not more than 3 million tonnes of ROM coal from the site in any calendar year.

The following are the mine contacts for any information with regards to this report.

Table 4: Site Contacts

Name	Position	Email Address	Contact Telephone Number
Mal Yule	Mine Manager	myunacolliery@centennialcoal.com.au	02 4970 0221
Pieter Van Rooyen	Technical Services Manager		02 4970 0207
Michael Gale	Environment and Community Coordinator		02 4970 0263

3. APPROVALS

The Colliery lease lies within the Parishes of Awaba, Coorumbung, Morisset and Wallarah in the County of Northumberland subsidence district and is located within the Shire of Lake Macquarie.

The Myuna Colliery Holding is covered by Mining Lease No 1632. Mining Lease No 1632 includes a surface land area of 33 hectares for mine infrastructure (Mining Purposes Lease No. 334). The total lease area is 7426.5 hectares.

Centennial Myuna had subleased part of Consolidated Coal Lease No 762 held by Centennial Mandalong Pty Limited. The sublease area was then transferred to Centennial Myuna Pty Limited as ML1632. Effectively ML1632 replaced Part CCL762. The lease areas are shown on the Myuna Colliery Holding Plan PC14.

MPL334 was granted the 20th October 1994 for a period of 21 years. The renewal of the Mining Purposes Lease 334 took effect 20th October 2015 for a further period of 21 years to 20th October 2036. The lease conditions were amended upon renewal.

Centennial Myuna submitted an Annual Compliance and Rehabilitation Report detailing compliance and rehabilitation performance against Myuna Colliery MPL334 conditions for the twelve month period ending the MPL334 grant anniversary date 20th October 2016 in accordance with MPL334, Condition 3 and Condition 4, and Department of Trade and Investment (DTI) Annual Review Guideline October 2015.

There is an overlap of the reporting periods for the MPL334 Annual Rehabilitation and Compliance Report 2016 and this Annual Review 2016 from the 1st January 2016 to 20th October 2016.

Myuna Colliery is classed a Level 1 mine. PA 10_0080 was granted by the Minister for Planning on 18th January 2012 under Section 75J of Part 3A of the EP&A Act 1979.

A summary of Myuna's Approvals, Authorities and Licences is presented in the Tables below.

Table 5: Project Approvals

Approvals			
Approval Number	**Summary**	**Date Granted**	**Expiry Date**
SH. 110/148	Development Consent for Myuna Colliery	21/12/1977	No expiration date specified in the consent. Subject to renewal of mining leases
PA 10_0080 (MOD1)	Myuna Colliery Mining Project Modification to Project Approval (increase ROM production from 2 to 3 Mtpa)	27/02/2015	31/12/2032

Table 6: Mining Authorisations

Mining Authorisations			
Approval Number	**Summary**	**Date Granted**	**Expiry Date**
ML 1632	Mining Lease	13/04/2013	13/10/2022
MPL 334	Mining Purposes Lease	20/10/1994	20/10/2036
ML 1370	Mining Lease	26/09/1995	07/03/2033
EL 4444	Exploration Lease	23/10/1992	23/10/2017
EL 6640	Exploration Lease	23/10/1992	23/10/2017

Table 7: Licences and Permits

Licences and Permits			
Approval Number	**Summary**	**Date Granted**	**Expiry Date**
Section 151 Licence	Mining Operations – Various Licence, Point Wolstoncroft	11/09/2015	10/09/2020
Section 151 Licence	Mining Operations – Various Licence, Pulbah Island	1/11/2016	31/10/2021
Section 151 Licence	Mining Operations – Various Licence, Wangi Wangi Point	16/02/2016	15/02/2021
20BL172565	Bore Licence (Dewatering ground water 4380 ML)	12/12/2015	
20BL173259	Bore Licence (Monitoring Bores)	7/08/2012	Perpetuity
D 171027	Trade Waste Permit	23/10/1995	N/A
EPL 366	Environment Protection Licence (EPL)	10/07/2000	N/A

4. OPERATIONS SUMMARY

Table 8: Production Summary

Material	Approved Limit (and source)	Previous Reporting Period 2015 (Actual)	This Reporting Period 2016 (Actual)	Next Reporting Period 2017 (Forecast)
Waste Rock/ Overburden	N/A	Nil	Nil	Nil
ROM Coal	3,000,000	1,707,027	1,381,968	1,776,240
Coarse reject	Nil	Nil	Nil	Nil
Fine reject (Tailings)	Nil	Nil	Nil	Nil
Saleable product	3,000,000	1,707,358	1,378,591	1,776,240

4.1. Other Operations

Table 9: Operations Summary

	Approved Limit (and source)	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Comment (if applicable)
Hours of operation	8760	8760	8760	Nil
Transport (rail)	Nil	Nil	Nil	Nil
Transport (road)	Nil	Nil	Nil	Nil
Overland Conveyor	8760	8760	8760	Nil

4.2. Next Reporting Period

There is no significant material change planned for Myuna Colliery in the next reporting period.

5. ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

The 2015 Annual Review was submitted to the Department of Industry - Division of Resources and Energy (DRE) 30th March 2016 and the Department of Planning and Environment (DPE) 24th March 2016 in accordance with Schedule 5, condition 4 of the Project Approval 10_0080.

DRE and DPE reviewed the Annual Review and determined that the report generally satisfied the requirements of relevant conditions of the company's approvals and mining

leases. DRE accompanied by DPE conducted a detailed site inspection of Myuna pit top and infrastructure areas on 6th May 2016. The purpose of the inspection was to review compliance with environmental requirements of relevant approval instruments including the Mining Lease, Mining Operation Plan (MOP) and Annual Environmental Management Report (AEMR).

During the inspection, there was general compliance with the relevant statutory approval instruments administered by the DRE.

DRE correspondence dated 23rd August 2016 outlines the actions required following the report review and site inspection. DRE advised the following actions were to be completed by 30th September 2016:

- Correctly store drums in workshop.
- Review waste handling procedure.
- Remove piles of coal fines from soil stockpile area.

No correspondence was received from DPE following the site inspection

Table 10: Actions undertaken since last report

Action Required	Requested By	Action Taken	Where addressed in Annual Review
Correctly store drums in workshop.	DRE	Oil drums correctly stored in bunded area. Hydrocarbon Management training package developed.	Section 12
Review waste handling procedure.	DRE	Waste management procedures reviewed.	Section 12
Remove piles of coal fines from soil stockpile area.	DRE	Coal fines removed from soil stockpile area.	Section 12

6. ENVIRONMENTAL PERFORMANCE

6.1 Noise

The control strategies were implemented as per the Noise Management Plan and were adequate to manage the risks associated with the operation during the report period.

The Myuna Colliery Noise Management Plan outlines potential sources and impacts of elevated noise levels. The Plan also identifies measures which must be in place to reduce noise levels. All contractors and employees undergo induction and regular refresher training that identifies individual responsibilities for noise management.

Result Summary

Attended noise monitoring is undertaken quarterly in accordance with the Myuna Colliery EPL 366 and the Project Approval. Noise monitoring is consistent with the OEH Industrial Noise Policy and Australian Standard AS 1055 Acoustics, Description and Management of Environmental Noise.

The attended monitoring is conducted at 8 locations around the Myuna Colliery pit top. The noise monitoring data is assessed against the Project Approval and EPL limit criteria.

There was one exceedance of the noise limit criteria for the 2016 report period. The exceedance of the limit criteria occurred during the daytime attended monitoring on Tuesday 28th June at the R4 and R6 receiver location. Details of the exceedance are provided in Section 11 of this report.

Trend

Myuna Colliery has undertaken a program of attended noise monitoring from December 2012 to December 2016. The attended monitoring results have shown a consistency over the 4 year period. Colliery operations were subjectively observed to contribute little to the measured LAeq noise levels during any period throughout the day apart from the exceedance in the 2016 report period. Extraneous noise sources, namely road traffic, contribute significantly to the noise levels.

EA Prediction

The Myuna Colliery Extension of Mining Project Noise Impact Assessment (Heggies 2010) predicted the operational noise levels and the noise emission levels of the Emergency Stockpile Area during operation would meet the project specific noise criteria at all assessed residential receivers under calm and prevailing weather conditions with the recommended noise mitigation and management strategies in place.

New Material

A Northern Region Noise Management Plan which will encompass the Centennial Coal operations, Mandalong, Myuna, Newstan and Northern Coal Services, has been developed and submitted to Department of Planning and Environment for approval.

6.2 Air quality

Control strategies were implemented as per the Air Quality Management Plan and were adequate to manage the risks associated with the operation during the report period.

The Air Quality Management Plan for the site outlines potential sources and impacts of elevated dust levels. The Plan also identifies measures which must be in place to reduce dust and environmental activities conducted to minimise elevated dust levels. All contractors and employees undergo induction and refresher training that identifies individual responsibilities for air quality management.

6.2.1 Depositional Dust Gauge

Result summary

The air quality monitoring data is assessed against the Project Approval and EPL limit criteria. There were no exceedances of the air quality limit criteria for the report period.

Depositional dust monitoring was performed at Myuna Colliery during 2016 on a monthly basis at four depositional dust gauges. The limit criteria for depositional dust is 4g/m^2/month applied as an annual average. A high recording of 18.5mg/m^2/month was recorded at DG 4 in July. Data collected at the Myuna Colliery weather station indicated predominantly west to north westerly winds during the sample period. DG 4 is located to

the west of the coal handling plant and waste depot. The CHP and the waste pad were considered to be a possible source of the dust recorded at DG 4. Contributing factors were considered to be a long dry spell and a consistent westerly wind.

The current air quality controls include enclosed conveyor and coal handling plant, water sprays on the conveyor system and haul road, and a road sweeper. Further controls are being investigated specifically for the waste handling facility which include resurfacing of the waste handling facility and water cannon.

Table 11: Dust Gauge Data

Dust Gauge	Number of samples req.	Number of samples collected and analysed	Lowest sample value	Mean of sample	Highest sample value
DG1	12	12	0.1	0.8	3.1
DG2	12	12	0.2	0.7	1.7
DG3	12	12	0.3	1.8	6.8
DG4	12	12	0.3	3.1	18.5

Trend

Myuna Colliery has 12 years of dust monitoring data over a 13 year period from January 2003 to December 2016. Data for a 10 month period from February 2007 to November 2007 is not available. A trend analysis was undertaken using a linear trend line for the dust deposition monitoring from January 2003 to December 2016.

The 2016 annual average and long term average for each dust gauge is provided in Table 12.

The 2016 annual average for dust gauge 1, 2 and 3 is consistent with the 13 year long term average. The 2016 average for DG2 & 3 is less than the long term average while DG1 annual average is equal to the long term average. The 2016 annual average for DG 4 is higher than the long term average. The difference between the annual average and the long term average for DG 4 is due to the high result of 18.5 mg/m^2/month recorded in July 2016.

The long term trend line of DG 1 and DG 3 displays a decreasing trend for the monthly dust deposition while DG 2 and DG4 displays an increasing trend.

Table 12: Dust Gauge Annual Average and Long Term Average

Dust Gauge	DG1	DG2	DG3	DG4
2016 annual average	0.8	0.7	1.4	3.0
Long Term Average	0.8	1.0	1.8	1.4

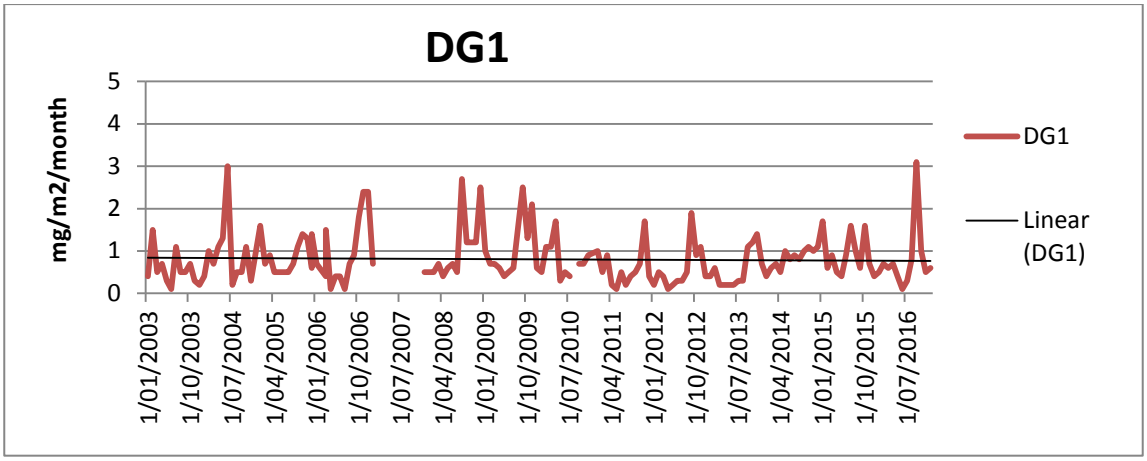


Figure 1: DG1 Monthly Monitoring Results and Linear Trend Line

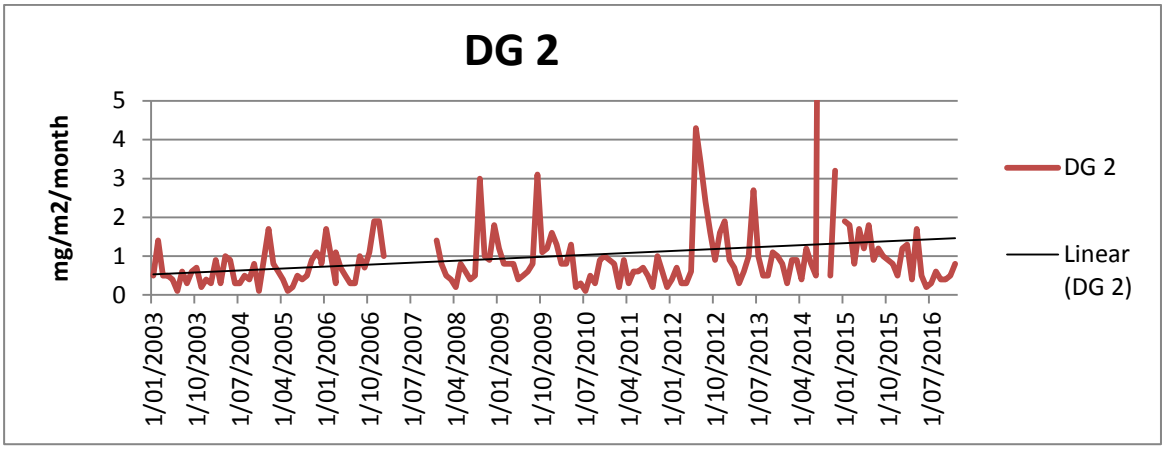


Figure 2: DG2 Monthly Monitoring Results and Linear Trend Line

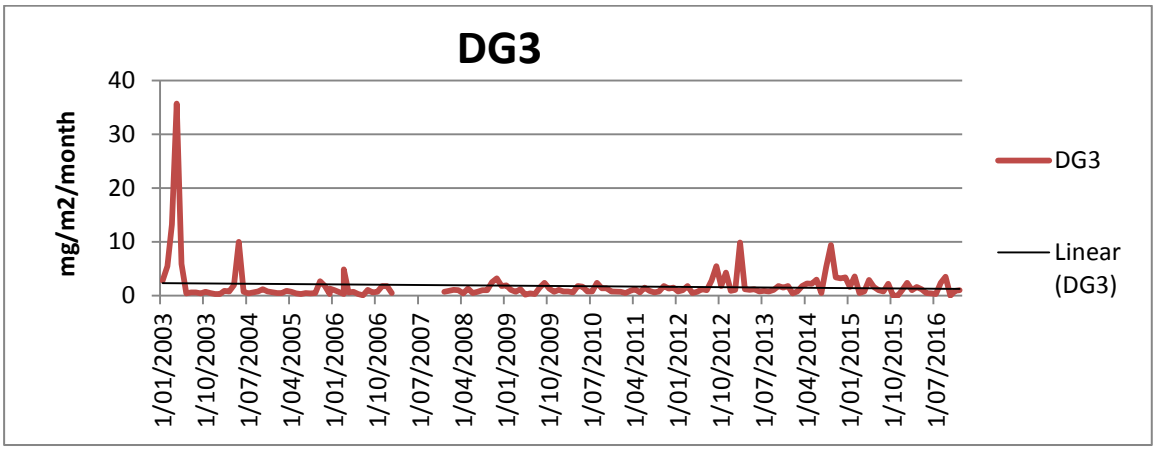


Figure 3: DG3 Monthly Monitoring Results and Linear Trend Line

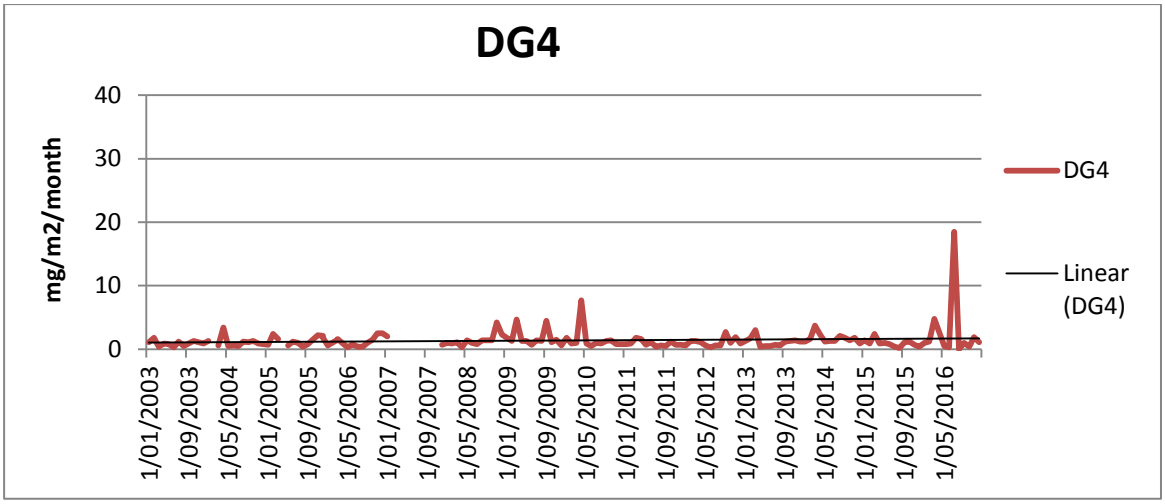


Figure 4: DG4 Monthly Monitoring Results and Linear Trend Line

The Dust Deposition Gauge DG4 for August 2016 and DG3 for October 2016 were heavily contaminated with material not associated with deposited dust. The visual analysis from the field staff indicated that the sample was primarily composed of bird droppings and insects.

The contaminated samples are excluded from the annual and long term average analysis

EA Prediction

The Myuna Colliery Extension of Mining Project Air Quality Impact Assessment (Heggies 2010) predicted the dust deposition levels would be below the Project air quality criteria at all receptors. The dust deposition results for the report period have been consistent with the EA prediction.

6.2.2 HVAS

Result Summary

Air quality monitoring for PM_{10} and Total Suspended Particles (TSP) commenced in August 2013. The monitoring has been conducted in accordance with PA10_0080 condition 17 and EPL366 condition M2.

The air quality monitoring data is assessed against the Project Approval and EPL limit criteria. The limit criteria for the annual average TSP is 90ug/m^3 and PM_{10} is 30ug/m^3. The limit criteria for 24 hour PM_{10} is 50ug/m^3. There were no exceedances of the air quality limit criteria for the report period.

The maximum recorded 24 hour PM_{10} concentration for the report period was 39ug/m^3 and the maximum recorded 24 hour TSP concentration for the report period was 81ug/m^3.

Trend

The 2016 annual average for TSP and PM_{10} is less than the long term average.

The trend analysis was undertaken using a linear trend line for the TSP and PM_{10} monitoring data from August 2013 to December 2016. The trend line indicates a decreasing trend for the TSP and PM_{10} over the long term monitoring period.

