Centennial Coal

MYUNA COLLIERY
EXTENSION OF MINING

ENVIRONMENTAL ASSESSMENT

February 2011
Volume 3 Appendices H-P

FUTURE POWER | Centennial Coal

Appendix H

Noise Impact Assessment (Heggies Pty Ltd, 2010b)

HEGGIES

REPORT 30-2558-R2

Revision 1

Myuna Colliery Extension of Mining
Part 3A Application
Noise Impact Assessment

PREPARED FOR

AECOM
Level 8, 17 York Street
Sydney NSW 2000

22 OCTOBER 2010

HEGGIES PTY LTD
ABN 29 001 584 612

Myuna Colliery Extension of Mining

Part 3A Application

Noise Impact Assessment

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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
30-2558-R2	Revision 1	22 October 2010	Nathan Archer	Daniel Weston	Jason Watson
30-2558-R2	Revision 0	30 July 2010	Nathan Archer	John Cotterill	John Cotterill

EXECUTIVE SUMMARY

Heggies Pty Ltd (Heggies) has been commissioned by AECOM Pty Ltd (AECOM) on behalf of Centennial Myuna Pty Limited (CMPL) to undertake a Noise Impact Assessment for the Myuna Colliery Extension of Mining (proposed Project) located in the township of Wangi Wangi on the western side of Lake Macquarie. This study was undertaken as part of an Environmental Assessment to support an application for Project Approval under Part 3A of the *Environmental Planning & Assessment Act 1979*.

The Project will extend mining and coal handling at Myuna Colliery within the Project Application Area and proposes to:

- mine using bord and pillar methods in the Wallarah, Great Northern and Fassifern seams in CCL762 and ML1370, for a further 21 years;
- produce, handle and distribute to Eraring Power Station, up to 2MTPA using existing infrastructure;
- continue the use of ancillary infrastructure for a further 21 years;
- upgrade the water management system; and
- rehabilitate the surface facilities within 5 years of completion of mining.

All existing infrastructure within the Surface Facilities Area of Myuna Colliery will be utilised to service the proposed Project, with some minor modification to the sites water management. Myuna Colliery will continue to use the Enclosed Overland Conveyor to transport coal to Eraring Power Station.

The objective of the Noise Impact Assessment was to identify the potential impacts of noise from the proposed Project and to provide advice with regard to effective mitigation strategies where necessary.

An ambient noise monitoring program was undertaken by Heggies. Ambient noise levels were monitored at two locations, considered to be representative of the nearest potentially affected receivers. The objective of this survey was to measure $L_{A90(period)}$ and $L_{Aeq(15minute)}$ noise levels at the nearest potentially affected residential locations during the day, evening and night-time periods and to confirm appropriate background levels. The background levels were used in the determination of the project specific noise criteria for the proposed Project.

OPERATIONAL NOISE PREDICTIONS

A computer model, developed in SoundPLAN, was used to predict noise emissions from the proposed project. Noise levels were predicted for the general operational scenario (i.e. 24 hour operation of the Surface Area Facilities with all equipment operating). Based on these predictions, noise levels are anticipated to meet the project specific noise criteria for the general operational scenario at all assessed residential receivers. The predictions considered calm and prevailing weather conditions with the recommended noise management and mitigation strategies in place.

The operational scenario modelled is likely to represent an acoustically worst-case scenario, actual operational noise levels from the project are likely to be less than those predicted.

SLEEP DISTURBANCE ASSESSMENT

Maximum noise levels on Summerhill Drive and Sunset Close, Wangi Wangi are predicted to be below L_{Amax} 30 dBA.

EXECUTIVE SUMMARY

The highest L_{Amax} noise level at any residential area is predicted to occur as a result of forklift pass-by events in the materials yard under the influence of a temperature inversion. External noise levels up to L_{Amax} 43 dBA may occur at residences on Donnelly Road under temperature inversion conditions. Hence, predicted noise levels meet the most stringent recommended sleep disturbance noise goal of 49 dBA at Donnelly Road receivers under calm and adverse weather conditions.

In the interests of minimising potential sleep disturbance it is recommended that CMPL educate and involve employees on minimising noise during the night-time period. This may include the following work practices:

- Regularly train workers (such as toolbox talks) to use equipment in ways to minimise noise.
- Operate mobile plant in a quiet, efficient manner.
- Turn off plant when not in use.
- Avoid dropping materials from a height.
- Where possible, schedule the noisiest works, such as moving metal objects, for the daytime period.
- Closing all doors when not in use.

ROAD TRAFFIC NOISE

The proposed Project will not significantly alter the existing traffic and transport network (refer to *Myuna Colliery Extension of Mining Traffic Impact Assessment*, AECOM 2010). Therefore, there will not be any additional road traffic noise impacts associated with the operation of the colliery.

VIBRATION ASSESSMENT

Limited underground shot firing may be required for the proposed Project. Vibration from underground shot firing is predicted to be negligible and below levels of human perception at the nearest residential locations. Notwithstanding this, it is recommended that all shots should be planned and designed to achieve the required outcomes with minimum impacts on the surrounding residential receivers.

The main potential vibration generating activities will include the operation of mobile equipment such as the loader and trucks. Given the minimum separation distance of approximately 500m between mining operations and the nearest potentially affected residential locations vibration levels from these activities is predicted to be negligible and below levels for human perception at the nearest residential receivers.

TABLE OF CONTENTS

TABLE OF CONTENTS

1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been commissioned by AECOM Pty Ltd (AECOM) on behalf of Centennial Myuna Pty Limited (CMPL) to undertake a Noise Impact Assessment for the Myuna Colliery Extension of Mining (proposed Project) located in the township of Wangi Wangi on the western side of Lake Macquarie. This study was undertaken as part of an Environmental Assessment to support an application for Project Approval under Part 3A of the *Environmental Planning & Assessment Act 1979*.

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All existing infrastructure within the Surface Facilities Area of Myuna Colliery will be utilised to service the proposed Project, with some minor modification to the sites water management. Myuna Colliery will continue to use the Enclosed Overland Conveyor to transport coal to Eraring Power Station.

Broadly, the objective of the noise assessment was to identify the potential impacts of noise from operation of the Proposed Project and to provide advice with regard to effective mitigation strategies where necessary.

The Noise Impact Assessment (NIA) has been prepared with reference to Australian Standard AS 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in accordance with the Department of Environment, Climate Change and Water (DECCW) NSW Industrial Noise Policy (INP). Where issues relating to noise are not addressed in the INP, such as sleep disturbance, reference has been made to the NSW Environmental Noise Control Manual (ENCM) and the Environmental Criteria for Road Traffic Noise (ECRTN). Vibration impacts have been assessed with reference to the DECCW *Environmental Noise Management – Assessing Vibration: a technical guide* and ISO 4150 Part 3:1999 *Structural Vibration: effects of vibration on structures.*

2 PROJECT OVERVIEW

2.1 Background

Myuna Colliery is a small underground coal mine owned and operated by CMPL, a wholly owned subsidiary of Centennial Coal Company Limited (Centennial). Myuna Colliery's surface facilities area is located in Wangi Wangi on the western side of Lake Macquarie, 25 kilometres south-west of Newcastle (refer to **Figure 1**).

Underground coal mining has already been carried out in the Project Application Area and surrounds. The Project Application Area is predominately positioned beneath Lake Macquarie which is NSW Government Crown land and is used primarily for recreational purposes. Other land ownership includes Crown and freehold land.

Myuna Colliery's Surface Facilities Area is located on land owned by Centennial Fassifern Pty Ltd, is surrounded by vegetated ridgelines and constructed adjacent to the now disused Wangi Power Station. The Enclosed Overland Conveyor is owned by Eraring Energy and situated on land owned by Eraring Energy, the State of NSW and Centennial Fassifern Pty Ltd to the north-west of the Surface Facilities Area. The Minister administering the National Parks and Wildlife Act 1974 owns the parkland areas to the south west of the Surface Facilities Area.