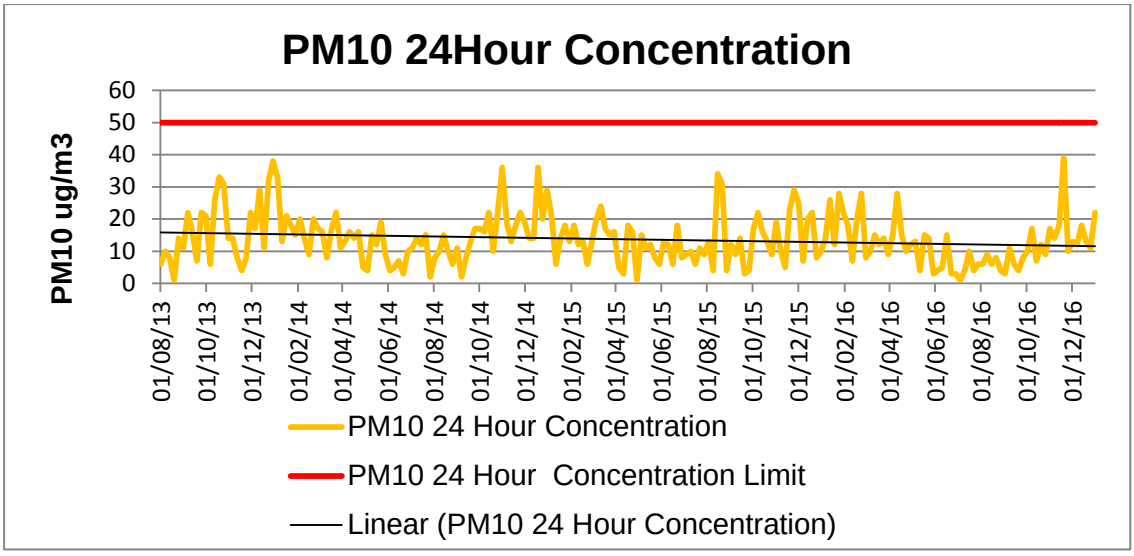


Figure 5: PM10 24 Hour Concentration Monitoring Results and Linear Trend Line

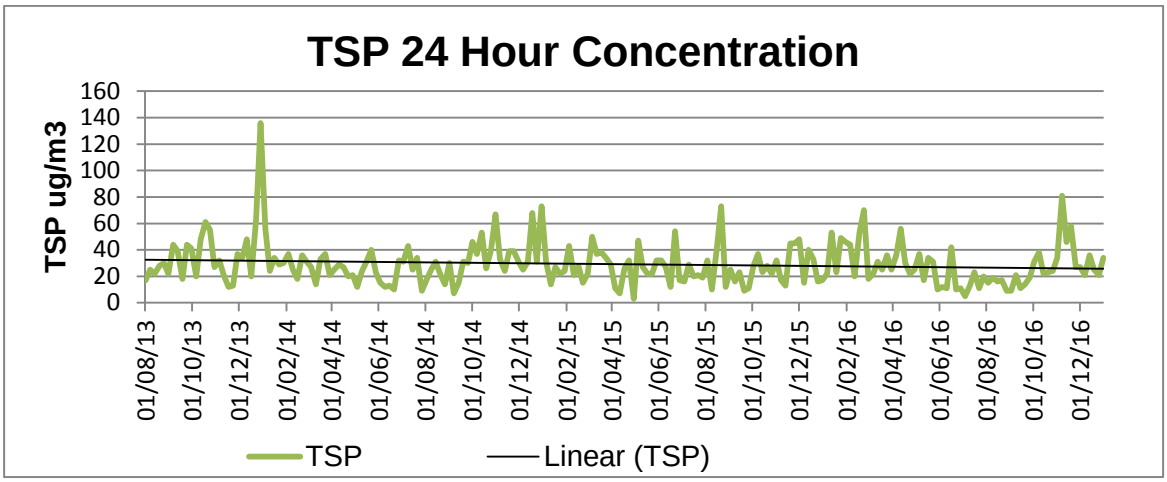


Figure 6: TSP 24 Hour Concentration Monitoring results and Linear Trend Line

Table 13: HVAS Data

HVAS	TSP	PM_{10}
2016 Annual Average (ug/m^3)	27.7	12
Long Term Average (ug/m^3)	29.1	13.7

EA Prediction

The Myuna Colliery Extension of Mining Project Air Quality Impact Assessment (Heggies 2010) predicted the cumulative annual average TSP and PM_{10} concentrations would be below the project air quality goal at all private receptors. Cumulative maximum 24-hour PM_{10} concentrations attributable to the Project were predicted to be below the project air

quality goals at all surrounding dwellings excluding periods of regional pollution events. The TSP and PM_{10} results for the report period have been consistent with the EA prediction.

New Material

A Northern Region Air Quality and Greenhouse Gas Management Plan which will encompass the Centennial Coal operations, Mandalong, Myuna, Newstan and Northern Coal Services has been developed and submitted to the Department of Planning and Environment for approval.

6.3 Biodiversity

Control strategies were implemented as per the Biodiversity Management Plan and were adequate to manage the risks associated with the operation during the report period.

The Biodiversity Management Plan for the site outlines measures in place to protect and enhance the Swamp Sclerophyll Forest on Coastal Floodplains Endangered Ecological Community (EEC) on Wangi Creek. All contractors and employees undergo induction and refresher training that identifies individual responsibilities.

Myuna Colliery engaged a consultant to conduct monitoring of the EEC near Wangi Creek. The 2016 Monitoring Report, Swamp Sclerophyll Forest on Coastal Floodplains EEC (RPS 2016) is provided in Appendix 3.

Result Summary

The EEC Monitoring Report (RPS 2016) provides the baseline assessment for ongoing annual monitoring.

Calculations were performed using the online NSW Bio Banking Credit Calculator (BBCC) to compare monitoring data with OEH published Plant Community Type (PCT) benchmark datasets to calculate site value scores; an objective and quantitative condition measure for vegetation and habitat. One ‘site based assessment’ assessment circle was used to evaluate native vegetation cover, condition, patch connectivity and size. Two vegetation management areas (VMAs) were mapped within the site. The site value score produced from data collected from three Biometric plots was compared with the corresponding PCT benchmark data (OEH 2016) to evaluate baseline condition (i.e. site value score).

Baseline site values scores for VMA 1 and VMA 2 (Table 6, Appendix 3) were found to be within a benchmark range (i.e. 71-100) thus represent vegetation and habitat in a ‘moderate/ good (high)’ condition. However, neither can be wholly classed within a benchmark state due to the presence of exotic plant species. VMA 2 is approaching the lower limit of the ‘benchmark range’ and requires active management in terms of exotic species, native groundcover shrub species and native plant species richness to produce an enhance outcome. A passive enhance outcome is anticipated in VMA 1 following the management of exotic species in VMA 2 (i.e. reduction in the source of exotic flora propagules).

Comparisons between Biometric monitoring data and the corresponding equivalent PCT benchmark dataset indicate the vegetation of the site is in moderate/ good (high) condition. Weed cover is highest in VMA 2 thus requiring focused weed management effort to meet enhancement objectives stated in the BMP. The Myuna Colliery Weed Action Plan 2017 (Appendix 2) describes the weed control work undertaken for the 2016 report period and provides an action plan for the next report period.

Approximately 120 labour hours was employed at the site actively controlling high priority target weeds. This equates to six days with a crew of two carrying out primarily cut and paint bush regeneration methods, supported by foliar spraying for dense Lantana, Cassia and Crofton weed infestations.

Weed control work was targeted at Area 2, 3, 4 and 5. Weeds targeted were Bitou Bush, Lantana, Crofton Weed and Cassia. Weeds targeted with in Area 4 along Wangi Creek where Lantana, Bitou Bush and Tree Tobacco. Other weeds targeted in Area 4 were Castor Oil and Pampas Grass. Area 2 was treated for Cape Broom, Cassia and Blackberry.

Ongoing works will be required in Areas 4 and 5 to control any new weed growth. Wangi Creek in Area 5 should be the focal point for 2017 with maintenance work in all other areas to follow.

Trend

From 2012 to the end 2016 there have been four Annual Weed Action Plans conducted at Myuna Colliery, including an annual weed survey and on ground works. This has resulted in the ongoing suppression and removal of Lantana, Bitou Bush, Pampas Grass, Pine Trees and Castor Oil among others.

EA Prediction

The Myuna Colliery Extension of Mining Project Terrestrial Flora and Fauna Assessment (RPS 2011) predicted due to negligible surface impacts the project was unlikely to impact on any threatened species, endangered populations or threatened ecological communities.

New Material

A Northern Region Biodiversity Management Plan which will encompass the Centennial Coal operations, Mandalong, Myuna, Newstan and Northern Coal Services, will be developed and implemented in the next annual report period.

6.4 Heritage (Aboriginal and European)

Control strategies were implemented as per the Northern Holding Aboriginal Cultural Heritage Management Plan (ACHMP) and the Non Indigenous Cultural Heritage Management Plan and were adequate to manage the risks associated with the operation during the report period.

Result Summary

RPS was engaged by Centennial Coal to prepare a baseline recording of middens at Pulbah Island in Lake Macquarie in accordance with Centennial ACHMP. The purpose baseline assessment was to provide a detailed recording of the conditions of the middens prior to undermining, as well as providing representatives of the registered Aboriginal Parties an opportunity to provide additional information on the ceremonial significance of the island. The baseline recording was undertaken in accordance with the approved Centennial ACHMP.

The survey of Pulbah Island was undertaken on Monday the 15th of August 2016 involving representatives from the Aboriginal parties who registered an interest in the Centennial Myuna Extension of Mining Cultural Heritage Assessment 2012.

RPS made the following observations, "*Midden sites 45-7-0087 and 45-7-0086 are in relatively good condition being stabilised by vegetation growth, new coordinates were gathered for site 45-7-0087. Midden site 45-7-0188 has suffered from natural erosion and has largely collapsed into the lake; this appears to be due to the sites north orientation which faces a large fetch. One new midden site was recorded on the south eastern shore of the island, AHIMS# 38-4-1823 and appears to be relatively stable due to vegetation growth, although some disturbances were noted such as camp fires*."

"This level of subsidence is negligible and therefore the proposed activity has no potential for harm to midden sites on Pulbah Island and on the land mass as whole. The level of subsidence does not pose a risk to the archaeological heritage values of Pulbah Island."

The recommendation of the report was to conduct post mining monitoring as per the Centennial ACHMP using the August 2016 Survey as the baseline record.

If a risk of harm, as a result of mining or mining associated activities, to the site becomes evident immediately post-mining Centennial, as per the ACHMP, will endeavour to protect the site from further harm. Centennial Myuna will inform and notify OEH of potential for harm to the site and follow the advice given by OEH. Additional measures will be taken under the advice of the heritage consultant, OEH and agreement of Aboriginal parties.

EA Prediction

The Myuna Colliery Extension of Mining Project Cultural Heritage Assessment (RPS 2011) considered there was minimal potential for impact from the Project on sensitive Aboriginal cultural places or objects or on European cultural heritage items.

New Material

Myuna Colliery commenced mining under Pulbah Island October 2016. In accordance with the ACHMP consultation was undertaken with the registered Aboriginal parties with regard to the management of the site.

The proposed mine plan consists of a bord and pillar mining method which will produce negligible subsidence and no surface impacts.

6.5 Environmental Values and Performance Summary

Table 14: Environmental Values and Performance

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period (actual)	Trend analysis/ key management implications	Implemented / proposed management action
Noise	Noise limit criteria/ Operations would meet the project specific noise criteria at all assessed residential receivers.	Exceedance of Noise criteria limit at R4 and R6 during second quarter day time monitoring.	Maintain management measures.	Contractor updated procedure, sweeper operation to be conducted in environment mode only. Personnel trained in updated procedure.
Air quality	Air quality limit criteria / below project air quality goal at all private receivers.	Operations below project air quality limit criteria at all private receivers.	DG 3 long term average is higher then dust gauge 1, 2 but shows a decreasing trend. DG4 displays an increasing trend.	DG 3 investigation identified possible sources, lawn mowing and sculls dump. DG 4 introduction of water cannon on waste pad for dust suppression.
Biodiversity	Negligible impact / Unlikely to impact	Negligible impact	Maintain management measures	
Heritage	Management Plan / Minimal potential for impact	No impact	Mine plan to undermine sensitive cultural heritage areas. (Pulbah Island)	Stakeholder consultation completed. Archaeological survey and assessment completed. Developed plan of management. Base line survey completed. Post mining surveys to be under taken.

7. WATER MANAGEMENT

7.1 LDP B

Control strategies were implemented as per the Water Management Plan and were in general adequate to manage the risks associated with the operation during the report period.

Myuna Colliery has a Water Management Plan which discusses responsibilities, pollution sources, hazards, risks and mitigation strategies of water management. Regular refresher training and site inductions discuss water management to make personnel aware of the site issues.

The surface water monitoring has been conducted in accordance with the conditions of EPL366. This Licence specifies monitoring and reporting requirements along with concentration limits for water discharged through LDP A and LDP B. Other EPL monitoring requirements included E1 Manganese monitoring in Wangi Bay.

Result Summary

Mine water discharged from LDP B is required to be monitored daily during discharge for the following parameters;

- Volume;
- pH;
- Total Suspended Solids (TSS); and
- Oil and Grease

Discharge of mine water occurred on every day in the report period. A sample was collected and analysed for the parameters on every day of discharge (Table 15).

The flow volumes through LDP B are monitored continuously in accordance with EPL366. The daily volume discharge limit for LDP B is 13000kL. The maximum daily volume discharged was 10377kL during the reporting period. The average daily volume discharged for 2016 was 5196kL. There were no exceedances of the LDP B volume limit criteria during the reporting period.

The pH of the mine water discharged through LDP B was consistent throughout 2016 with a minimum pH level of 7.0 and a maximum 8.2. The limit criteria for pH is a range between 6.5 and 8.5. There were no exceedances of the concentration limit.

The concentration of total suspended solids analysed in the mine water discharged through LDP B was consistently low with an average concentration of 5.79 mg/L during 2016. There was 1 exceedance of the TSS limit criteria of 111mg/L on 14th March 2016. Details of the exceedances are discussed in Section 11.

The concentration of oil and grease analysed in the mine water discharged through LDP B was consistently low with a maximum below the limit of reporting. The concentration limit for oil and grease is 10mg/L.

Table 15: Water Quality Data

Pollutant	Unit of Measure	Licence Limit Criteria	No. of Samples required	No. of Samples Collected	Minimum Value	Mean	Maximum Value
pH	pH	6.5 – 8.5	366	378	7	7.7	8.2
Total Suspended Solids	mg/L	50	366	378	0	5.80	111
Oil & Grease	mg/L	10	366	378	0	0	0

Trends

Visual inspection of the flow volume trend, in the Centennial Myuna Annual Groundwater Management Report Figure 4–1(GHD February 2017), indicated that extraction from underground workings was decreasing between mid 2013 and 2014. Extraction rates began to increase in 2015. In 2016 extraction rates generally remained similar to 2015 extraction rates.

A linear trend line was applied to the monitoring data from 2011 to 2016 for pH, TSS and oil and grease. The trend line displayed decreasing trend over the five year period for TSS and Oils.

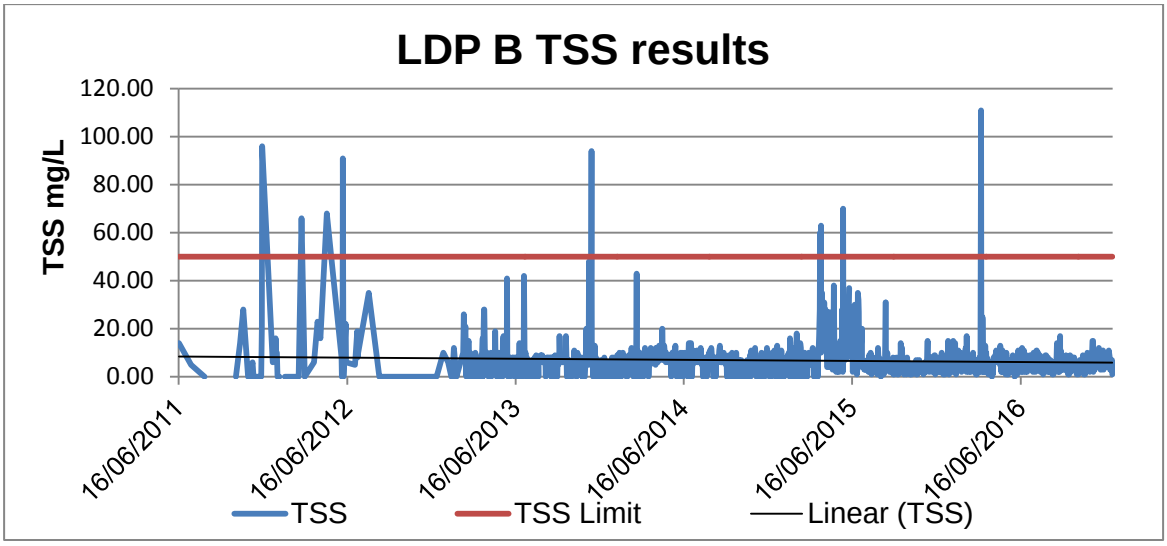


Figure 7: LDP B TSS Monthly Monitoring Results and Linear Trend Line

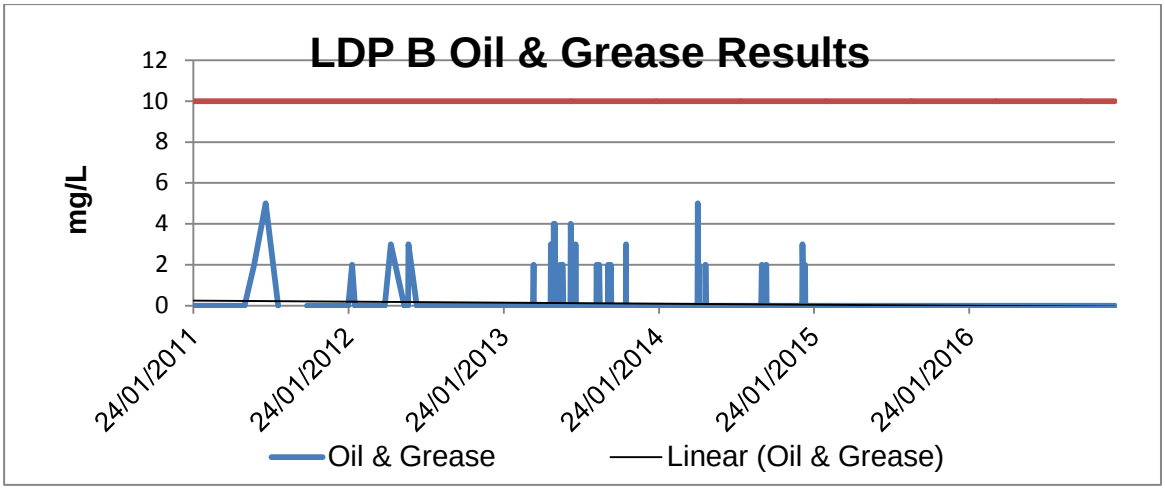


Figure 8: LDP B Oils Monthly Monitoring Results and Linear Trend Line

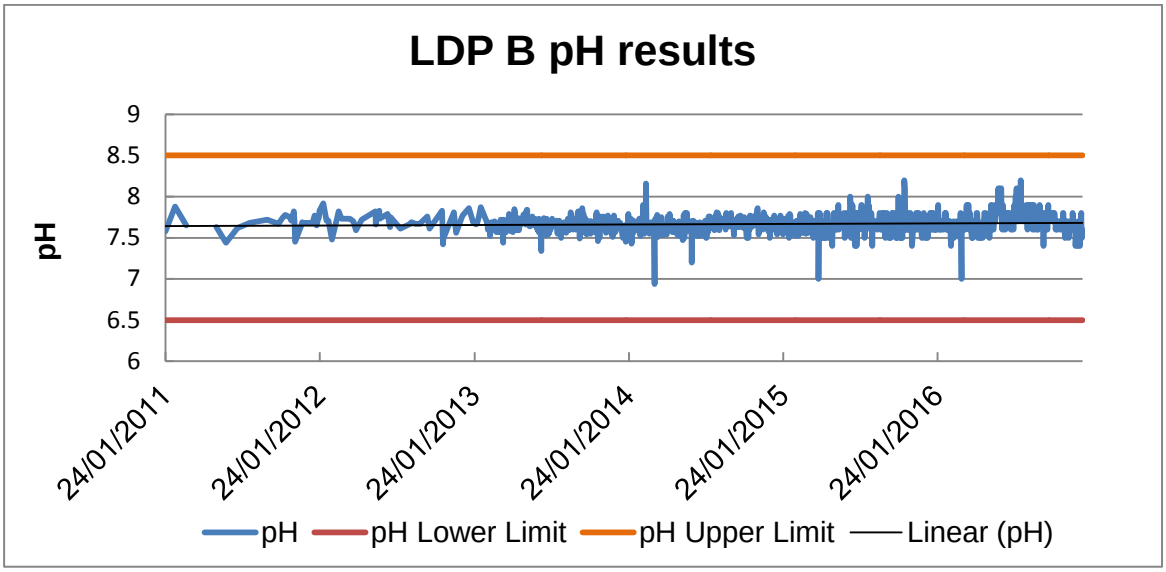


Figure 9: LDP B pH Monthly Monitoring Results and Linear Trend Line

7.2 LDP A

There was no discharge of water through LDP A during 2016.