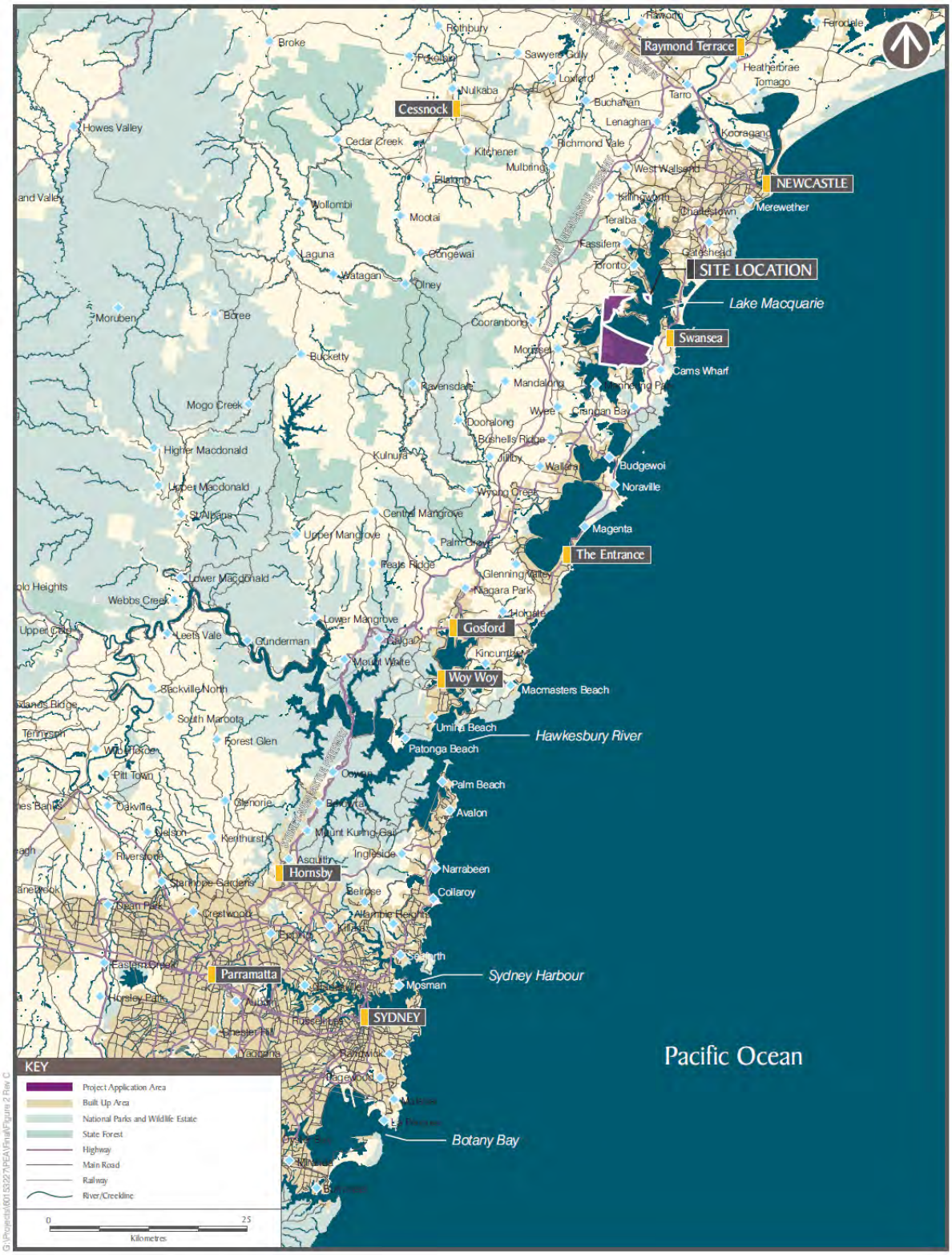
The closest residential areas to the proposed Project are Arcadia Vale (approximately 0.6 kilometres east of the Myuna Colliery Surface Facilities Area) and Wangi Wangi (approximately 0.5 kilometres south east of the Myuna Colliery Surface Facilities Area). The closest residence is approximately 0.5 kilometres south east of the Surface Facilities Area.

CMPL undertakes underground mining at Myuna Colliery:

- Within the Development Consent Mining Area; and
- Within CCL 762 and ML 1370 but external to the Development Consent Mining Area, pursuant to the combined operation of Section 74(1) of the *Mining Act 1992* (*Mining Act*) and clause 8K of the *Environmental Planning and Assessment Regulation 2000.*

The Development Consent Mining Area, and the areas comprised in CCL 762, MPL 334 and ML 1370 are shown on **Figure 2.**

Figure 1 Regional Locality



Source: AECOM, 2010

3 PROJECT AND SITE DETAILS

3.1 Site Details

Myuna Colliery is bordered by vegetation and is generally well screened from the surrounding private receivers.

The township of Wangi Wangi is situated approximately 500m southeast and Arcadia Vale is approximately 600m northwest of the Surface Facilities Area. The shore of Myuna bay in Lake Macquarie is approximately 400m south of the Surface Facilities Area.

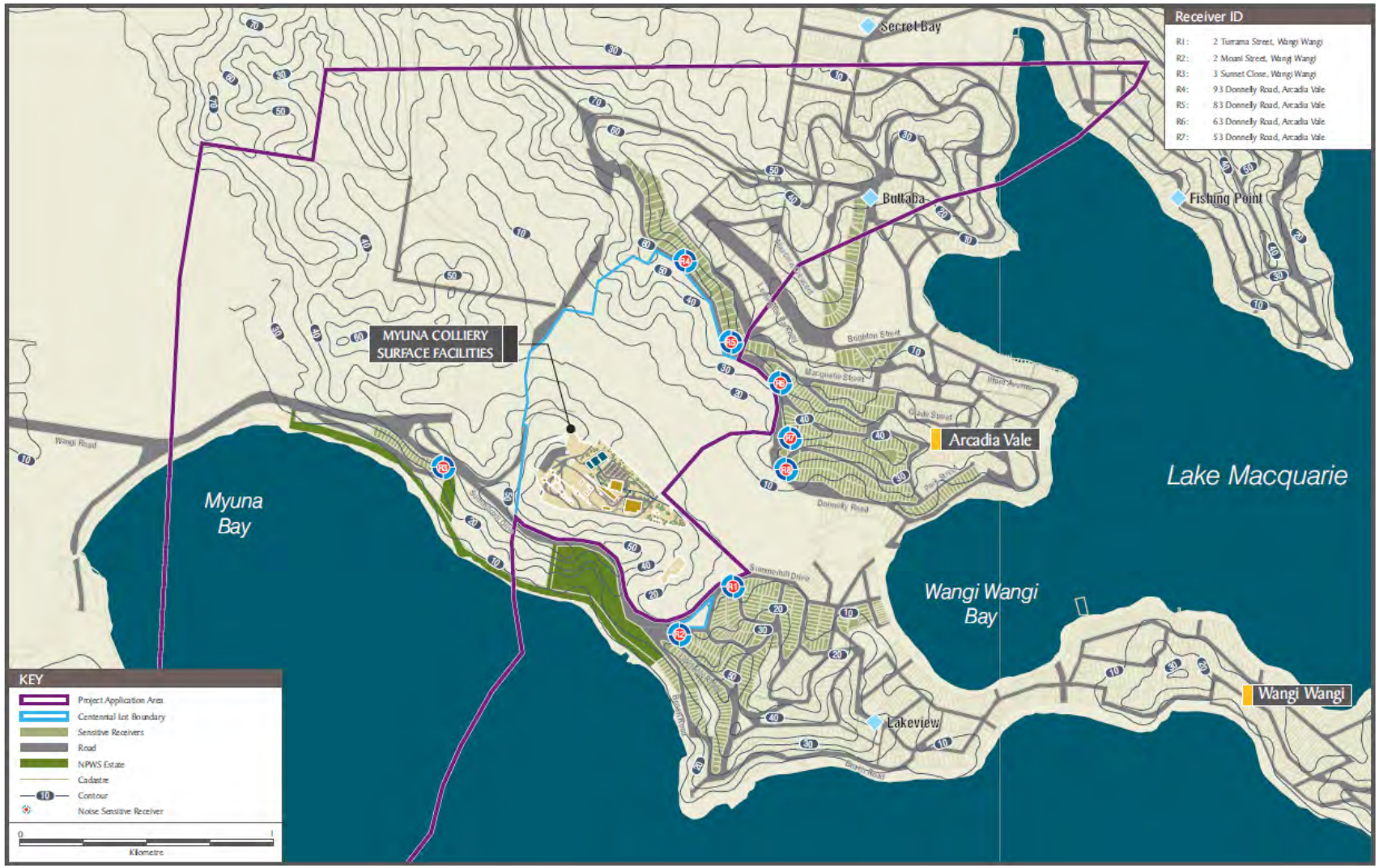
3.2 Sensitive Receptors

A number of residences are located in the area surrounding the Surface Facilities Area. The nearest residences have been identified as sensitive receptor locations to be taken into account during the assessment. A list of the nearest sensitive receptors (R1 to R8) identified in the immediate vicinity of the Project Site, and their respective distances from the Surface Facilities Area, are presented in **Table 1** and **Figure 3**.

Table 1 Nearest Sensitive Receptors

Receptor ID	Location	Location (m, MGA56)		Elevation (m, AHD)
		Easting	Northing	
R1	2 Turrama Street, Wangi Wangi	366858	6340370	12
R2	2 Moani Street, Wangi Wangi	366652	6340175	29
R3	3 Sunset Close, Wangi Wangi	365707	6340844	36
R4	119 Donnelly Road, Arcadia Vale	366662	6341662	50
R5	93 Donnelly Road, Arcadia Vale	366857	6341348	40
R6	83 Donnelly Road, Arcadia Vale	367049	6341185	31
R7	63 Donnelly Road, Arcadia Vale	367091	6340965	32
R8	53 Donnelly Road, Arcadia Vale	367072	6340821	19

Figure 3 Surrounding Sensitive Receptor Locations



Source: AECOM, 2010

3.3 Acoustically Significant Sources

3.3.1 Mining Operations

Myuna Colliery utilises continuous miners for coal extraction and a range of other ancillary equipment both in the underground workings and during operations at the Surface Facilities.