7.3 Manganese Monitoring

The monitoring of filterable Manganese is undertaken as per special condition E1 Additional Monitoring of EPL366, in Wangi Bay on a quarterly schedule. There is no limit criteria applied to the Manganese monitoring. The monitoring results are submitted to the EPA quarterly.

Result Summary

Four samples are collected quarterly from Wangi Bay at the outlet of Wangi Creek. The average of the samples for each quarter is provided in Table 16.

Table 16: Manganese Monitoring Data

Date	March 2016	June 2016	September 2016	December 2016
Unit - ug/L	41.25	58.25	78.5	<10

Trends

The Manganese monitoring has been conducted over a period of six years from 2011. Manganese concentrations recorded in Wangi Bay over the six year period of monitoring display a downward trend. The results have decreased in consecutive years from 2013 to 2015. The results for 2016 have shown a slight increase from the previous report period.

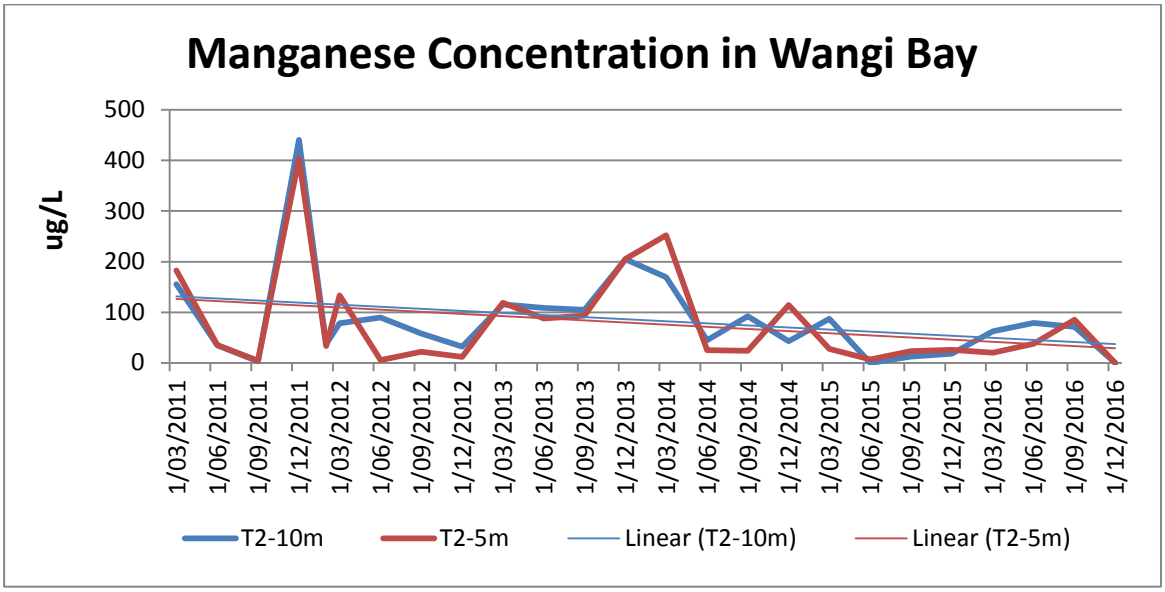


Figure 10: Manganese Annual Average Monitoring Results and Linear Trend Line

7.4 Water Take

Results Summary

Centennial Myuna was granted Bore Licence 20BL172565 in December 2010 for the purpose of dewatering up to 4,380 ML/ year of ground water from mine workings at Myuna Colliery. Ground water extracted from the underground mine workings is currently discharged from site via LDP B. Volumetric and water quality monitoring data at LDP B is therefore representative of ground water volumes and ground water quality extracted from the mine workings.

The volume of ground water extracted from the works authorized by the licence shall not exceed 4380 ML in any twelve month period commencing the 1st July. The total volume of water discharged through LDP B for the 2015 / 2016 period is 1922 ML. There is no exceedance of the Bore Licence criteria.

Table 17: Volume Extraction Data

License #	Water Sharing Plan, source and management zone (as applicable)	Entitlement	Passive take / inflows	Active pumping	TOTAL
20BL172565	North Coast Fractured and Porous Rock Ground Water Sources	4380	1746.4	175.8	1922.2

Volume is reported in megalitres (ML)

The Wallarah, Great Northern and Fassifern seams contain reservoirs which are used for the retention and settlement of mine water and surface water prior to pumping to the surface settlement ponds. Significant improvements in the water management system have been achieved by increasing the rate of transfer (approximately 10L/sec to 50L/sec) from the CHP dam to the underground settlement reservoir. This has been achieved by the addition of a larger diameter pipe line to the automated pumping system and the implementation of a syphon line from the CHP dam to an underground reservoir via a surface to seam borehole. The pump line and syphon line are metered for the purpose of measuring the volume pumped to the underground. The volume of surface water pumped to the underground reservoir during the 2016 report period was approximately 31.2 ML.

The underground water storages in the Wallarah Seam, the Great Northern Seam and the Fassifern Seam are based on an average seam height of 3 m and a recovery ratio of 0.333, Centennial Myuna has estimated the volume of water storages in each of the seams. The underground water storage volumes are shown below in the table below.

The hydrogeological model developed for Myuna Colliery assumes that the volumes of each of these storages are constant. An annual survey of the water storage areas will be conducted when possible for the Annual Groundwater Management Report to determine whether storage volumes have changed and the hydrogeological model is recalibrated as required.

Table 18: Water Storage

SEAM	WATER STORAGE VOLUME (ML)
Wallarah Seam	740
Great Northern Seam	1407
Fassifern Seam	1326

Myuna Colliery used 129 ML of potable water for the 2016 reporting period of which approximately 95% (or 122 ML) was used for mining operations.

In accordance with the requirements Groundwater Management Plan, the transfer of water from the underground workings to the surface has been monitored daily. The transfer volume for the 2016 report period was approximately 1902 ML.

An Annual Water Balance 2016 for Myuna Colliery is provided in Appendix 1.

Trends

The extraction volumes generally over estimated groundwater inflows into the mine since they also included potable water transfers to the mine. The addition of the pump line for the transfer of surface water to the underground reservoir in 2014 and subsequent upgrade in 2015 increases inflows into the mine.

Visual inspection of the mine water extraction rates trend indicates that extraction from underground workings was decreasing between mid 2013 and 2014. Extraction rates began to increase in 2015. In 2016 extraction rates generally remained similar to 2015 extraction rates.

The annual mine water extraction volumes between 2011 and 2016 are listed in the Table 19.

Table 19: Water Volumes

YEAR	ANNUAL VOLUME (ML)
2011	2047
2012	2580
2013	2281
2014	1614
2015	1930
2016	1902

EA Predictions

GHD Pty Ltd (GHD) revised the hydrogeological model for Myuna Colliery as part of the preparation of the Northern Operations Regional Water and Salt Balance (GHD, 2014). The original hydrogeological model was developed in 2010 to support the Part 3A project application for Myuna Colliery (GHD, 2010). A three dimensional eight layer numerical hydrogeological model has been constructed to estimate groundwater inflow into the underground workings at Myuna Colliery up to 2200. The results of this modelling have been incorporated into the Centennial Northern Regional Water and Salt Balance.

Hydrogeological modelling was undertaken using the MODFLOW-NWT solver of the MODFLOW 2005 groundwater modelling code. The model was constructed using the GMS graphical user interface with reference to the NSW Aquifer Interference Policy and Australian Groundwater Modelling Guidelines (Barnett et al., 2012). The hydrogeological model was calibrated under transient conditions using available underground water extraction data. The calibrated hydrogeological model was used to provide estimates of future groundwater inflows and dewatering volumes under approved and proposed conditions. The results of the modelling shows the total predicted groundwater inflows into the Myuna workings are predicted to peak at 7.5 ML/day in year 2032. The original hydrogeological model predicted that groundwater inflows would peak at 28.4 ML/day, and 8.3 ML/day would be extracted (GHD, 2010). The original hydrogeological model for Myuna was highly conservative because underground water storage levels were not being monitored and that only a proportion of groundwater inflow was extracted within each seam, resulting in ongoing flooding of some areas of old workings. Therefore, groundwater inflow exceeded extraction from underground workings. As such, overall a conservative model was built due to lack of data of the underground water system. As

part of the review and calibration of the hydrogeological model undertaken in 2014, additional information and data was added which included that:

- all groundwater inflow is extracted;
- the extraction of groundwater volumes was actually equal to groundwater inflows; and
- Underground storages are managed to maintain certain levels.

As part of the 2011 EIS for the Myuna Part 3A application, negligible changes in groundwater levels in the shallow alluvial aquifers were predicted during the life of Myuna's operation due to the limited connection between the shallow alluvial aquifers and the deeper coal seam aquifers that were to be affected. It was considered that the variation in groundwater levels in the shallow alluvial aquifers is attributable to changes in rainfall recharge and evaporation. Therefore, impacts on alluvial aquifers, existing alluvial groundwater users and Groundwater Dependent Ecosystems (GDEs) resulting from the proposed Project would be minimal, and therefore significant impacts to the groundwater environment were not expected.

8. REHABILITATION

8.1. Next Reporting Period

The rehabilitation performance of Myuna Colliery for the next reporting period will be measured against the targets outlined in the currently approved MOP (2016 – 2022).

All surface infrastructure associated with Myuna Colliery's operations is located at the Surface Facilities Area. The Surface Facilities Area encompasses a footprint of approximately 89 hectares, of which 25.2 hectares includes the surface infrastructure. These 25.2 hectares is the total area currently requiring rehabilitation prior to mine closure. The remainder of the Surface Facilities Area is predominantly natural bushland vegetation, the Wangi Creek watercourse and existing cleared easement corridors.

Table 20: Rehabilitation Status

Mine Area Type	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
	2015 (ha)	2016 (ha)	2017 (ha)
A. Total mine footprint[1]	7426.5	7426.5	7426.5
B. Total active disturbance[2]	25.2	25.2	25.2
C. Land being prepared for rehabilitation[3]	Nil	Nil	Nil
D. Land under active rehabilitation[4]	Nil	Nil	Nil
E. Completed rehabilitation[5]	Nil	Nil	Nil

[1] **Total Mine Footprint:** includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities. As such it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands (as defined in the DRE MOP/RMP Guidelines). Please note that subsidence remediation areas are excluded.
[2] **Total Active Disturbance:** includes all areas requiring rehabilitation
[3] **Land being prepared for rehabilitation:** includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growth medium development (as defined in DRE MOP/RMP Guidelines)
[4] **Land under active rehabilitation:** includes areas under rehabilitation and being managed to achieve relinquishment – includes 'ecosystem and land use establishment' and 'ecosystem and land use sustainability (as defined under the DRE MOP/RMP Guidelines)

Final landform creation and rehabilitation activities will largely be undertaken following the completion of mining. Centennial Myuna will redevelop the existing Myuna Colliery Site for light industry based land uses. The area of the downcast shaft will be rehabilitated to natural bush land.

There are no proposed rehabilitation trials or research projects to be undertaken in the next report period.

There are no rehabilitation activities proposed for the next report period.

9. COMMUNITY

Centennial Myuna operates under a Stakeholder Engagement Plan, and continues to support the local community through various sponsorship schemes. The following is the sponsorship and support carried out locally during the calendar year:

- Myuna Colliery was a major sponsor of the Wangi Dobell Festival of Arts and Crafts 2016 hosted by the Wangi Lions Club;
- Myuna Colliery was major sponsor of the Wangi Amateur Sailing Club events the Centennial Coal Australia Day Regatta and the Youth sail Lake Macquarie Regatta.

Centennial Myuna supported corporate sponsorships for local sporting organisations, with sponsorship assistance for new equipment and operational costs. These sporting clubs included Rathmines Memorial Bowling Club, Toronto Awaba Junior Soccer Club, Westlakes Districts Netball Association, Southern Lakes Cricket Club, Macquarie Scorpions Rugby League Club.

Centennial Myuna supported corporate sponsorship for community organisations and events including Meals on Wheels, Hunter Research Foundation, Hunter Valley Training Company, Toronto Bridge Club, Wangi Public School, Toronto Chamber of Commerce, Wallsend Public School, Lara Jean Association, Retired Mine Workers Association, Westlakes Senior Computer Club, Rotary Newcastle Enterprise, Rotary Club of Toronto Sunrise.

Community Complaints

A community complaints register is kept on site. All community enquiries and complaints received by Myuna Colliery are to be recorded as per MY-EWP-038 Community Complaint and Enquiries Procedure. This information is then entered into the Centennial Coal Environment and Community Database (ECD).

There were no community complaints received in the 2016 report period.

10. AUDITING

10.1. Independent Environmental Audit

Centennial Myuna engaged MCW Environmental Pty Ltd (MCW) as the independent expert approved by the DPE to carry out an Independent Environmental Audit (IEA) of Myuna Colliery in accordance with condition 9, schedule 5 of Project Approval 10_0080 MOD1.

[5] **Completed rehabilitation**: requires formal sign off from DRE that the area has successfully net the rehabilitation land use objectives or completion criteria

The audit period was defined as from 26 June 2012 (last date of the previous IEA site inspection) to 31 May 2016 (date of site visit conducted by MCW Environmental). The Independent Environmental Audit assessed compliance with the PA10_0080 MOD1, EPL366, Mining Lease 1632 and Mining Purposes Lease 334. In addition the audit included a review of the adequacy of the strategies plans and programs required under the project approval.

Table 21: Independent Environmental Audit Compliance

Relevant Approval	Percent Compliant (%)	Number of Conditions Non-compliant	Number of Conditions Not Verified
Project Approval Myuna Mine PA 10_0080	94	3	1
Project Approval Myuna Mine PA 10_0080 Appendix 3 Statement of Commitments	100	0	0
Environmental Protection Licence No. 366	91	7	0
Mining Lease 1632	97	1	0
Mining Purposes Lease 334 (Covering Pit Top area only)	87	3	2

An Action plan was developed and submitted to the Department of Planning and Environment which describes the corrective actions to be undertaken for each non compliance and recommendation. The Action Plan has a scheduled completion date for each action. The Audit Report and Action Plan has been published on the Centennial Coal website.

Progress against the action plan is shown in Table 22. The next Independent Environmental Audit is scheduled for June 2019.

Non compliances and indeterminate compliance status's in relation to conditions in Project Approval 10_0080 MOD1, EPL 366, ML1632 and MPL334 along with the required actions to achieve compliance are summarised in Table 23. These were identified in an audit carried out by MCW Environmental Pty. Limited on 31st May 2016.

Table 22: Independent Environmental Audit Action Plan

Item No.	Title Condition No.	Requirement	Compliance/ Recommendations	Action Required	Date Required	Progress
1	PA 10_0080 S3.13	Noise Management Plan	Preparation – Compliant (pending approval from the Secretary) Implementation – Non-compliant Administrative Non-compliance **PA 10_0080-REC-02** - The Noise Management Plan should be updated to reflect the maintenance, operation, collection and use of modelling data of the on-site real-time noise logger.	Update the Noise Management Plan to reflect the maintenance, operation, collection and use of modelling data of the on-site real-time noise logger.	30/6/2017	Ongoing
2	Soil and Water	*Note: Under the Water Act 1912 and/or the Water Management Act 2000, The Proponent is required to obtain the necessary water licences for the project.*	Not Verified	Obtain approval for a licence to inject water to the under ground workings from DPI Water.	30/06/2018	Ongoing Centennial corporate in discussions with DPI Water.
3	PA 10_0080 S3.21	Surface Water Discharges Compliance with EPL limit criteria.	Non-compliant Low Risk	Nil, Implemented manual operation of the syphon line from the CHP dam to the U/G reservoir.		No Action Required

Item No.	Title Condition No.	Requirement	Compliance/ Recommendations	Action Required	Date Required	Progress
5	PA 10_0080 S5.10	Independent Environmental Audit	Non-compliant Administrative Non-Compliance	Noted		No Action Required
6	EPL366 L2.1	Concentration Limits Water quality.	Non-Compliant Low Risk **EPL 366-REC-01** - Monitor the effectiveness of the change to the water management system and if exceedances (i.e. TSS) continue, implement further measures to address the exceedances.	Monitor the effectiveness of changes to the Water Management System. Investigate further measures to improve the effectiveness of the water Management System.	30/05/2017 30/06/2017	Ongoing Ongoing
7	EPL366 L2.2	Concentration Limits pH quality limit	Non-Compliant Low Risk	Nil, Action taken following the incident. Upgraded the Emergency Stockpile Dam pump.		No Action Required
8	EPL366 L3.1	Water discharge Volume and Mass Limits	Non-Compliant Low Risk	Nil, Implemented manual operation of the syphon line from the CHP dam to the U/G reservoir.		No Action Required
9	EPL366 M2.1 M2.2	Requirement to monitor concentration of pollutants discharged	Non-compliant Low Risk	Nil, Implemented procedure for the secure transport of dust deposition sampler jars.		No Action Required

Item No.	Title Condition No.	Requirement	Compliance/ Recommendations	Action Required	Date Required	Progress
10	EPL366 M4.1	Environmental Monitoring Requirement to monitor noise	Non-compliant Administrative Non-compliance	Nil, implemented action to include the noise monitoring schedule in the Quarterly Noise Monitoring report.		No Action Required
11	EPL366 M8.1	Requirement to Monitor Volume or Mass	Non-compliant Low Risk	Nil, Implemented manual operation of the syphon line from the CHP dam to the U/G reservoir to prevent re-occurrence.		No Action Required
12	ML1632 c12	Prevention of Soil Erosion and Pollution	Non-compliant Low Risk	Install sediment erosion controls beneath the outflow to LDP A to minimise the potential for erosion to the drainage channel.	30/03/2017	Completed.
13	MPL334 c6	Dams and Escape of Water	Not Verified	Noted		No Action Required
14	MPL334 c14	Annual Review	Administrative Non-compliance **MPL 334-REC-01** - Include medium and long-term mining plans in the AEMR.	Review the requirements of the Annual reporting Guidelines and Include all plans required by the guideline.	30/01/2017	Completed. Annual Review Guidelines Oct 2015. MPL334 Lease Conditions. Consent Conditions.
15	MPL334 c21	Prevent contamination, pollution, erosion.	Non-compliant Low Risk	Install sediment erosion controls beneath the outflow to LDP A to minimise the potential for erosion to the drainage channel.	30/03/2017	Completed.
16	MPL334	The registered holder shall	Non-compliant	Install sediment erosion controls beneath the	30/03/2017	Completed

Item No.	Title Condition No.	Requirement	Compliance/ Recommendations	Action Required	Date Required	Progress
	c30	ensure that the run off from any disturbed areas including the overflow from any depression of ponded area is discharged in such a manner that it will not cause erosion.	Low Risk **MPL 334-REC-02a** – Erosion controls should be installed beneath the outflow to LDP A to minimise the potential for erosion to the drainage channel. Consideration should be given to the installation of a spillway at the Emergency Coal Stockpile Dam including provision of a safe sampling site for the LDP A outflow pipe. **MPL 334-REC-02b** – The earthen bund adjacent to the container housing the water pump at the Emergency Coal Stockpile Dam should be reformed to prevent run-off from a disturbed area to flow into the drainage channel at LDP A. Refer to **PA 10_0080-REC-05** (PA 10_0080, S3.24)	outflow to LDP A to minimise the potential for erosion to the drainage channel. Investigate the installation of a spillway at the Emergency Coal Stockpile Dam. Install a safe sample collection site for the LDP A outflow pipe. Construct a bund adjacent to the container housing the water pump to direct surface flow into the Emergency Coal Stockpile Dam.	30/06/2017 30/06/2017 30/03/2017	Ongoing Ongoing Completed

10.2. Independent Audit of Groundwater Conditions

Centennial Myuna engaged GHD as the independent expert, approved by the Office of Water, to undertake an independent audit of the groundwater conditions, all monitoring records and any related impacts in accordance with condition six of Bore Licence 20BL172565. The audit period was from December 2010 (licence commencement date) to April 2016.

Centennial Myuna broadly met the requirements of bore licence 20BL172565 as shown in the table below. The Bore Licence 20BL172565 was granted 13/12/2010. Myuna was not informed of the licence approval or issued a copy of the licence and conditions by the Office of Water until 31/10/2014, and as a result a number of the requirements of the licence have not been conducted within the specified timeframes. The majority of these conditions have since been fulfilled.

Table 23: Independent Groundwater Audit Compliance

Relevant Approval	Percent Compliant (%)	Number of Conditions Non-compliant	Number of Conditions Not Verified
Bore Licence 20BL172565	75	4	0

An Action plan was developed and submitted to the NSW Office of Water which describes the corrective actions to be undertaken for each non compliance. The Action Plan has a scheduled completion date for each action.

Progress against the action plan is shown in Table 24. The next Independent Audit of Groundwater conditions are scheduled for December 2020.

Non compliances in relation to conditions in Groundwater Extraction Licence 20BL172565 along with the required actions to achieve compliance are summarised in Table 24.

Table 24: Independent Groundwater Conditions Audit Action Plan

Condition No.	Requirement	Compliance/ Recommendations	Action Required	Progress
2	The approval of this licence is based on interception and extraction of groundwater from the central coast-hunter porous rock groundwater source. No authorisation is granted to intercept or extract surface or ground waters from any other water source.	2. Conduct additional model runs to assess pre-mining water budgets for the alluvium and compare this to current conditions. 3. Implement a groundwater elevation monitoring programme for the shallow alluvial bores on site to: a. Further characterise the influence of the mine relative to climatic changes. b. Further validate the predicted modelling impacts and the uncertainty associated with the predictions. 4. Clarify the rationale behind changing overburden thickness as part of model calibration via clarification in future annual reports.	1. Assess pre-mining water budget for the alluvium and compare with current conditions in the Annual Groundwater Management Report. 2. Implement a groundwater elevation monitoring program. 3. Provide clarification in the Annual Groundwater Management Report of the rationale behind changing overburden thickness as part of model calibration.	Completed. Section 5.2 2016 Annual Groundwater Report. Completed. Section 3.3 2016 Annual Groundwater Report. Completed. Section 5.1.1 2016 Annual Groundwater Report
3	The licence holder must provide to the NSW Office of Water for approval a groundwater management plan (GMP) within three months of the issue of this licence, which includes: a) detailing monitoring, remediation and contingency measures, and mine water discharge scenarios and criteria. b) long term water balance calculations for the site to show that the proposed volumes and rates of groundwater extraction are	5. The GMP is recommended to be updated to include a discussion of the long term water extraction, the discharge criteria set in the licence and the sustainability of the scheme, making reference to the impacts on sensitive features identified in this condition. The update should also consider the development of contingency measures	4. Update the Groundwater Management Plan to include a discussion of the long term water extraction, the discharge criteria set in the licence and the sustainability of the scheme, making reference to the impacts on sensitive features identified in this condition.	Ongoing, Water Management plan currently under revision. To be completed by 30/06/2017.

Condition No.	Requirement	Compliance/ Recommendations	Action Required	Progress
	sustainable. c) measures to monitor the operation of the work, which will demonstrate surface and subsurface mining operations are conducted in a manner which minimises potential impacts on groundwater flow and quality, aquifer integrity, groundwater-dependent ecosystems and other off-site water related impacts, including: a. groundwater sources to which no extraction authorisation is included in this licence b. other groundwater users within a radius from the work defined in the approved groundwater management plan. c. and groundwater dependent ecosystem or surface water source which may be affected by operation of the work. d) verification of any predictive modelling or other assessments related to impacts on groundwater source(s), other users or groundwater dependent ecosystems e) a monitoring and response plan, which is approved by the NSW Office of Water. The plan shall include: i. methods to assess the extent of depressurisation created by a operation of the work and determining the volume of any inflow from overlying seams or other groundwater sources ii. contingency arrangements in the event of predicted interception of groundwater exceeding predictions iii. options to replace groundwater user supply for any affected licensed groundwater licence holder.	following on from verification of the model with monitoring data from the surrounding alluvial system. Also refer to recommendations 2 to 4 with regard to model verification.	5. Update the Groundwater Management Plan to include a groundwater elevation monitoring program.	Ongoing, Water Management plan currently under revision. To be completed by 30/06/2017.

Condition No.	Requirement	Compliance/ Recommendations	Action Required	Progress
4	The licence holder must submit a report to the NSW Office of Water (the annual groundwater management report or annual report) each year after the commencement of this licence, which will include: a) all raw water monitoring data, an interpretation of that data and a discussion of trends identified in the data and their implications. b) all groundwater extraction data (volumes and rates) taken by the works, the extent of aquifer depressurisation and the salinity impacts, compared with predictions of aquifer performance made in the environmental impact statement(s) or similar project documents. c) an overall comparison of groundwater performance with predictions for the life of the mine provided in the development application and supporting documentation d) water related activities performed and the level of compliance with the GMP, and an outline of proposed adaptive or remediation actions, and, e) assessment of extraction or other depressurisation impacts caused by the work(s) to external water sources, water users or groundwater dependent ecosystems, as specified in condition 2.	6. Include the manually recorded extraction data (field sheets) in an appendix of the annual reports. 7. Clarify the water quality analytes and criteria reported in the annual report with reference to both the surface water management plan and GMP. This would include a discussion to demonstrate that discharges are compliant with licence requirements.	6. Provide all groundwater extraction data in the appendix of the Annual Groundwater Management Report. 7. Conduct a gap analysis on the water quality reporting requirements of the Groundwater Management Plan and the Annual Groundwater Management Report. 8. Investigate and implement formats for presenting data in the Annual Groundwater Management Report in a clear and concise manner.	Completed. Appendix E 2016 Annual Groundwater report. Completed. Section 4.2 2016 Annual Groundwater Report. Completed. Section 4.2 2016 Annual Groundwater Report.
8	The licensee shall install to the satisfaction of NSW Office of Water in respect of location, type and construction an appliance(s) to measure the quantity of water extracted from the works. The appliance(s) to consist of either a measuring weir or weirs with automatic recorder, or meter or meters of the dethridge type, or such other class of meter or means of measurement as may be approved by NSW Office of Water. The appliance(s) shall be maintained in good working order and condition. A record of all water extracted from the works shall be kept and supplied to the department upon request. The licensee when requested must supply a test certificates to the accuracy of the appliance(s) furnished either by the manufacturer or by some person duly qualified.	8. Seek approval from DPI-Water for the measurement device.	9. Acquire the specifications from DPI Water for an appliance to measure water volumes extracted. Verify the meter is an acceptable appliance. Seek approval from DPI-Water for the appliance...	Ongoing. Acquired the specifications for an acceptable appliance. Investigating most suitable appliance for Myuna.

11. INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

Table 25: Incident/Non-Compliance Summary 1

Nature of the incident/non-compliance	Exceedances of EPL 366 TSS concentration limit criteria.
Date of incident/ non-compliance (if known; if not known state not known)	14th March 2016
The location of the incident/ non-compliance (include a figure if appropriate), if known	LDP B
Detail the cause of the incident/non-compliance, including investigation findings	Dirty water from car park storm water drain
Detail action that has been, or will be, taken to mitigate any adverse effects of the incident/ non-compliance	An inspection of the area was completed immediately following the incident. There were no adverse effects identified.
Detail action that has been, or will be, taken to prevent recurrence of the incident/ non-compliance	Road sweeper swept car park, Straw bales placed around drain, closed off connection form storm water drain to discharge line, repaired potholes with asphalt.
Consultation with relevant agency (who, when and the response), or agencies if more than one	Notification sent to EPA, DRE, and DPE.

Table 26: Incident/Non-Compliance Summary 2

Nature of the incident/non-compliance	Exceedance of EPL 366 noise criteria limit.
Date of incident/ non-compliance (if known; if not known state not known)	28th June 2016
The location of the incident/ non-compliance (include a figure if appropriate), if known.	R4 and R6 Donnelly Road Arcadia Vale.
Detail the cause of the incident/non-compliance, including investigation findings	The road sweeper has two modes of operation; standard and environment. The road sweeper was operated in standard mode and not environment mode.
Detail action that has been, or will be, taken to mitigate any adverse effects of the incident/ non-compliance	NA
Detail action that has been, or will be, taken to prevent recurrence of the incident/ non-compliance	Contractor notified of incident. Contractor updated work procedure to included mode in which the road sweeper is being operated at Myuna Colliery and implemented training of personnel in the revised procedure.
Consultation with relevant agency (who, when and the response), or agencies if more than one	Notification sent to EPA and DPE.

Table 27: Summary of Regulatory Actions

Compliance Type	Agency	Number	Response
Incidents	Not Relevant	2	
Caution Notices	EPA	2	
Warning Letters		Nil	
Penalty Notices		Nil	
Prosecutions		Nil	

Note: This table includes actions taken by DPE, DRE and the EPA during the reporting period.

Reportable Incident 1

On Wednesday, 16th March 2016 total suspended solids (TSS) levels of discharge at LDPB exceeded the limits set out in Condition L2 of EPL366 for LDPB. The discharge was recorded at 111 mg/l TSS from LDPB. The estimated duration of the discharge which exceeded the limits is estimated to be from 10.50 am to 1.20 pm, as calculated from the real time monitoring data from LDPB.

The Myuna Colliery meteorological station recorded 29mm of rainfall for the 24 hours preceding the sample collection. The monitoring data shows that there was a heavy 30 minute downpour at 10:30am of 13.6mm of rain which led to a sudden increase in turbidity at 10:45am, from 20 NTU to 42 NTU. The turbidity peaked at 42 NTU at11:00am.

Daily sampling taken by the independent sampler Carbon Based was taken at 11:00am on the 16th of March 2016. The field notes describe the discharge at LDPB as slight turbidity of brown colour.

The Environment Community Coordinator inspected the water quality at LDPB at 1.25pm on the 16th of March 2016. The discharge water was observed to be clear with a slight cloudiness. The real time monitor recorded an NTU of 31. The mine water settlement ponds were observed to be clear. The Coal Handling Plant dam (CHP dam) was maintained at minimum levels. There was no overflow from the CHP dam into the mine water settlement ponds.

Lab results were received on the 17th March 2016 indicating TSS levels exceeding Licence limits and notification was made to the EPA hotline.

The microscopic analysis conducted by Steel River Laboratory found that the ratio of the suspended solids from the discharge water was 60% minerals, 20% coal fines and 20% vegetation. Minerals are described as incombustible matter such as silica and clays. The high percentage of minerals is inconsistent with the materials that would be expected to come from the settlement ponds.

An investigation following the incident was undertaken to determine the cause of the exceedance. The nature of the materials identified in the sample suggested that the solid material did not come from the mine water settlement ponds. The rainfall event was minor and was not sufficient to generate the volume of surface run off required for the CHP dam to over flow.

The LDP B real time monitoring flow data showed that there was an increase in volume discharged during the rain event. Myuna Colliery has established a network of clean water diversion drains and storm water drains around and throughout the site. Albin Civil was engaged by Myuna Colliery to investigate possible connectivity between the drains and the mine water discharge pipe line.

The investigation found that a stormwater drain at the northern end of the car park was connected to the mine water discharge pipe line. The connection was not identified on the site services plan. The site carpark is sealed and guttered. An area of the carpark contained a number of potholes which had broken up due to weathering. Traffic passing over the potholes had created the source of dirty water that passed through the discharge point. The actions listed below were undertaken following the investigation:

- Straw bales were placed around the drains;
- Road sweeper swept the car park clean;
- The pot holes were repaired with asphalt; and
- Stormwater connection to mine water discharge pipe line was closed off.

Reportable Incident 2

On Tuesday, 28th June 2016 noise levels exceeded those set out in Condition L5 of EPL366 for R4 at 11:54am and R6 at 12:49pm. An estimated contribution for daytime LAeq (15min) of 41dBA at R4 and 49dBA at R6. The noise limit criteria for day time LAeq (15 min) at R4 and R6 is 35dBA and 37dBA respectively.

A consultant was engaged by Centennial Myuna to undertake attended noise monitoring on Tuesday 28th June 2016. While conducting the monitoring at the R4 and R6 receiver locations the consultant could distinguish a noise coming from the Myuna Colliery Site.

The noise levels exceeded those set out in Condition L5 of EPL366 for R4 at 11:54am and R6 at 12:49pm. An estimated contribution for daytime LAeq (15min) of 41dBA at R4 and 49dBA at R6. The noise limit criteria for day time LAeq (15 min) at R4 and R6 is 35dBA and 37dBA respectively.

Myuna Colliery was conducting normal operations 28th June 2016 which included the operation of the coal handling plant and conveyors, forklift and truck movements. A road sweeper was brought to the Myuna Colliery site at 10:30am on Tuesday 28th June for the weekly service. The road sweeper was in operation on the site until leaving the site at 1:02pm.

The consultant identified the noise as coming from a road sweeper.

An investigation into the incident determined that the road sweeper was the source of the noise limit exceedance.

The road sweeper has two modes of operation; standard (high power) and environment (low power). The road sweeper was operated in standard mode and not the required environment mode. Operator was not aware of two modes. The road sweeper procedure did not specify two modes of operation and did not identify noise as a risk. The operator had not used the road sweeper at Myuna Colliery before.

There were no community complaints or enquiries received as a result of the noise exceedance.

The contractor revised the Safe Work Method Statement for Road Sweeper Operation at Myuna Colliery to include the mode of operation. The contractor retrained personnel in the revised procedure.

12. ACTIVITES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

DPE and DRE conducted a detailed site inspection of Myuna Colliery 6th May 2016. The purpose of the inspection was to review compliance with environmental requirements of relevant approval instruments including the Mining Lease, Mining Operation Plan (MOP) and Annual Environmental Management Report (AEMR).

DRE correspondence received 23rd August 2016 outlines the actions required following the report review and site inspection. DRE advised the following actions were to be completed by 30th September 2016:

- Correctly store drums in workshop.
- Review waste handling procedure.
- Remove piles of coal fines from soil stockpile area.

Table 28: Action Progress

Action Required	Requested By	Action Taken	Progress
Correctly store drums in workshop.	DRE	Oil drums correctly stored in bunded area. Hydrocarbon Management training package developed.	Completed 7th May 2016. Completed 3rd August 2016.
Review waste handling procedure.	DRE	Waste management procedures reviewed.	Completed 30th September 2016.
Remove piles of coal fines from soil stockpile area.	DRE	Coal fines removed from soil stockpile area.	Completed 30th May 2016.

Phase 2 Site Assessment

A Phase 2 Environmental Site Assessment (ESA) was conducted, by AECOM 2013, subsequent to the decommissioning by foam filling of the Underground Petroleum Storage Systems (UPSS) infrastructure. The objective of the Phase 2 ESA was to assess the presence of soil, sediment, surface water and ground water contaminations in targeted areas identified as areas of potential concern within the Site and determine Centennials remedial obligations.

The targeted Phase 2 ESA identified on-site Phase separated hydrocarbons, soil and ground water impact and off-site sediment and surface water impact related to historic and current Site mining operations, which under the Contaminated Land Management Amendment Act 2008 triggered the duty to report to the NSW EPA. The extent and associated risk of the impact was not evaluated and therefore it had not been determined if remedial action was required or not.

Centennial Coal had reported Myuna Colliery to the EPA in a letter dated 2nd February 2012. The EPA responded to Centennial acknowledging receipt of the Duty To Report letter and Centennials commitment to for staged investigation and remediation works at its mine sites.

EPA officers conducted a site inspection 29th June 2015 for the purpose of reviewing the information provided from the Section 60 Duty to report and the Phase 2 Environmental Assessment.

Work commenced in November 2016 to undertake the recommendations of the Targeted Phase 2 Environmental Site Assessment (AECOM 2013) and is scheduled for completion by May 2017.

The progress of the Hydrocarbon Site Assessment is tabled below.

Table 29: Site Assessment Action Progress

Action	Progress
Installation and development of new targeted monitoring ground water wells.	Completed
Initial gauging of the ground water wells onsite	Completed
Undertake a comprehensive hydraulic investigation (including determining the transmissivity of the identified PSH), including but not limited to the assessment of the hydraulic gradient of the groundwater to identify the potential for the PSH and the impacted groundwater to migrate off-site towards Wangi Creek and/or Lake Macquarie.	Completed
Delineate the extent of the PSH plume and petroleum hydrocarbon impacted groundwater, further downgradient of the decommissioned USTs and towards Wangi Creek.	Completed
Document the nature and location of the identified PSH, TPH impacted soils and groundwater across the Site in Centennial's Environmental Management Plan (EMP) so that all necessary precautions are taken to ensure that any intrusive works for maintenance or otherwise is undertaken in a manner that protects and mitigates harmful exposure to workers.	Ongoing
Undertake a Human Health and Ecological Risk Assessment (HHERA) in order to assess the potential human health risk associated with vapor intrusion into the office block/bath house from the identified PSH and TPH solute plumes and the potential ecological and secondary human health risk associated with the metal impact migrating from the site to natural water bodies.	Ongoing
Report on the findings of the above investigations.	Ongoing


Centennial Coal

APPENDICES

Appendix 1. Water Cycle Accounting 2016
Appendix 2. Myuna Weed Action Plan 2017
Appendix 3. 2016 Monitoring Report - Swamp Sclerophyll Forest on Coastal Floodplain EEC

APPENDIX 1. Water Cycle Accounting 2016

24 February 2017

Environment and Community Coordinator
Centennial Myuna Pty Ltd
14 Summerhill Drive
Wangi Wangi NSW 2267

Our ref: 22/18756/
Your ref:

Dear Morgan

Annual Groundwater Management Report
Update of Water Cycle Accounting for 2016

GHD Pty Ltd (GHD) was engaged by Centennial Myuna Pty Ltd (Centennial Myuna) to update the water cycle accounting for 2016 for Myuna Colliery. The updated water cycle accounting has been prepared as part of the Annual Groundwater Management Report.

1 Methodology

The inflows and outflows of water during 2016 for Myuna Colliery were accounted for using the site water balance model developed for Myuna Colliery, as described in GHD (2014). The water balance modelling was informed by monitoring data that was observed during 2016, including:

- Daily rainfall totals from the site meteorological station at Myuna Colliery.
- Daily totals of discharge volume from LDPB.
- Approximately fortnightly readings of CHP Dam pump meter.
- Monthly totals of potable water usage volume.

Based on advice from Centennial Myuna, the following changes to the water management system have been updated in the site water balance model during 2016:

- Emergency stockpile dam reports to CHP Dam instead of Mine Water Settling Pond 2 (MWSP2).
- CHP Dam pump and siphon report to the underground workings instead of MWSP2. The operations of the transfer from CHP Dam to the underground workings was updated to be consistent with items 3 and 4 of the safe work procedure MY-EMP-048 *"Monitoring of CHP Dam during a rainfall event"*. Level 1 and Level 2 defined in MY-EMP-048 were assumed to be 1 m and 0.2 m below the invert of CHP Dam spillway, respectively.
- First Flush Tank reports to the underground workings instead of LDPB.
- Washdown Bay reports to Primary Settling Tank instead of HWC Trade Waste.

As described in the Annual Groundwater Management Report, the estimated actual groundwater inflows are approximately 68 % of groundwater modelling predictions for 2016. For the purpose of reporting on the water cycle for 2016, the groundwater inflows were scaled linearly in order to match total modelled LDPB discharge to site observations.

GHD Pty Ltd ABN 39 008 488 373
Level 3 GHD Tower 24 Honeysuckle Drive Newcastle NSW 2300 PO Box 5403 Hunter Region Mail Centre NSW 2310 Australia
T 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com

2 Validation

In order to check that the site water balance model is representative of site conditions in 2016, modelling results were compared to site observations. A comparison of the cumulative observed and modelled discharges from LDPB, pumped flows from CHP Dam to underground workings and potable usage are shown in Figure 2-1, Figure 2-2 and Figure 2-3 respectively.

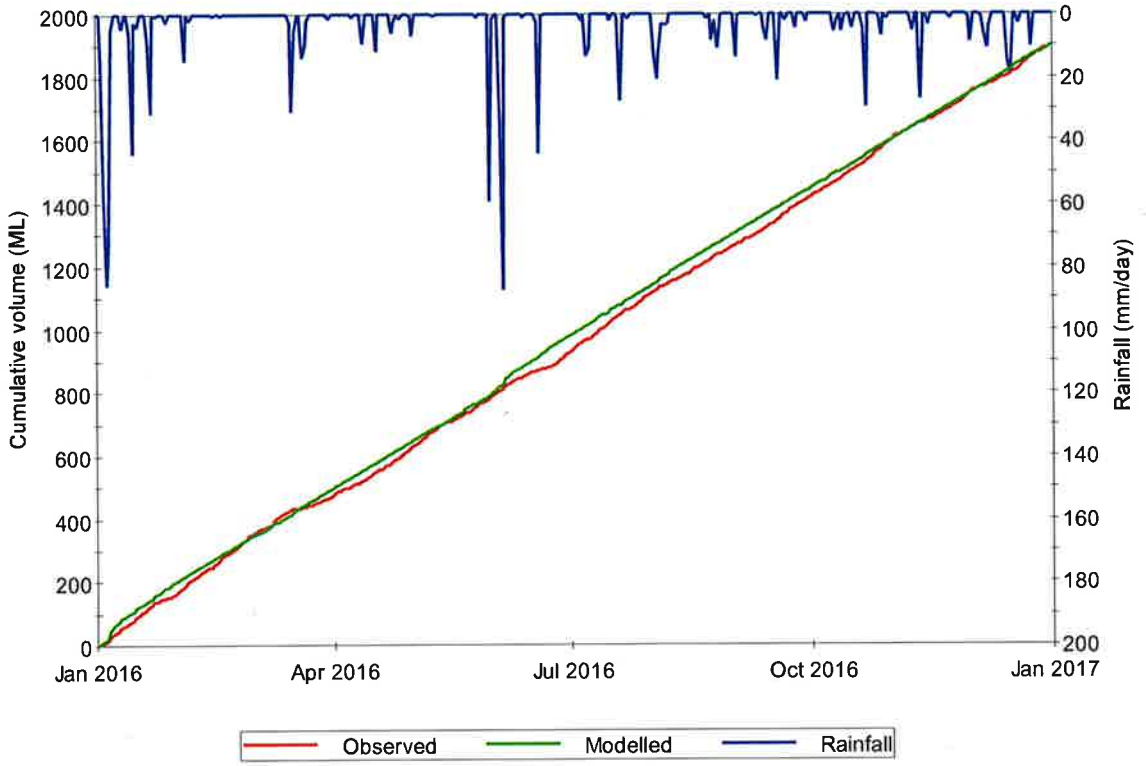


Figure 2-1 Cumulative observed and modelled LDPB discharges

Figure 2-1 shows the close agreement between the observed and modelled LDPB discharges during 2016, both in terms of annual total and the flow rate. This validates the groundwater inflows scaling discussed in Section 1.

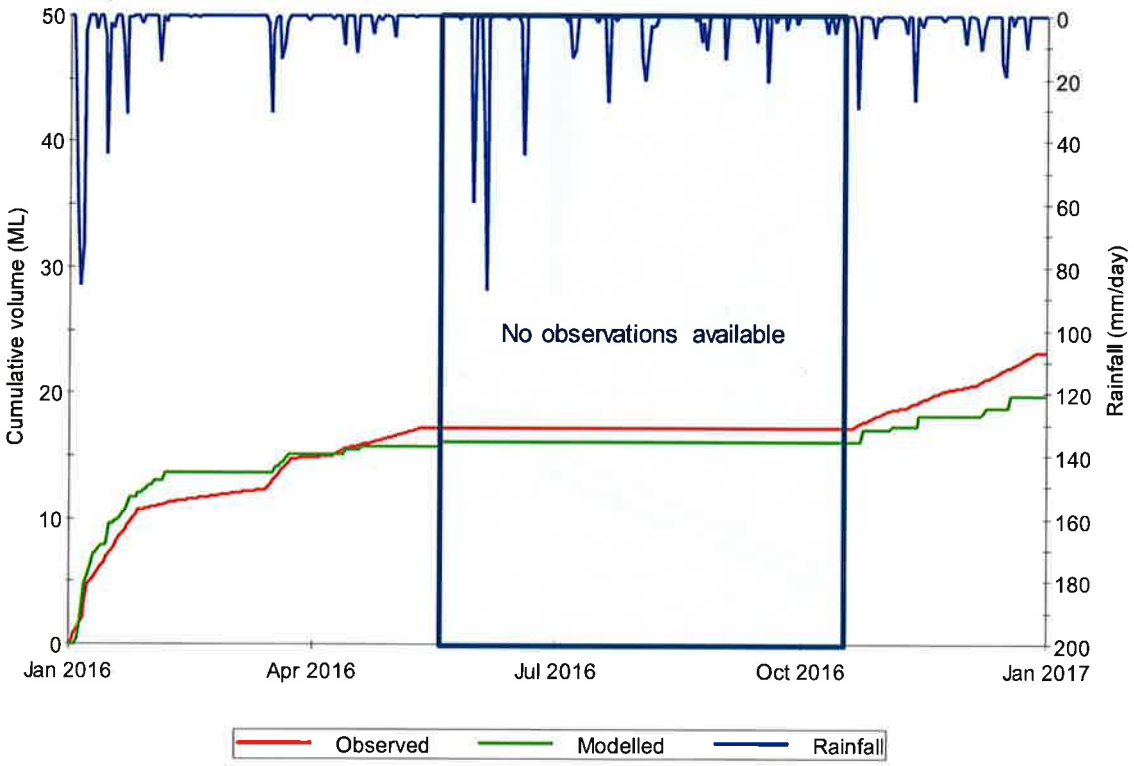


Figure 2-2 Cumulative observed and modelled pumping from CHP Dam to underground workings

Figure 2-2 shows a satisfactory fit between observed and modelled pumping from CHP Dam to the underground workings over 2016, both in terms of total volume and the response of flow rate to rainfall events. This validates both the catchment runoff model used in the water balance model and the modelling of the operation of the CHP Dam. No observed data was available for comparison for the period from 20 May 2016 to 20 October 2016.

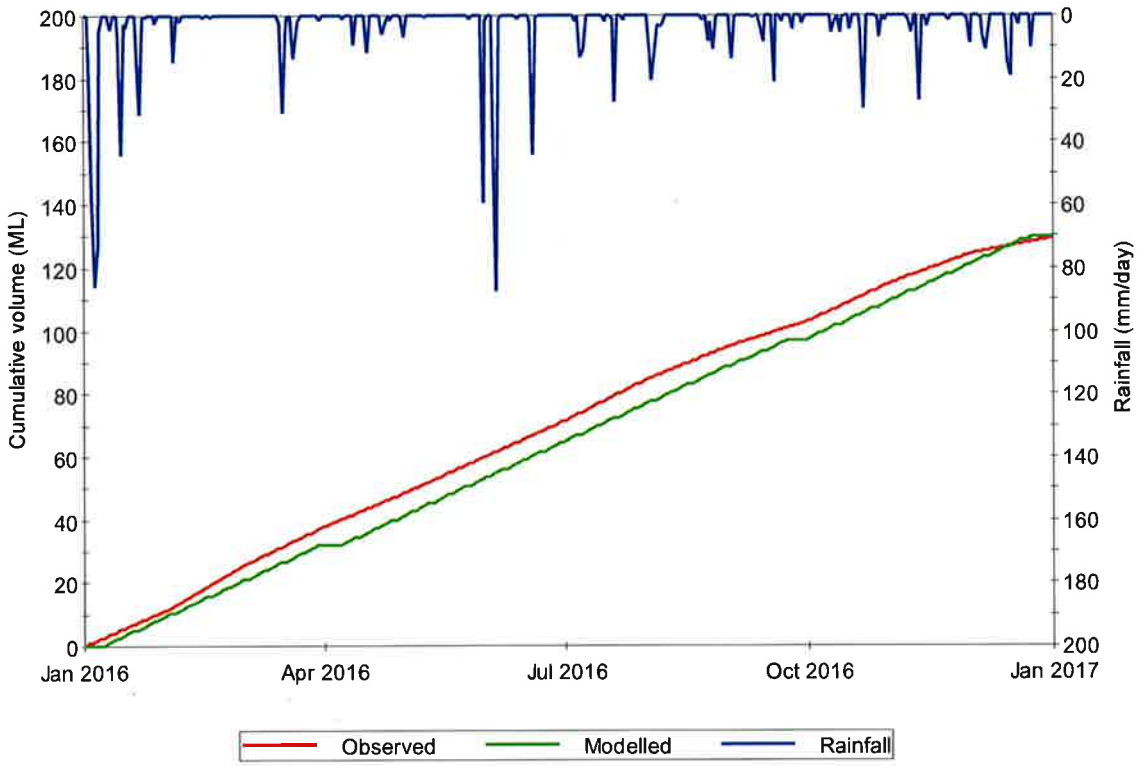


Figure 2-3 Cumulative observed and modelled potable water usage

Figure 2-3 shows a close agreement between the observed and modelled potable usage during 2016, both in terms of total volume and the rate over time. This validates the modelling of the operations on the potable water usage in the water balance model.

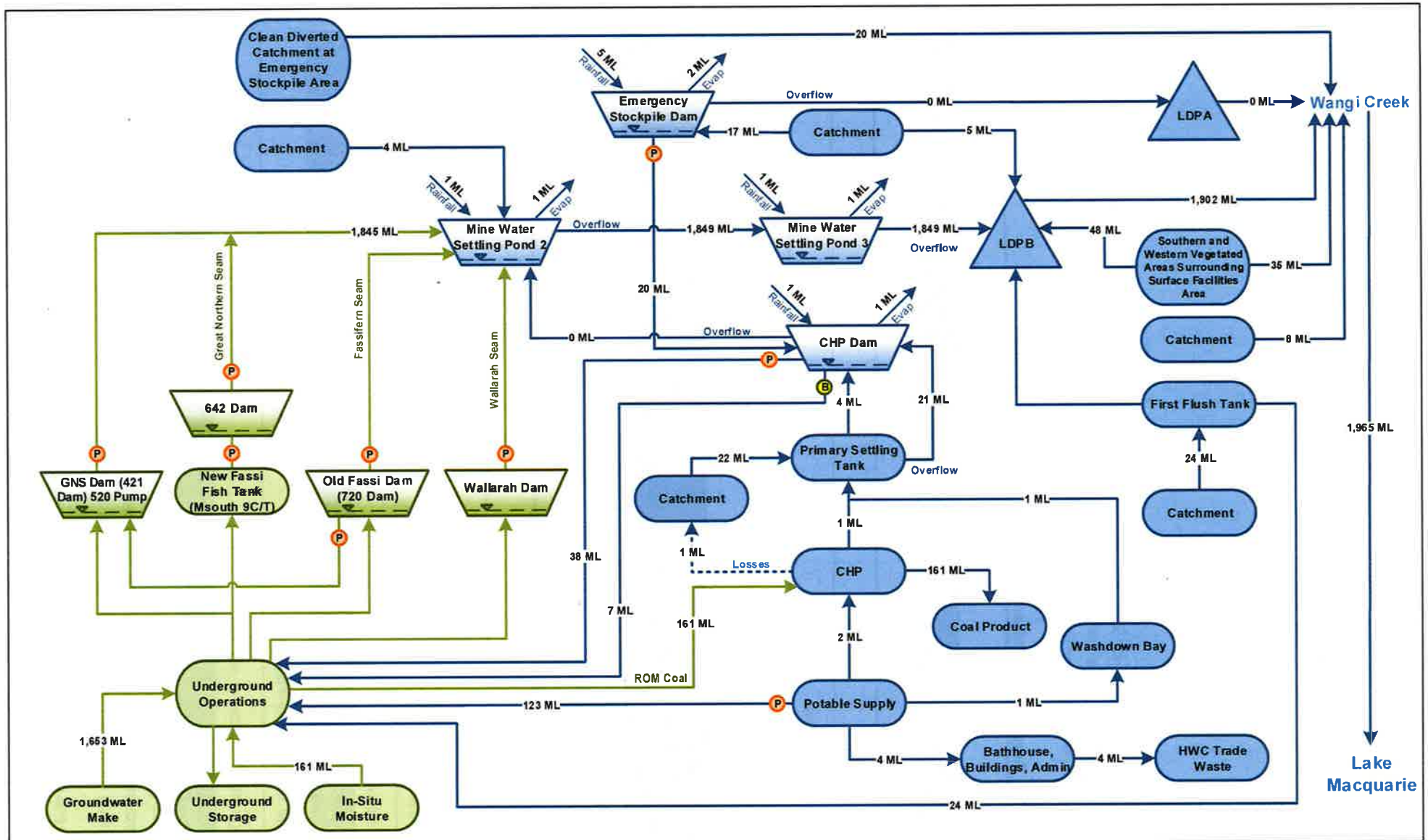
3 Results

The overall water balance for 2016 is shown in Table 3-1 and a water cycle schematic for 2016 is shown in Figure 3-1. The results shown are the modelled outputs from the water balance model and include modelled estimates of water volumes that are not able to be directly measured.

Table 3-1 Annual water balance for 2016

Flow	Total volume for 2016 (ML)
Inputs	
Direct rainfall	8
Catchment runoff	120
Groundwater inflows	1653
In situ coal moisture	161
Potable supply	130
Total inputs	**2072**
Outputs	
Evaporation	5
LDPA	0
LDPB	1902
Product coal moisture	161
HWC trade waste	4
CHP losses	1
Total outputs	**2072**
Change in surface storage	0
Change in underground storage	0
Balance	**0**

Table 3-1 shows that the main inflow during 2016 at Myuna Colliery was groundwater inflows, accounting for approximately 80 % of inflows. The main outflow from Myuna Colliery was to Wangi Creek via LDPB, accounting for approximately 92 % of outflows during 2016.



LOCATION	Myuna
SEAM	Wall., G.N., Gt Nrth
DRAWN	SM
CHECKED	TD
APPROVED	AW
SCALE	NTS

Myuna Colliery

Annual water cycle 2016

Centennial Coal

DATE Mar 2017

Figure 3-1

\\ghdnet\ghd\AU\Newcastle\Projects\22\18756\Tech\Visio\2218127-VIS-Myuna_Colliery-Annual_water_cycle-2016.vsdm

4 Conclusion

GHD was engaged by Centennial Myuna to update the water cycle accounting for 2016 for Myuna Colliery. The update was based on the site water balance model and monitoring data for 2016.

The water balance model was found to satisfactorily match observed monitoring data. It is understood that a meter has been installed on the siphon pipe from the CHP Dam in late 2016. This will provide additional observed data to validate the model in 2017.

The water balance model was used to determine modelled estimates of the water cycle at Myuna Colliery. The main inflow during 2016 at Myuna Colliery was groundwater inflows, accounting for approximately 80 % of all inflows. The main outflow from Myuna Colliery was to Wangi Creek via LDPB, accounting for approximately 92 % of all outflows during 2016.

Sincerely
GHD Pty Ltd

Tyler Tinkler
Water Engineer 0249799061

APPENDIX 2. Myuna Colliery Weed Action Plan 2017

RESTORING THE BALANCE

Myuna Colliery Weed Action Plan 2017

Centennial Coal

February 2017

This Annual Weed Action Plan has been prepared for the Myuna Colliery site off Summerhill Drive, Wangi Wangi, NSW. It has been produced for Morgan Gleeson in March 2017 to provide an overview of previous control works conducted on the site and current weeds present on the site. This plan also discusses control requirements under the NSW Noxious Weeds Act and proposed control methods and timing for 2017.

SUBMITTED TO	DATE	REVISION
Morgan Gleeson	19/02/2017	Draft
Morgan Gleeson	02/03/2017	Version 2

This document can only be considered as having permission for final distribution if an original signature of an authorized representative of HLM is found below:

02/03/2017

SIGNATURE DATE

Daniel Lewer

Managing Director

HUNTER LAND MANAGEMENT PTY LTD

Box 776 | Maitland | NSW 2320

P 02 4932 1550 | F 02 4932 1558

daniel.lewer@hlmaus.com.au

www.hlmaus.com.au

Cover Photo: Lantana controlled amongst Sweet Pittosporum

Contents

1. Introduction

Myuna Colliery is located off Summerhill Drive in the suburb of Wangi Wangi, New South Wales, an active underground mining operation which supplies coal to nearby Eraring Power Station directly via conveyor. The disturbance area associated with day to day operations covers less than one quarter of the total landholding, which when combined with previous disturbance impacts of road, access points and superseded infrastructure clearing or regular access has affected approximately one third of the total management area.

Observations of vegetation and landscape integrity indicate that more than one half of the landholding has never been disturbed, or has been disturbed infrequently by mining and associated activities. These areas support functional natural vegetation communities with little to no weed invasion and minimal management requirements. The main management need in these areas is the maintenance of boundary edges to control weeds established there and reduce the likelihood of creeping establishment of weed species in from these edges. The labour and material input required for effective suppression of weeds and integrity of the natural system is minimal, as competition from indigenous species is high.

From 2012 to the end 2016 there have been five Weed Action Plans conducted at Myuna Colliery, including an annual weed survey and on ground works. This has resulted in the ongoing suppression and removal of Lantana, Bitou Bush, Pampas Grass, Pine Trees and Castor Oil among others from those areas identified in **Figure 2**.

During 2016 HLM spent approximately 120 labour hours on ground at the site actively controlling high priority target weeds. This equates to six days with a crew of two carrying out primarily cut and paint bush regeneration methods, supported by foliar spraying for dense lantana, Cassia and Crofton weed infestations. Where suitable (i.e. away from waterways) selective herbicides such as Starane and 2-4-D were used to spray lantana to limit the off target damage to grasses and other non-susceptible species. This in turn helps to maintain active groundcover. This was primarily used on plants growing up to and through boundary fences in hard to reach locations for time efficient control.

2016 weed control work (outlined in **Figure 2** below) was targeted at all areas excluding Area 1 were minimal work was completed. Weeds targeted were Bitou Bush, Lantana. Crofton Weed and Cassia. Work included areas along Wangi Creek in Area 4 with Lantana, Bitou Bush and Tree Tobacco were targeted. Other weeds targeted in Area 4 were Castor Oil and Pampas Grass. Area 2 was treated for Cape Broom, Cassia and Blackberry.

Ongoing works will be required in Areas 4 and 5 to eradicate any new weed growth. Wangi Creek in Area 5 should be the focal point for 2017 with maintenance work in all other areas to follow. Area 2 along Summer Hill Drive boundary had a large infestation of Lantana and will require ongoing treatment in 2017 and beyond.

Weed Infestation Survey Summary by Area

Area 1 – Large Coral Tree and Scattered Cassia

Area 2 – Scattered pockets of Lantana and Bitou Bush and Pampas Gras in North East

Area 3 – Scattered singular Bitou Bush throughout site with seedlings along with a few scattered Lantana and Castor Oil Plants

Area 4 – Tobacco Bush around Coal Pad and Scattered Lantana along creek line

Area 5 – Scattered Lantana along creek line and roadsides

HLM undertook the following methodology to conduct the Weed Action Plan. This included conducting a 4WD/walking survey of the site, geo-referencing weed locations, researching and prioritising weeds identified onsite and outlining proposed timing and control methods for 2017.

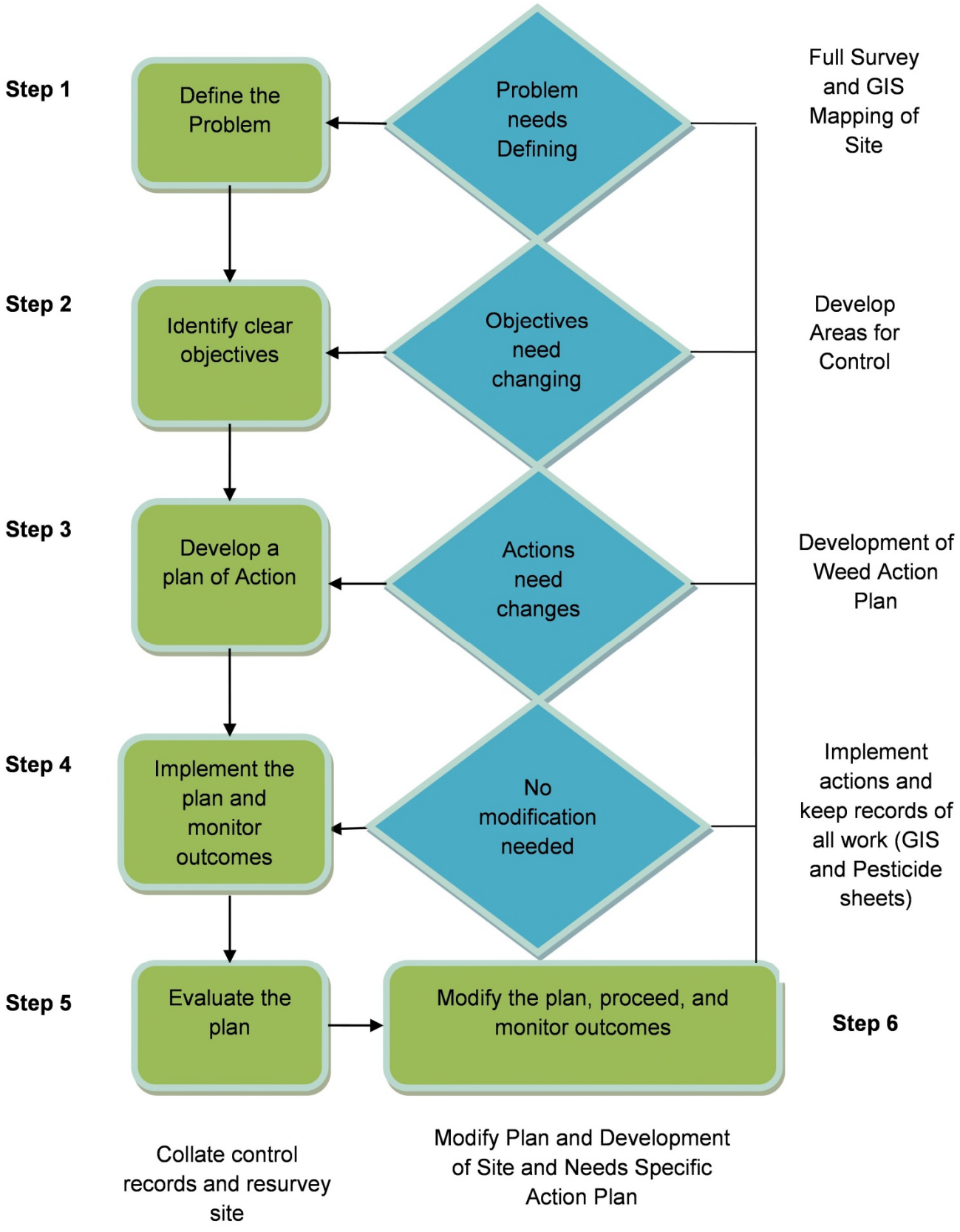


Figure 1 Weed Action Plan development methodology

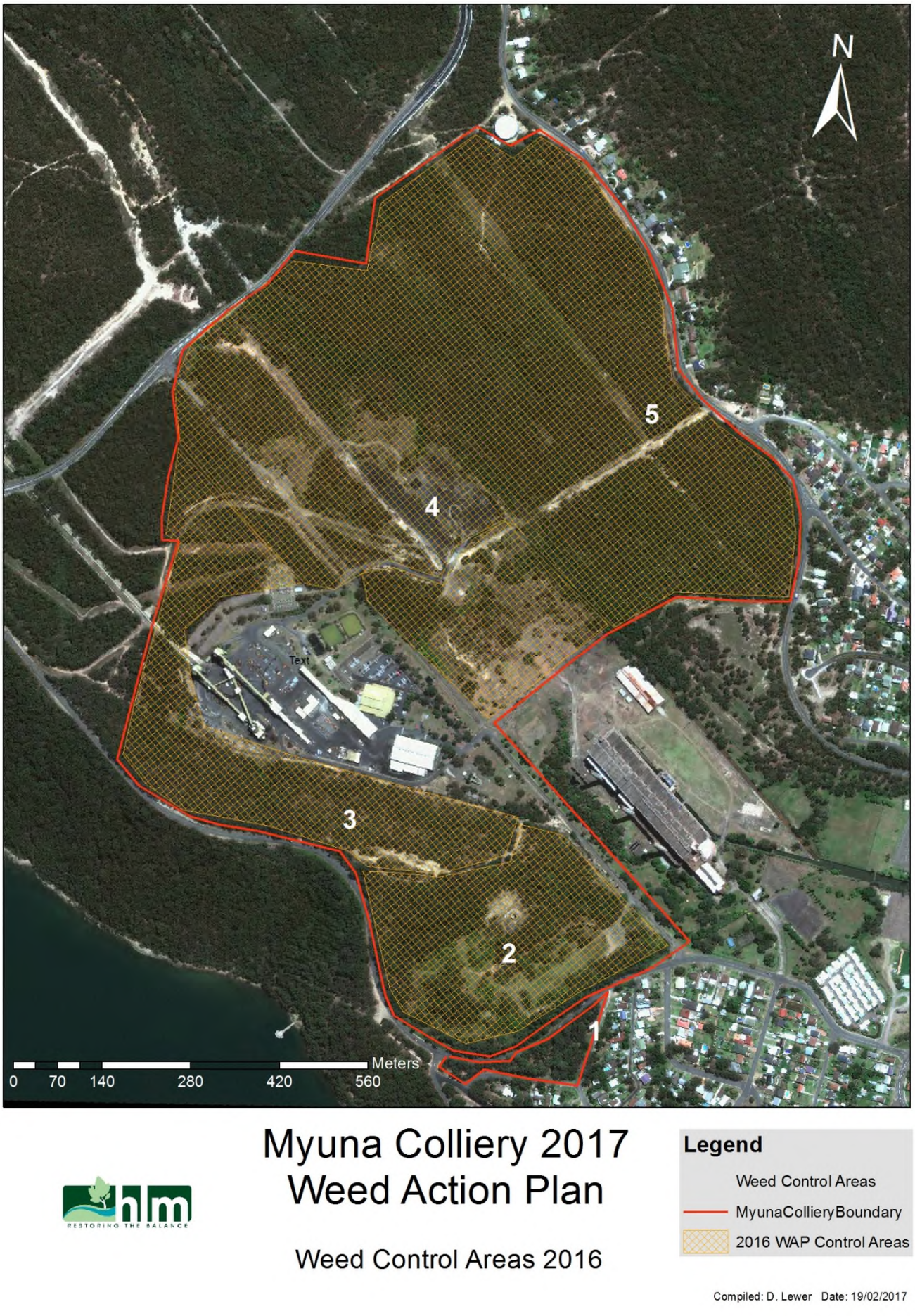


Figure 2 Weed Control Areas 2016

2. Control Approach (2017 Weed Action Plan)

All areas (excluding Area 1) were treated for various weeds to maintain suppression and this should again be the focal point for 2017 with maintenance crucial to maintain pressure on weeds in these area which is the Groundwater Dependant Ecosystem (GDE) area on site. Area 2 along Summer Hill Drive boundary had an infestation of Lantana and will require ongoing treatment in 2017 and beyond. Figure 1 in **Section 3** outlines the areas proposed for weed control works in 2017.

Community members continue to carry out landcare activities along the Donnelly Rd roadside to reduce weeds and plant local indigenous species. Continual removal of lantana and other weeds along the fence line will capitalise on this work by removing all mature Lantana and Bitou Bush plants in the area, and is also a low energy opportunity to cultivate positive neighbour relationships through contributing to an existing initiative. This area also represents the disturbed margin above a large expanse of intact bushland with a low weed load. Through being vigilant along the boundary, the risk of weed invasion into the high value bushland will be limited. Once primary weeding along the top ridge is complete the area can be designated a maintenance zone and will require only light annual follow up control of emerging seedlings and regrowth.

Working down the hill towards the creek line the lower flats have a higher weed load as moisture availability and disturbance frequency increases. Lantana and Bitou Bush are found along tracks and in mid-story openings. Field teams must leave the existing tracks and move through the bushland as isolated weeds are scattered throughout the vegetation and will need to be treated with cut and paint techniques.

Once the maintenance weeding has been completed, focus is to remain on Wangi Creek as the secondary focus for 2017. This area will require repeated backpack foliar spray, cut and paint, and isolated high volume spray treatments to bring the Lantana, Crofton Weed, Bitou Bush and Pampas Grass infesting the creek line under control. The main access point will be the gateway located at the south eastern tip of Area 5. This is easily accessed from Donnelly Road and will permit vehicle access in dry weather and all weather access on foot. Weed control will move from this point upstream to Wangi Road.

Area 1 and 2 in particular still contains established Lantana, Cape Broom, Bitou Bush, Crofton Weed and Tree Tobacco, which will need to be moved into from areas controlled during 2017. The well-established nature of these infestations and the highly disturbed nature of the landscape makes this a higher energy input area in terms of intervention needed to allow the surrounding native species to establish dominance. Area 2 will require several more years of applied weed control to achieve effective management.

A proposed weed action plan budget which outlines a plan for ten days of onsite weed control with a crew of two, and the intended break up of effort over the site is included on Page 14.

As stated above it is considered top priority to work from the top of Area 5's boundary fence to Wangi Creek and these areas are to be completed before carrying out any maintenance program in previously treated areas in order to achieve these desired outcomes.

3. 2017 Target Areas

Myuna Colliery 2017 Weed Action Plan

Legend

- Weed Control Areas
- MyunaColliery Boundary
- 2017 WAP Target Areas

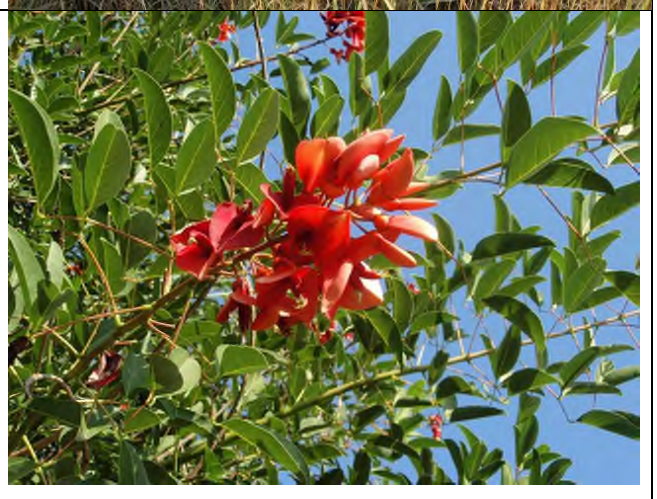
Figure 1: Target Areas 2017

Compiled: D. Lewer Date: 19/02/2017

4. Weed Species Classification and Profile

Table 1 Weed Species Classification and Detail

Weed Name (Common Name) Weed Classification	Description of Infestation/Field Notes	Weed Photograph
Lantana **Noxious Weed Class 4** **Weed of National Significance (WoNS)**	A listed noxious weed, this perennial large shrub is the dominant weed found over the whole site with the exception of dense, natural bushland on the north eastern hill as seen in Figure 4. In heavily disturbed areas it forms a dense mid-story and supresses the growth of native species. In less disturbed areas it is largely found as scattered shrubs within mixed native and weed based vegetation which is easily removed through cut ant paint or hand pulling. In this competitive environment with established and recruiting native vegetation removal has a good chance of success.	
Bitou Bush **Class 4 Noxious Weed**	A list noxious weed, the South African shrub is very well suited to coastal areas where it forms dense monocultures. It is present over most of the site, interspersed with other vegetation as single plants or small clumps. All but the largest plants are easily removed by hand. Persistent ongoing removal will be needed.	
Pampas Grass **Noxious Weed Class 4**	A noxious weed particularly prevalent in disturbed areas such as mines and quarries. This perennial grass has a very high seed load and can outcompete most other vegetation in disturbed areas. Control all plants encountered to limit seed set and distribution.	
Crofton **Noxious Weed Class 4**	Crofton weed is present throughout most wet or occasionally inundated areas in low to medium densities. Ongoing spot spraying and manual removal of isolated plants is required to remove established populations, and prevent the suppression of native species common in dense infestations. Primary infestations have been in Areas 2 and 4.	
Easter Cassia **Noxious Weed Class 4**	This noxious weed is a spreading shrub to 3m high, flowering all year with the bright yellow flowers seen to the right, producing large amounts of viable seed in bean like seed pods. Found mostly on disturbed margins in the southern area of the site. Most common around the horse paddock.	

Camphor Laurel **Environmental Weed**	Large, broad tree with glossy leaves, pinkish new growth and a strong smell of camphor from crushed leaves. Invasive and coppice forming, particularly along drainage lines and water ways. This tree is scattered throughout the southern part of the site, largely through regenerating previously disturbed areas. Control with Cut and paint method as encountered.	
Fire Weed **Weed of National Significance (WoNS)**	Native to south eastern Africa it is highly invasive in disturbed areas and pasture. Quickly developing a persistent seed bank it flowers in late winter to early spring. Toxic to livestock primarily through liver damage It is primarily restricted to Area 2, and was treated through foliar spray in 2013. Follow up treatment in 2014 will be needed.	
Cape Broom **Weed of National Significance (WoNS)**	Upright, evergreen shrub from 1-3m, usually with one main stem with many branchlets holding small dark green leaves. Finely hairy on the underside of leaves, bearing clusters of yellow pea like flowers followed by small brown to black seed pods. Highly invasive with weed declarations between category class 4 – 2 around New South Wales. Primarily found in the area surrounding the hose paddock (Area 2) extending into Area 3. Early control before seed set in spring. Plants must be two year old before they reproduce, so ongoing control of young plants is desirable.	
Coolatai Grass **Environmental Weed**	This is an invasive perennial grass that is an environmental weed. Found in association with whisky grass onsite.	
Coral Tree **Environmental Weed**	Widely naturalised, this tree with distinctive scarlet flowers generally found near watercourses and drainage lines has the ability to grow readily from broken branches. Monitor and control populations where they show signs of expansion. Treatment for mature plants is cut and paint or direct injection of herbicide, followed up with foliar spray of regrowth. Note that freshly cut plant material is not to be left in contact with the ground. It must be hung in nearby vegetation and or removed to a designated waste area or facility.	

Spear Thistle **Environmental Weed**	An annual environmental weed of disturbed areas and roadsides. This weed can be treated with spot spraying. Scattered across disturbed and recovering areas of the site opportunistic control should be carried out while targeting high priority species.	
Buchan Weed **Environmental Weed**	An erect bristly herb to 1m with yellow flowers clustered at the top of branched, spike-like inflorescences. A major weed of agricultural cropping areas in South Australia, the infestation is restricted to around the coal stand pad and various dams/creeks nearby. Control optimal via foliar spray before flowering in spring. Control opportunistically at any time.	
Castor Oil **Environmental Weed**	This annual is a spreading, upright shrub to 6m with large dark green palmate leaves often with red veins and coloration. The leaves have a strong, unpleasant smell, with the dusty grey green branches and main stem highly visible. It develops large clusters of spiny seed pods, drying to a ruddy brown. Widespread and common in disturbed land, ongoing management of seedlings and adults is needed.	
Wild Tobacco **Environmental Weed**	An annual environmental weed of disturbed areas and roadsides. This weed can be treated with spot spraying or cut and paint methods	
Whiskey Grass **Environmental Weed**	This invasive perennial grass is an environmental weed of disturbed areas. Stems grow up to 1m long and brown off over summer, revealing a distinctive upright, orange tinged habit. It can also successfully invade undisturbed bushland. Effective control can be achieved through foliar spraying.	

Table 2 Weed Control Calendar and Methodolgy

Species	Scientific Name	Weed Status	Weed Class	Control Requirements	Treatment	Priority	Autumn			Winter			Spring			Summer		
							Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018
Lantana	Lantana camara	Noxious	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.	Spot Spray Round Up Biactive© 1/100L Spot Spray Starane Advanced© 0.6/100L	High												
Pampas Grass	Cortaderia selloanana	Noxious	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.	Spot Spray Round Up Attack© 0.625/100L	High												
Bitou Bush	Chrysanthemoides monilifera	Noxious	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.	Hand Pull/Cut and Paint with Glyphosphate	High												
Crofton	Ageratina adenophora	Noxious	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.	Spot Spray Round Up Biactive© 1/100L	High												
Cape Broom	Genista monspessulana	WoNS	-	No legislative requirements. Control should be conducted to prevent spread into rehabilitation areas.	Spot Spray Garlon™ 600 0.17/100L	High												
Easter Cassia	Senna pendula	Noxious	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction.	Spot Spray Round Up Attack© 2L /100L Cut Stump 1 part Round Up Attack© : 1.5 parts water	Med												
Camphor Laurel	Cinnamomum camphora	Noxious	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and	Cut Stump 1 part Round Up Attack© : 1.5 parts water	Med												

				continuously inhibits its reproduction.														
Coral Tree	Erythrina sp	Environmental	-	No legislative requirements. Control should be conducted to prevent spread into rehabilitation areas.	Cut Stump/Inject 1 part Round Up Attack© : 1.5 parts water	Low												
Coolatai Grass	Hyparrhenia hirta	Environmental	-	No legislative requirements. Control should be conducted to prevent spread into rehabilitation areas.	Spot Spray (PER11916) Round Up Biactive© 1.3L/100	Low												
Buchan (mustard) Weed	Hirschfeldia incana	Environmental	-	No legislative requirements. Control should be conducted to prevent spread into rehabilitation areas.	Spot Spray Round Up Attack© 0.45L /100L	Low												
Spear Thistle	Cirsium vulgare	Environmental	-	No legislative requirements. Control should be conducted to prevent spread into rehabilitation areas.	Spot or Boom Spray Grazon Extra© 0.35/100L	Low												
Purple Top	Verbena bonariensis	Environmental	-	No legislative requirements. Control should be conducted to prevent remove weed from rehabilitation areas.	Spot Spray Round Up Attack© 0.65L /100L	Low												
Castor Oil	Ricinus communis	Environmental	-	No legislative requirements. Control should be conducted to prevent remove weed from rehabilitation areas.	Cut Stump 1 part Round Up Attack© : 1.5 parts water	Low												
Wild Tobacco	Solanum mauritianum	Environmental	-	No legislative requirements. Control should be conducted to prevent spread into rehabilitation areas.	Cut Stump 1 part Round Up Attack© : 1.5 parts water	Low												
Whiskey Grass	Andropogon virginicus	Environmental	-	No legislative requirements. Control should be conducted to prevent spread into rehabilitation areas.	Spot Spray Round Up Attack© 0.65L /100L	Low												
2016 Weed Survey and creation of 2017 Weed Action Plan																		

5. Myuna Colliery Weed Action Plan 2017

The Myuna Colliery Weed Action Plan has allocated 10 days with a crew of two onsite over a twelve month period (reduced from 16 days in 2015), plus project management and 2017 WAP development.

It is expected that this allocation would complete the primary weed control works program for Myuna, and provide follow up for previous works. On completion of primary weeding the 2018 WAP program would be a reduced maintenance schedule requiring approximately 8 days over the twelve month period.

Month 2016	**Allocation per month for 2017**
March	2 days
April	0
May	2 days
June	0
July	0
August	0
September	2 days
October	0
November	2 days
December	0
January	2 days
February	0
All Sites Weed Survey & 2017 WAP	1 day
Total 2017 WAP Allocation	**11 Days**

Appendix 1. Daily Report Sheet

All chemical applications will require the detailed filling of this record sheet along with GPS data gathered for all areas controlled.

HUNTER LAND MANAGEMENT

PO Box 776, Maitland NSW 2320
Phone: (02) 4932 1550
Mobile: (0412) 404499
Fax: (02) 4932 1558

DAILY REPORT SHEET
0001

Date:	Site: ☐ Mine Site	Supervisor:	Project Manager:

Job Details

Job numbers	Times		Hours			
	Start Time	Finish Time	Normal Time	Time and a half	Double time	Total

Equipment/Plant used (tick if used)

Ute ☐ Unit No:	Quikspray ☐ Unit No:	Tractor ☐ Make:	Mine radio: ☐	Other: (describe) ☐
Drivers/Operators:		Work Request Number		

Daily Breakdown

Time left depot:	Time arrived on site:	Crib break start/finish time:	Lunch break start/finish time:	Time left site:

Chemical Use Record

Property/Holding: (residential address)	
Applicator's Full Name:	
Sensitive Areas (including distances, buffers): N / W / Treated Area / E / S	Comments (including risk control measures for sensitive areas):

Application Data

Full Label Product Name:		Rate/Dose:	Water Rate @ L/ha:
Permit No.:	Expiry Date:	Additives/Wetters:	
Total L/kg:	Applicators Initials:	Water quality(pH or description):	
Equipment type:	Nozzle Type:	Nozzle Angle:	Pressure:	Date Last Calibrated:

Weather Showers ☐ Overcast ☐ Light Cloud ☐ Clear sky ☐

Rainfall (24 hours before and after)
Before: mm During: mm After: mm

Time (show time in this column)	Temperature °C	Relative Humidity (%)	Wind Speed	Direction	Variability (e.g. gusting)
Start					
Finish					

Description of day's work completed/issues encountered:	Materials Used:

HLM Staff Members Used

Name:	Sign:	O/N Allowance
Name:	Sign:	
Name:	Sign:	
Name:	Sign:	
Name:	Sign:	

Comment from / by Client	
Client sign:	Client Name:

Job Completed ☐ Job Ongoing ☐ Other Works ☐ .....

Appendix 2. Example of proposed Component Update

HLM Land Management Project Report v1

Client	
Project Name/Number	
Date or Date Range (including)	
Client Project Manager	
HLM Staff Involved	
Relevant Invoice/s	
Work Type	✓ Weed Control ☐ Vertebrate Pest Control ☐ Revegetation ☐ Seed Collection ☐ GIS Mapping ☐ Fencing ☐ Erosion Control ☐ Grounds Maintenance ☐ APZ Maintenance ☐ Consulting Project ☐ Bushfire Management ☐ _____
Detailed Work Description (including any Site Supervisor Comments)	
Photos (if applicable)	
Mapping, GIS Points (if applicable)	
Herbicide Application Record Sheets (if applicable)	
Other Land Management Issues encountered (if applicable)	
Recommendations / Further Works / Comments	

APPENDIX 3. 2016 Monitoring Report - Swamp Sclerophyll Forest on Coastal Floodplains EEC

2016 Monitoring Report: Swamp Sclerophyll Forest on Coastal Floodplains EEC

Myuna Colliery, Wangi Wangi NSW

Prepared by:

RPS AUSTRALIA EAST PTY LTD

241 Denison Street
BROADMEADOW NSW 2292

T: +61 4940 4200
F: +61 4961 6794
E: arne.bishop@rpsgroup.com.au

Client Manager: Arne Bishop
Report Number: 130932
Version/ Date: Final/June 2016

Prepared for:

CENTENNIAL COAL COMPANY LTD

Myuna Colliery
14 Summerhill Drive
Wangi Wangi NSW 2267

T: +61 4970 0263
E: Morgan.Gleeson@centennialcoal.com.au

IMPORTANT NOTE

Document Status

Version	Purpose of Document	Orig	Review	Review Date
Draft 1	Draft for internal review	JD	MA	21 June 2016
Draft 2	Draft for client review	MA	AB	27 June 2016
Final (R1)	Final	MA	Client	9 August 2016
Final (R2)	Final	MA	Client	18 October 2016

Approval for Issue

Name	Signature	Date
Mark Aitkens		18 October 2016

Contents

Tables

Figures

Plates

Appendices

Summary

Annual monitoring performed for Project Approval 10_0080 under the approved Myuna Biodiversity Management Plan (BMP) for 2016, and herein reported, is listed below:

- General flora surveys;
- Swamp Sclerophyll Forest on Coastal Floodplains endangered ecological community (EEC);
- Groundwater Dependant Ecosystems (GDEs).

Method

BioMetric (Gibbons et al. 2009), as amended by the NSW BioBanking Assessment Methodology 2014 (BBAM 2014) (Office of Environment and Heritage, OEH 2014), was used as the monitoring method. Calculations were performed using the online NSW BioBanking Credit Calculator (BBCC) to compare monitoring data with OEH published Plant Community Type (PCT) benchmark datasets to calculate site value scores; an objective and quantitative condition measure for vegetation and habitat.

Landscape Score, Site Assessment and Benchmark Comparison

One 'site based assessment' assessment circle was used to evaluate native vegetation cover, condition, patch connectivity and size. Two vegetation management areas (VMAs) were mapped within the site. The site value score produced from data collected from three BioMetric plots was compared with the corresponding PCT benchmark data (OEH 2016) to evaluate baseline condition (i.e. site value score). Results are provided in the table below.

Comparison between VMA Benchmark data

BioMetric Site Attribute	OHE Published Benchmark	VMA 1	VMA 2
Native plant species richness (NPSR)	>=24 (number)	30-33 species	23 species
Native Overstorey Cover (NOC)	15-70	50.5-58	62.5
Native Midstorey Cover (NMS)	10-60	29-40	25.5
Native Groundcover Grasses (NGCG)	5-50	12-24	16
Native Groundcover Shrubs (NGCS)	5-30	8-18	2
Native Groundcover Other (NGCO)	5-40	54	42
Exotic Species (ES)	-	0-2	10
Number of Hollow-bearing Trees (NHT)	>=0 (number)	0 trees	0 trees
Overstorey Regeneration (OR)	1 (100)	1 (100)	1 (100)
Fallen Log Length (FL)	>=5 m	22-79 m	85 m
Site Value Score	*71-100*	*98.00*	*79.33*
Baseline condition	n/a	Moderate/ Good (High)	Moderate/ Good (High)

Baseline site values scores for VMA 1 and VMA 2 were found to be within a benchmark range (i.e. 71-100) thus represent vegetation and habtiat in a 'moderate/ good (high)' condition. However, neither can be wholly classed within a benchmark state due to the presence of exotic plant species. VMA 2 is approaching the lower limit of the 'benchmark range' and requires active management in terms of ES, NPSR and NGCS to produce an enhance outcome (as indicated by red shaded cells). A passive enhance outcome is anticipated in VMA 1 following the management of exotic species in VMA 2 (i.e. reduction in the source of exotic flora propagules).

Management Implications

Exotic species cover, native groundcover shrub species cover and native plant species richness are below benchmark in VMA 2. An appropriate management response would include exotic species management to reduce exotic species cover. Supplementary plantings using native groundcover shrub species would accelerate the enhancement of native plant species richness and native groundcover shrub cover.

Conclusions

Exotic species cover is highest in VMA 2 and represents an important management issue within the context of condition 28 within Project Approval 10_0080 and the approved BMP (e.g. weed management and protection and enhancement of native vegetation and habitat). Reductions in exotic species cover and supplementary plantings of native groundcover shrub species are recommended in VMA 2 as a consequence of the 2016 baseline monitoring event . Ongoing annual monitoring, as specified in the Biodiversity Management Plan, is required to evaluate the ecological benefit of management actions performed within the site.

1.0 Introduction

RPS Australia East Pty Ltd (RPS) was engaged by Myuna Colliery, Centennial Coal Ltd to perform annual monitoring for a patch of Riparian Melaleuca Swamp Woodland (MU 42; LHCREMS 2000) in accordance with the approved Myuna Biodiversity Management Plan (BMP) for the colliery (Centennial Coal 2016). The patch of vegetation subject to monitoring works is shown in **Figure 1** and is hereafter referred to as the site.

1.1 Background

Centennial Coal Myuna is currently undertaking continuous Miner Bord and Pillar Operations in the Newcastle Coalfields near Toronto, NSW. Operations are regulated by the Consolidated Project Approval (Project Approval 10_0080) and its conditions, including compliance with an approved BMP (i.e. condition 28).

1.1.1 Approved BMP

Schedule 3, Condition 28 of the Consolidated Project Approval binds Centennial to the implementation of an agency approved BMP for the life of the mine. The condition also requires the BMP to provide for:

- Weed management;
- Protection and enhancement of native vegetation and habitat;
- Feral animal control;
- Fire management; and
- Management of public access within the endangered ecological community (EEC) (NSW DPI 2012).

The site BMP originally released in 2012 was recently updated in May 2016 (Centennial Coal 2016). The annual monitoring of general flora, Groundwater Dependant Ecosystems (GDEs) and Swamp Sclerophyll Forest on Coastal Floodplains EEC is a requirement specified in this BMP.

1.1.2 Monitoring Area

Riparian Melaleuca Swamp Woodland (MU42) is the vegetation characterising the site. It occurs in deltaic floodplains, alluvial flats and drainage lines on the central coast lowlands from Wyong to Port Stephens where it is usually restricted to narrow creek lines, depressions and soak (LHCCREMS 2000). As noted in the site BMP, it forms part of the Swamp Sclerophyll Forest on Coastal Floodplains EEC and is generally characterised by several layers of vegetation and is commonly found close to standing water on humic clay and sandy loam soils on waterlogged or periodically flooded areas (DECC 2007). Within the Lower Hunter area, MU42 is associated with other ecological communities such as Swamp Mahogany-Paperbark Swamp Forest (MU 37) and Melaleuca Scrub (MU 42a) (NPWS 2000), which also form part of the EEC.

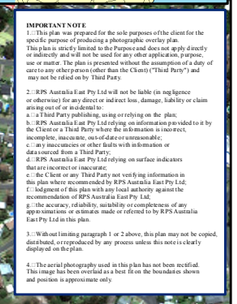
1.1.3 Baseline Management Assessment

Hunter Land Management (2016) performed an assessment in December 2015 for the site to evaluate the management scope for GDEs, general flora and Swamp Sclerophyll Forest on Coastal Floodplains EEC located within the site. This baseline assessment evaluted ten condition criteria at four locations along the mapped EEC including the incidence of weed species, hollows, fallen logs and soil type. Recommendations were provided to guide management towards outcomes consistent with the BMP including weed control and native species planting to improve patch condition.

Legend

N

- Project Area
- Mining Lease 1632
- Mining Lease 334



IMPORTANT NOTE

1. This plan was prepared for the sole purposes of the client for the specific purpose of producing a photographic overlay plan. This plan is strictly limited to the Purpose and does not apply directly or indirectly and will not be used for any other application, purpose, use or matter. The plan is presented without the assumption of a duty of care to any other person (other than the Client) ("Third Party") and may not be relied on by Third Party.

2. RPS Australia East Pty Ltd will not be liable (in negligence or otherwise) for any direct or indirect loss , damage, liability or claim arising out of or incidental to:
   a. a Third Party publishing, using or relying on the plan;
   b. RPS Australia East Pty Ltd relying on information provided to it by the Client or a Third Party where the information is incorrect, incomplete, inaccurate, out-of-date or unreasonable;
   c. any inaccuracies or other faults with information or data sourced from a Third Party;
   d. RPS Australia East Pty Ltd relying on surface indicators that are incorrect or inaccurate;
   e. the Client or any Third Party not verifying information in this plan where recommended by RPS Australia East Pty Ltd;
   f. lodgment of this plan with any local authority against the recommendation of RPS Australia East Pty Ltd;
   g. the accuracy, reliability, suitability or completeness of any approximations or estimates made or referred to by RPS Australia East Pty Ltd in this plan.

3. Without limiting paragraph 1 or 2 above, this plan may not be copied, distributed, or reproduced by any process unless this note is clearly displayed on the plan.

4. The aerial photography used in this plan has not been rectified. This image has been overlaid as a best fit on the boundaries shown and position is approximate only.

0 2460 m

SCALE 1:8,000 AT A3 SIZE

TITLE : **FIGURE 1: PROJECT AREA LOCATION**

LOCATION : **MYUNA, NSW**

DATUM:GDA 1994

PROJECTION: GDA 1994 MGA Zone 56

DATE : **5/31/2016**

PURPOSE: **ECOLOGY**

VERSION (PLAN BY): A A3 (amy.obrien)

PATH: J:\JOBS\Centennial\All Jobs\130932 Myuna\10 - Drafting\Arcgis Map Documents\Eco\130932 Figure 1 - Site Location A A3 20160531.mxd

CLIENT: **CENTENNIAL**

JOB REF: **PR130932**

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

creative people making a difference

RPS

1.1.4 Baseline dataset

As described in **Section 1.1.2**, native vegetation of the site is described as Riparian Melaleuca Swamp Woodland (MU42), which forms part of the Swamp Sclerophyll Forest on Coastal Floodplains EEC. The equivalent Plant Community Type (PCT) for MU42 is HU633 Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion. OEH published benchmark data for HU633 has been relied on as the comparative dataset in this monitoring program for calculating the site value score of the management areas. Benchmark data for HU633 is provided in **Table 1**.

Table 1 BioMetric Site Attribute Benchmark Data for HU633

BioMetric Site Attribute	Benchmark Data (per cent % unless otherwise indicated)
Native plant species richness (NPSR) (#)	>=24 (number)
Native Overstorey Cover (NOC) (%)	15-70
Native Midstorey Cover (NMS) (%)	10-60
Native Groundcover Grasses (NGCG) (%)	5-50
Native Groundcover Shrubs (NGCS) (%)	5-30
Native Groundcover Other (NGCO) (%)	5-40
Exotic Species (ES) (%)	-
Number of Hollow-bearing Trees (NHT) (#)	>=0 (number)
Overstorey Regeneration (OR) (0-1)	1 (100)
Fallen Log Length (FL) (m)	>=5 m
Site Value Score (high condition within benchmark range)	*71-100*

A qualitative scale providing an appreciation for site value scores calculated from the comparison between benchmark and site data is provided below in **Table 2**.

Table 2 Qualitative scale for calculated site value scores

Site Value Score	Qualitative Scale	Comments
71-100	Moderate/ good (high)	Generally within benchmark range for most BioMetric site attributes. Presence of exotic species cover, absence of hollow-bearing trees and/ or sub benchmark fallen logs generally responsible for sub 100 site value scores.
35-70	Moderate/ good (medium)	At least half the BioMetric site attributes are within or close to benchmark. Moderate to high exotic species cover and sub native plant species richness scores often responsible for lower site value scores.
34-50?	Moderate/ good (derived)	Representative of shrublands or grasslands derived from a parent grassy/ shrubby woodland/ forest PCT. Native plant species richness usually moderately intact but below benchmark. Usually impaired vegetation structure (i.e. absence of overstorey and/ or midstorey). Absence of fallen logs and hollow-bearing trees.
17-34	Moderate/ good (poor)	Native vegetation cover (i.e. >50% indignenous vegetation cover) attributable to a PCT that is highly impaired. Native plant species richness usually moderately intact but below benchmark. Usually highly disturbed r modified vegetation structure (i.e. absence of overstorey and/ or midstorey). Fallen logs and hollow-bearing trees are generally absent.
<17	Low	Generally not defined as native vegetation cover (i.e. <50% of groundcover vegetatin is indigenous), however, can be assigned to a PCT (e.g. presence of indicator species). Nearly all BioMetric site attributes are less than 25% of the lower value of the corresponding benchmark.

1.2 Purpose

The purpose of this report is to document the annual monitoring results and associated management recommendations for general flora, GDEs and Swamp Sclerophyll Forest on Coastal Floodplains EEC, as

specified under the approved BMP. As the inaugural assessment, this report has the dual purpose of reporting baseline conditions within the monitoring area.

1.3 Scope

The monitoring has the aim of evaluating the condition of biodiversity values within the site against the management objectives specified in the BMP. Monitoring reported herein are listed below:

- General flora surveys;
- Swamp Sclerophyll Forest on Coastal Floodplains EEC; and
- Groundwater Dependant Ecosystems (GDEs).

Monitoring tasks were performed using the BioMetric method (Gibbons et al. 2009) as amended by the NSW BioBanking Assessment Methodology 2014 (BBAM 2014) (OEH 2014). Calculations were performed in the online BBCC (accessed June 2016).

1.4 Definitions

BBAM 2014: BioBanking Assessment Methodology 2014 (OEH 2014).

BBCC: BioBanking Credit Calculator administered by the Office of Environment and Heritage (online accessed June 2016).

Benchmark: Benchmarks are quantitative measures that describe the range of variability in condition of vegetation (i.e. PCTs) with relatively little evidence of alteration, disturbance or modification by humans since European settlement. Vegetation with relatively little evidence of modification generally has minimal timber harvesting (few stumps, coppicing, cut logs), minimal firewood collection, minimal exotic weed cover, minimal grazing and trampling by introduced herbivores or over-abundant herbivores, minimal soil disturbance, minimal canopy dieback, no evidence of recent fire or flood, not subject to high-frequency burning, and positive evidence of recruitment of native species.

BioMetric: Gibbons et al. (2009) describes a plot based approach to quantifying the condition of native vegetation cover and habitat called BioMetric. This method is fundamental to the BBAM 2014 and BBCC.

Net change: A term describing change in the monitoring area before and after measurement.

PCT: The NSW Plant Community Type (PCT) classification developed in 2011 established an unambiguous master community-level classification for use in vegetation mapping programs, BioMetric-based regulatory decisions, and as a standard typology for other planning and data gathering programs. PCTs are maintained in the NSW Vegetation Information System (VIS) classification database. There are approximately 1,500 PCTs within 99 NSW Vegetation Classes and 16 NSW Vegetation Formations (Keith 2004).

Repeated measures: Measurements collected in a longitudinal study in which change over time is assessed using the same subjects (e.g. same plot locations and methods).

Site value score: Score derived from a comparison between BioMetric plot data and OEH published PCT benchmarks. Algorithm described by Gibbons et al. (2009) as adapted in the BBCC.

Vegetation zone: An area of native vegetation cover aligning with a PCT described by the Office of Environment and Heritage.

2.0 Methods

2.1 Overview

Monitoring has been performed using a composite of management units (i.e. vegetation management areas (VMAs) and BioMetric plots (Gibbons et al. 2009) to quantify Swamp Sclerophyll Forest on Coastal Floodplains EEC condition. Management directives have been evaluated by comparing monitoring data with OEH published benchmark conditions for Swamp Sclerophyll Forest on Coastal Floodplains EEC. Site value scores have been used to track enhancement outcomes specified in the BMP.

2.2 Site Value Scores

2.2.1 Landscape Analysis

A lansdcape score is calculated in the BBCC using the algorithm published in Gibbons et al. (2009). Data inputs required to calculate the landscape score are outlined in the sections below.

2.2.1.1 Assessment Circles

One assessment circle was established to calculate the landscape value score. No net change in vegetation area and condition has been assumed in this monitoring program.

2.2.1.2 Regions

The following spatial datasets were interrogated to evaluate landscape condition of the site:

- Mitchell Landscapes (NPWS 2003);
- IBRA Region and subregion mapping (IBRA7); and
- Vegetation mapping produced in the environmental impact statement for the approved project.

2.2.1.3 Patch Size

The patch size adjoining the site was calculated using applicable regional vegetation mapping and classification criteria specified in the BBAM 2014. No net change in patch size has been assumed in this monitoring program as management activities will not result in an increase or decrease in patch size (i.e. no change in the aerial extent of native vegetation cover).

2.2.1.4 Connectivity

Connectivity was determined using the classification criteria specified in the BBAM 2014. No net change in connectivity has been assumed in this monitoring program (i.e. no change in patch size or shape that would otherwise alter the existing connectivity class).

2.2.2 Site Analysis

2.2.2.1 Vegetation/ Management Areas

VMAs were mapped on the basis of management parameters specified in the BMP. Spatial implications arising from management issues identified by Hunter Land Management (2016) were also considered in defining VMA boundaries.

2.2.2.2 Condition

Condition was quantitatively calculated from data collated within a BioMetric plot and nested flora quadrat. A BioMetric plot and nested floristic plot is diagrammatically shown in **Figure 2**.

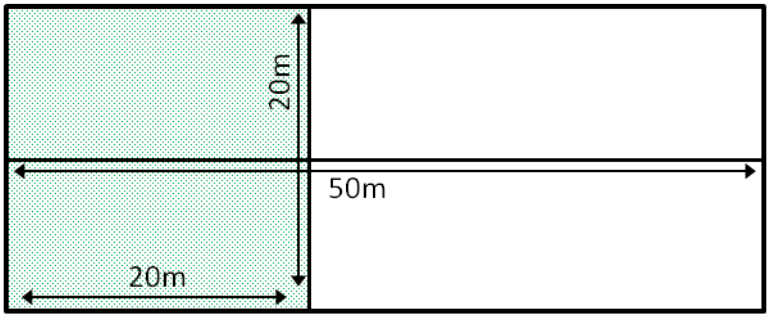


Figure 2 BioMetric Plot Dimensions

Plot location was recorded using a hand held global positioning system (GPS), accurate to approximately five metres. A description of the methods is provided below.

BioMetric Plots

BioMetric plots provide a detailed investigation of a 50m by 20m area (i.e. 1,000 m^2) to measure 10 variables, as listed below:

- Native plant species richness (NPSR) (see floristic plot for method details);
- Native Overstorey Cover (NOC);
- Native Midstorey Cover (NMS);
- Native Groundcover Grasses (NGCG);
- Native Groundcover Shrubs (NGCS);
- Native Groundcover Other (NGCO);
- Exotic Species (ES);
- Number of Hollow-bearing Trees (NHT);
- Overstorey Regeneration (OR); and
- Fallen Log Length (FL).

Floristic Plots

NPSR was recorded within a 400m^2 plot. Cover abundance for each plant species was estimated and recorded in accordance with a modified Braun Blanquet scale, as outlined below in **Table 3**.

Table 3 Cover Abundance Scale

Modified Braun Blanquet Score	Scale
1	<5% cover and rare
2	<5% and common
3	6-25%
4	26-50%
5	51-75%
6	76-100%

Exotic plant species cover abundance was also recorded in addition to the ES per cent cover estimate obtained from the BioMetric plot.

2.2.2.3 Sampling Effort

Two VMAs were sampled using three BioMetric plots as shown in **Figure 3**.

2.2.3 Photographs

Photographs were taken of each BioMetric plot from a standardised point coincident with the transect origin (i.e. recorded GPS point) at an approximate height of 1.5m. A horizontal field of view of approximate 40 degrees is achieved, which is within the central angle of view for human vision (i.e. 40-60 degrees).

2.3 Baseline data

Published benchmark values for HU633 were obtained from the NSW PCTs database (OEH, 2012) to define the expected natural range for each BioMetric site attribute measured in **Section 2.2.2.2**. This benchmark dataset was used as a compare for assessing the baseline condition of native vegetation cover and habitat in management zones subject to this monitoring program. Published scientific literature, where available, was used to aid in the interpretation of the calculated baseline condition (e.g. referenced source documents).

2.4 Nomenclature

Plant taxonomy used was consistent with the nomenclature of the Flora of NSW (Harden 1990-1993; 2000 and 2002), except where more recent revisions are published in recognised scientific journals and accepted by the National Herbarium of New South Wales (PlantNet web site http://plantnet.rbgsyd.nsw.gov.au/).

2.5 Data Recording

Data was collected using the OEH BioBanking plots templates. Paper copies were returned to the office, entered into excel and stored digitally.

Legend

- VMA 1
- VMA 2
- Monitoring Points
- Mining Lease 1632
- Mining Lease 334

N

1
2
3

Wangi Rd
Sunset Cl
Eucalypt Cl
Summerhill Dr
Wangi Point Rd
Lemington Pwy
Abercarn Ct
Todmorden Rd
Brighton St
Eastcote Av
Sherwood St
Macquarie St
Glade St
Donnelly Rd
Arcadia St
Fern St
Tuloa St
Minnamurra

IMPORTANT NOTE

1.: This plan was prepared for the sole purposes of the client for the specific purpose of producing a photographic overlay plan. This plan is strictly limited to the Purpose and does not apply directly or indirectly and will not be used for any other application, purpose, use or matter. The plan is presented without the assumption of a duty of care to any other person (other than the Client) ("Third Party") and may not be relied on by Third Party.

2.: RPS Australia East Pty Ltd will not be liable (in negligence or otherwise) for any direct or indirect loss , damage, liability or claim arising out of or incidental to:
a.: a Third Party publishing, using or relying on the plan;
b.: RPS Australia East Pty Ltd relying on information provided to it by the Client or a Third Party where the information is incorrect, incomplete, inaccurate, out-of-date or unreasonable;
c.: any inaccuracies or other faults with information or data sourced from a Third Party;
d.: RPS Australia East Pty Ltd relying on surface indicators that are incorrect or inaccurate;
e.: the Client or any Third Party not verifying information in this plan where recommended by RPS Australia East Pty Ltd;
f.: Judgment of this plan with any local authority against the recommendation of RPS Australia East Pty Ltd;
g.: The accuracy, reliability, suitability or completeness of any approximations or estimates made or referred to by RPS Australia East Pty Ltd in this plan.

3.: Without limiting paragraph 1 or 2 above, this plan may not be copied, distributed, or reproduced by any process unless this note is clearly displayed on the plan.

4.: The aerial photography used in this plan has not been rectified. This image has been overlaid as a best fit on the boundaries shown and position is approximate only.

0 100 200 300 400 m

SCALE 1:5,000 AT A3 SIZE

TITLE : **FIGURE 3:VEGETATION MANAGEMENT ZONES & MONITORING POINTS**

LOCATION : **MYUNA, NSW**

DATUM:GDA 1994

PROJECTION: GDA 1994 MGA Zone 56

DATE : **24/06/2016**

PURPOSE: **ECOLOGY**

VERSION (PLAN BY): A A3 (amy.obrien)

PATH: J:\JOBS\Centennial\All Jobs\130932 Myuna\10 - Drafting\Arcgis Map Documents\Eco\130532 Figure 3- Veg Management and Monitoring 20160624.mxd

CLIENT: **CENTENNIAL**

JOB REF: **PR130932**

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

3.0 Results

3.1 Landscape Score

One 'site based assessment' assessment circle was used to evaluate native vegetation cover, condition, patch connectivity and size. The parameters listed in **Table 4** were entered into the BBCC.

Table 4 Landscape Variables for Site

Landscape Variable	Assessment Circle 1
IBRA subregion	Hunter
Native vegetation cover OUTER - before	51-55%
Native vegetation cover OUTER - after	51-55%
Native vegetation cover INNER - before	61-65%
Native vegetation cover INNER - after	61-65%
Connectivity value class	Riparian buffer of a local wetland
Mitchell Landscape	Gosford – Cooranbong Coastal Slopes
Patch Size	250 ha

A patch size score of 12 and landscape score of 18 was calculated by the BBCC.

3.2 Site Assessment

3.2.1 Vegetation/ Management Areas

Two VMAs have been mapped to reflect the management imperatives evident within the site (i.e. weed management) and are shown in **Figure 2**. VMAs mapped within the site are listed below (with notional condition states):

- VMA 1: MU42 in moderate/good (high) condition; and
- VMA 2: MU42 in moderate/good (medium) condition.

3.2.2 BioMetric Plot Data

BioMetric plot data is provided in **Appendix 1** and is summarised in **Table 5**. OEH defined 'benchmark data' for HU633 (Swamp Mahogany swamp forest on coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion) is also provided for comparison.

Table 5 Summary of BioMetric Plot Data

BioMetric Variable	VMA 1[1]	VMA 2
Native plant species richness (NPSR) (#)	30-33	23
Native Overstorey Cover (NOC) (%)	50.5-58	62.5
Native Midstorey Cover (NMS) (%)	29-40	25.5
Native Groundcover Grasses (NGCG) (%)	12-24	16

[1] This VMA has two BioMetric plots within it as indicated in Figure 3 and Appendix 1.

BioMetric Variable	VMA 1[1]	VMA 2
Native Groundcover Shrubs (NGCS) (%)	8-18	2
Native Groundcover Other (NGCO) (%)	54	42
Exotic Species (ES) (%)	0-2	10
Number of Hollow-bearing Trees (NHT) (#)	0	0
Overstorey Regeneration (OR) (0-1)	1	1
Fallen Log Length (FL) (m)	22-79	85

The following sections broadly describe these results.

3.2.2.2 Native Plant Species Richness

The total number of species recorded was 61 species (See **Appendix 1**). Native plant species richness was highest in plot 2 with 33 species recorded. Exotic plant species richness was greatest in plot 3 with 9 species recorded.

The most common native overstorey species recorded within the plots was Swamp Mahogany (*Eucalyptus robusta*). Rough-barked Apple (*Angophora costata*) and Snappy Gum (*Eucalyptus racemosa*) were also recorded. Mid storey was dominated by Saw Sedge (*Gahnia clarkei*). Native ground cover was dominated by Wiry Panic (*Entolasia stricta*) with *Hydrocotyle sibthorpioides* and Spiny-head Mat-rush (*Lomandra longifolia*) also present and characteristic of the groundcover stratum.

3.2.2.3 Vegetation Structure

Analysis of the three separate biometric plots yielded 57% native overstorey cover (NOC), 31.5% native midsotery cover (NMS), 17.3% native groundcover grass cover (NGCG), 9.3% native groundcover shrub cover (NGCS) and 50% native groundcover other cover (NGCO).

3.2.2.4 Exotic Plant Species

Eleven exotic species were recorded within the site with three listed as 'declared weeds' in the Lake Macquarie City Council Local Government Area, as listed below:

- *Ageratina adenophora* (Crofton Weed); and
- *Senecio madagascariensis* (Fireweed).
- *Lantana camara* (Lantana);

Crofton weed is a rapid-spreading weed, and has become a nuisance in many areas along the eastern coast of Australia. This species can become particularly invasive on cleared lands with no grazing pressure, such as along public reserves (DPI, 2014a). Crofton weed is declared a noxious plant in 35 LGAs of coastal NSW, most lying between Gosford and the QLD border. This species is listed as a Class 4 weed in the Lake Macquarie area, indicating that '*The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.'*

Fireweed is a serious pasture weed of coastal NSW, which is able to grow on most soil types and in all aspects (DPI 2014b). Fireweed is known to form a persistent seedbank if not controlled before it flowers and can rapidly take over heavily grazed and neglected pastures, where it competes strongly with existing pasture plants. This species is listed as a Class 4 weed in the Lake Macquarie area, indicating that *'the plant must not be sold, propagated or knowingly distributed'.* It is also classed as a weed of national significance (WoNS).

Lantana shrubs that have been grown as ornamentals are now major weeds in coastal and sub-coastal areas. Lantana is one of Australia's most debilitating invasive weeds. The species is known to negatively impact

forestry, pasture productivity, the environment (biodiversity conservation), recreation and transport. It is recognised as a WoNS because of its impacts on primary industries, conservation and biodiversity, and the extent of its distribution (DPI 2008). This species is listed as a Class 4 weed in the Lake Macquarie area, indicating that *'the plant must not be sold, propagated or knowingly distributed'.*

Other weed species observed within the site that require management include Whiskey Grass (*Andropogon virginicus**), Camphor Laurel (*Cinnamomum camphora**), Fleebane (*Conyza* spp.*), Narrow-leaved Cotton Bush (*Gomphocarpus fruiticosus**), Nightshade (*Solanum nigrum**) and *Senna* spp.*. Suppression and/ or removal performed in tandem with natural regeneration or targeted revegetation works to improve native plant species richness and maintain vegetation structure would repreasent a dual improve outcome.

3.2.2.5 Habitat

No hollow-bearing trees were recorded within any of the BioMetric pots. A total of 22 m of fallen log length was recorded in plot 1, 70 m in plot 2 and 85 m within plot 3. These are all above the benchmark condition.

3.2.3 Threatened Species

One threatened species was recorded within the plots. *Callistemon linearifolius* (Netted Bottle Brush), listed as vulnerable under the TSC Act, was recorded within plot 1. This shrub species is recorded from the George and Hawkesbury River in the Sydney area, and north to Nelson Bay. The species was more widespread in the past, and there are currently only 5 or 6 populations remaining from the 22 historically recorded within the Sydney area (OEH 2013).

3.3 Baseline Site Value Score

Data outlined in **Section 3.1** to **3.2** was entered into the BBCC to calculate a baseline site value score for each VMA. Results are provided in **Table 6**. Red shaded cells indentify BioMetric site attributes outside benchmark conditions (i.e. identify opportunities for improvement).

Table 6 Baseline Site Value Score including Benchmark Comparison

BioMetric Site Attribute	Data (per cent (%) unless otherwise indicated)		
	Benchmark	VMA 1	VMA 2
Native plant species richness (NPSR) (#)	>=24 (number)	30-33 species	23 species
Native Overstorey Cover (NOC) (%)	15-70	50.5-58	62.5
Native Midstorey Cover (NMS) (%)	10-60	29-40	25.5
Native Groundcover Grasses (NGCG) (%)	5-50	12-24	16
Native Groundcover Shrubs (NGCS) (%)	5-30	8-18	2
Native Groundcover Other (NGCO) (%)	5-40	54	42
Exotic Species (ES) (%)	-	0-2	10
Number of Hollow-bearing Trees (NHT) (#)	>=0 (number)	0 trees	0 trees
Overstorey Regeneration (OR) (0-1)	1 (100)	1 (100)	1 (100)
Fallen Log Length (FL) (m)	>=5 m	22-79 m	85 m
Site Value Score (Baseline)	*71-100*	*98.00*	*79.33*

NPSR accounts for the highest weighting in the calculation of the site value score (i.e. 25%), thus explaining the relatively low site value score calculated for VMA 2. The below benchmark state for NGCS in VMA 2 is matched with relatively high ES cover; a circumstance that potentially indicates the displacement of native ground cover shrub species by exotics such as Lantana. The removal of Lantana, for example, may be sufficient for the gaining improvement in the NGCS attribute.

4.0 Recommendations

4.1 Enhancement Opportunities

The site value score for VMA 1 and, to a lesser extent VMA 2, indicates vegetation and habitat in moderate/ good (high) condition. Limited potential exists to enhance the biodiversity values within VMA 1 as the site value score was almost 100. However, considerable potential exists for improving the site value score in VMA 2. Management implications for VMA 2, as derived from the plot data, are outlined in **Table 7**.

Table 7 Recommended Enhancement Works

BioMetric Site Attribute	Data (per cent % unless otherwise indicated)		
	Benchmark	VMA 2	Management Action
NPSR	>=24 (number)	23 species	None. Continue to monitor effectiveness of natural regeneration.
NOC	15-70	62.5	None. Continue to monitor for change.
NMS	10-60	25.5	None. Continue to monitor for change.
NGCG	5-50	16	None. Continue to monitor for change.
NGCS	5-30	2	None. Continue to monitor effectiveness of natural regeneration.
NGCO	5-40	42	None. Continue to monitor for change.
ES	-	10	Perform targeted exotic species control concentrating on Lantana, Crofton Weed and Fireweed.
NHT	>=0 (number)	0 trees	None. Continue to monitor for change.
OR	1 (0-1)	1 (0-1)	None. Continueto monitor for change.
FL	>=5 m	85 m	None. Continue to monitor for change.
Site Value Score	*71-100*	*79.33* (current)	*85+* (predicted within three years following management)

4.2 Management Specifications

Management measures expected to result in an enhance outcome are specified in **Table 7**. Specifications for performing these management works are listed below:

- Perform weed management twice a year targeting Lantana, Crofton Weed and Fireweed. The initial weed management works are to reduce exotic plant species cover. The following weed management event is to remove recruiting individuals. Weed management thereafter would be performed on a need basis and determined through monitoring activities.
- Evaluate the potential benefits of natural regeneration in weed management areas with respect to the enhancement of NPSR and NGCS.

Should natural regeneration as a passive management action be insufficient for the enhancement of NPSR and NGCS within weed managed area over a five year period, then alternate integrated weed management practices should be considered.

No hollows were recorded within the plots, however, the installation of next boxes could provide habitat for a number of species such as possums, gliders, owls and other birds. This management recommendation is not mandatory for achieving the enhancement objectives stated in the BMP.

4.3 Ongoing Monitoring

Three BioMetric plots were established in the 2016 monitoring event. Consideration should be given to the inclusion of an additional plot in VMA 1 and two plots in VMA 2 for the 2017 monitoring event to better define variance. A repeated measures sampling approach should be adopted for established plots.

5.0 Conclusions

Comparisons between BioMetric monitoring data and the corresponding equivalent PCT benchmark dataset indicate the vegetation of the site is in moderate/ good (high) condition. Weed cover is highest in VMA 2 thus requiring focused weed management effort to meet enhancement objectives stated in the BMP. Consequently, weed management are recommended in VMA 2. Further monitoring is required to evaluate the ecological benefit of management actions performed within the site.

6.0 References

Centennial Coal (2016). Biodiversity Management Plan. Myuna Colliery. May 2016.

DECC (2007) *Swamp Sclerophyll Forest on Coastal Floodplains*. Guidelines for Endangered Ecological Communities. http://www.epa.nsw.gov.au/resources/threatenedspecies/EECSwampSclerophyllForestLowRes.pdf

DPI (2014a). *Crofton weed* (Ageratina adenophora) *Profile*. Primary Industries – Agriculture. http://weeds.dpi.nsw.gov.au/Weeds/Details/47

DPI (2014b). *Fireweed* (Senecio madagascariensis) *Profile.* Primary Industries – Agriculture. http://weeds.dpi.nsw.gov.au/Weeds/Details/53

Gibbons, P., Briggs, S.V., Ayes D., Seddon, J., Doyle, S., Cosier, P., McElhinny, C., Pelly, V., and Roberts, K. (2009). *An operational method to assess impacts of land clearing on terrestrial biodiversity*. Ecological Indicators Vol 9 pp 26-40.

Harden, G.J. (1992). *Flora of New South Wales Volume 3 revised edition*. NSW University Press, Sydney NSW.

Harden, G.J. (1993). *Flora of New South Wales Volume 4 revised edition*. NSW University Press, Sydney NSW.

Harden, G.J. (2000). *Flora of New South Wales Volume 1 revised edition*. NSW University Press, Sydney NSW.

Harden, G.J. (2002). *Flora of New South Wales Volume 2 revised edition*. NSW University Press, Sydney NSW.

Hunter Land Management (2016) *Groundwater Dependant Ecosysem Monitoring - Baseline Assessment.* Myuna Colliery.

Keith D. (2004) Ocean Shores to Desert Dunes: the native vegetation of New South Wales and the ACT, NSW National Parks and Wildlife Service, Sydney.

LHCCREMS (2000) *Vegetation Survey, Classification and Mapping - Lower Hunter and Central Coast Region.* Lower Hunter and Central Coast Regional Environmental Management Strategy.

NPWS (2000) *Vegetation Survey, Classification and Mapping: Lower Hunter and Central Coast Region.* Version 1.2. NSW National Parks and Wildlife Service, Sydney.

NSW DPI (2012) Project Approval - Section 75J of the Environmental Planning & Assessment Act 1979. https://majorprojects.affinitylive.com/public/0cdedbdfa86eb751107373ad762adea9/Consolidated%20Project%20Approval%20MOD%201.pdf

OEH (2013). *Netted Bottle Brush – profile.* http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10129

OEH (2014). *BioBanking Assessment Methodology and Operational Guidelines* [BBAM 2014]. Office of Environment and Heritage, Sydney, Australia.

Appendix 1

BioMetric data including flora species lists

Table A1.1: Flora species incidence measured in cover and abundance for plots 1 to 3.

Scientific Name	Common Name	Plot 1		Plot 2		Plot 3	
		Cover	Abundance	Cover	Abundance	Cover	Abundance
Acacia longifolia		2	5	1	2		
Acianthus spp.	Mosquito Orchid			1	1		
*Ageratina adenophora**	Crofton Weed					2	10
Allocasuarina littoralis	Black She-oak	5	5	5	8	2	2
*Andropogon virginicus**	Whisky Grass			1	5		
Angophora costata	Smooth-barked Apple	10	2	10	3		
Banksia spinulosa var. *collina*	Hairpin Banksia	1	1	1	2		
Billardiera scandens	Hairy Appleberry			1	2		
Blechnum indicum	Swamp Water Fern	1	1				
Blechnum spp.						2	10
Breynia oblongifolia	Coffee Bush	1	2	1	1		
Callistemon linearifolius	Netted Bottle Brush	1	2				
Calochlaena dubia	Rainbow Fern					2	10
*Cinnamomum camphora**	Camphor Laurel	2	1			2	2
*Cirsium vulgare**	Spear Thistle					1	1
Clematis aristata	Old Man's Beard			1	1	1	5
*Conyza spp.**	A Fleabane			1	1	1	1
Cymbidium suave	Snake Orchid			1	1		
Cymbonotus spp.						1	2
Desmodium varians	Slender Tick-trefoil					1	2
Dianella caerulea	Blue Flax-lily	1	5	1	5	1	3
Dichondra repens	Kidney Weed			1	5	1	20
Dillwynia floribunda var. *floribunda*	Parrot Pea	1	1				
Dodonaea triquetra	Hop-bush	2	5	5	5		
Echinopogon caespitosus	Bushy Hedgehog-grass			1	3		
Entolasia marginata	Bordered Panic			1	10	2	20
Entolasia stricta	Wiry Panic	10	100	5	50		
Eucalyptus racemosa	Narrow-leaved Scribbly Gum	5	3				
Eucalyptus robusta	Swamp Mahogany	30	4	25	7	50	19
Exocarpos cupressiformis	Native Cherry	2	2	2	2		

Scientific Name	Common Name	Plot 1		Plot 2		Plot 3	
Gahnia clarkei	Tall Saw-sedge	30	200	20	100	20	150
Geitonoplesium cymosum	Scrambling Lily	2	10	1	5		
Glochidion ferdinandii	Cheese Tree	2	3	5	4	2	3
Glycine canescens	Silky Glycine			1	1	1	2
*Gomphocarpus fruiticosus**	Narrow Leaf Cotton Bush					1	1
Hydrocotyle sibthorpioides		1	1	2	20	1	20
Imperata cylindrica	Blady Grass			1	5		
*Lantana camara**	Lantana			1	5	2	5
Leptospermum polygalifolium	Tantoon	1	1	1	2		
Lindsaea microphylla	Lacy Wedge-fern	2	10				
Lomandra longifolia	Spiky-headed Mat-rush	5	15	2	20		
Lomandra obliqua	Twisted Mat-rush	1	15				
Melaleuca linariifolia	Snow in Summer	40	21			5	9
Notelaea venosa	Veined Mock Olive	1	1				
Oplismenus aemulus	Basket Grass			1	10	1	10
Oplismenus imbecillis	-			1	20	1	10
Oxalis perrenans	Yellow-flowered Wood Sorrel			1	5	1	5
Parsonsia straminea	Common Silkpod	1	5	1	2		
Persoonia linearis	Narrow-leaved Geebung			1	1		
Pittosporum undulatum	Sweet Pittosporum	1	1			5	3
Polyscias sambucifolia	Elderberry Panax	1	2	1	3	1	1
Pratia purpurascens	Whiteroot			2	20		
Pteridium esculentum	Bracken	2	10	1	5	1	2
Pultenaea daphnoides	Large-leaf Bush Pea	1	1				
Rubus moorei	Silky Bramble					1	1
*Senecio madagascariensis**	Fireweed					1	1
*Senna spp.**				1	5		
Smilax glyciphylla	Sarsaparilla					1	1
*Solanum mauritianum**	Wild Tobacco					2	10
*Solanum nigrum**	Black Nightshade, Black-berry Nightshade					1	2
Xanthosia tridentata	Rock Xanthosia	1	1				

Table A1.2: BioMetric site attributes for three monitoring plots (1 to 3) describing Native plant species richness (NPSR), Native over story (NOS), Native mid storey (NMS), Native ground cover grasses (NGCG), Native ground cover shrubs, Native ground cover other (NGCO) and Exotic species (ES).

Plot Name	NPSR	NOS	NMS	NGCG	NGCS	NGCO	ES	NTH	OR	FL	Easting	Northing	Zone
Plot 1	30	58	40	24	18	54	0	0		22	366476	6341205	56
Plot 2	33	50.5	29	12	8	54	2	0		70	366562	6341149	56
Plot 3	23	62.5	25.5	16	2	42	10	0		85	366724	6340992	56

Appendix 2

BioMetric Site Photographs

Plate 1: Plot 1

Plate 2: Plot 2

Plate 3: Plot 3

PLAN – MY11552 ANNUAL REVIEW PLAN