Noise measurements have been conducted of acoustically significant plant and equipment utilised during operations at the Surface Facilities. Sound power levels of such plant have been determined and utilised for the purpose of this noise assessment. Where on-site measurements could not be conducted sound power levels have been obtained from a Heggies database of similar equipment. The relevant acoustically significant plant and equipment and the associated sound power levels are provided in **Table 2**. Bracketed noise levels indicate the sound power level of the relevant item of fixed plant with enclosure doors closed.

Figure 4 illustrates the location of the plant and equipment associated with the Proposed Project.

Table 2 Myuna Colliery - Acoustically Significant Plant and Equipment

Plant and Equipment	**Sound Power Level**
Mining - Surface Operations	**dBA**
Final Product Bin	98
ROM Bin	98
Rotary Breaker	111 (106[1])
Crusher conveyor drive house	107 (101)
Drift conveyor drive house	104
Compressor	108
Crusher	111 (106[1])
Final Product conveyor drive house	102
Forklift	105
Ventilation fan	88
Underground man transport vehicle	111[2]
Workshop (i.e. use of grinder)	104[3]

1 – Assumes a conservative 5 dBA noise reduction with enclosure doors repaired and closed based on measured noise levels outside of the enclosure walls.

2 – Sound power level taken from measurements at Awaba Colliery.

3 – Sound power levels for these sources have been obtained from a Heggies database.

All other sound power level data presented here has been obtained from noise measurements undertaken at the project site.

It should be noted that the plant and equipment utilised underground has not been considered as it is not acoustically significant to surface receptors.

Figure 4 Location of Plant and Equipment

Source: AECOM, 2010

3.3.2 Construction

There are no changes proposed to the existing surface operations which would contribute to the acoustic environment. Therefore, no construction activities have been considered as part of this assessment.

3.4 Noise Complaints

Myuna Colliery has been operating for over 28 years and has received no community complaints regarding noise emissions in the past five years.

4 NOISE IMPACT ASSESSMENT PROCEDURES

4.1 General Objectives - Industrial Noise Policy

The Industrial Noise Policy (INP) was released in January 2000 and provides a framework and process for deriving noise criteria for consents and licences that enables the DECCW to regulate premises that are scheduled under the Protection of the Environment Operations Act, 1997 (the Act).

The specific policy objectives are:

- To establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses.
- To use the criteria as the basis for deriving project specific noise levels.
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.
- To outline a range of mitigation measures that could be used to minimise noise impacts.
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development.
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the Act.

The INP provides two forms of noise criteria with the aim of achieving environmental noise objectives; one to account for intrusive noise which involves setting a noise goal relative to the existing acoustic environment and the other to protect the amenity of particular land uses.

For assessing intrusiveness, the background noise needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level of the source over any 15 minute period ($L_{Aeq(15minute)}$) should not be more than five (5) decibels above the measured background level (L_{A90}).

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. An extract from the INP that relates to the amenity criteria is given in **Table 3**.

Table 3 Amenity Criteria
Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level (dBA)	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban/Industrial Interface (for existing situations only)	Day	65	70
		Evening	55	60
		Night	50	55
School classrooms - internal	All	Noisiest 1 hour period when in use	35	40
Hospital wards	All	Noisiest 1 hour period		
- internal			35	40
- external			50	55
Place of worship - internal	All	When in use	40	45
Area specifically reserved for passive recreation (eg National Park)	All	When in use	50	55
Active recreation area (eg school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am, On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

If the measured existing noise level from industry approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. In this case, the amenity criteria provided in **Table 3** would need to be adjusted in accordance with the INP as per **Table 4**.

Table 4 Modification to Acceptable Noise Level (ANL)* to Account for Existing Levels of Industrial Noise

Total Existing L_{Aeq} noise level from Industrial Noise Sources	**Maximum L_{Aeq} Noise Level for Noise from New Sources Alone, dBA**
≥ Acceptable noise level plus 2 dBA	If existing noise level is *likely to decrease* in future acceptable noise level minus 10 dBA If existing noise level is *unlikely to decrease* in future existing noise level minus 10 dBA
Acceptable noise level plus 1 dBA	Acceptable noise level minus 8 dBA
Acceptable noise level	Acceptable noise level minus 8 dBA
Acceptable noise level minus 1 dBA	Acceptable noise level minus 6 dBA
Acceptable noise level minus 2 dBA	Acceptable noise level minus 4 dBA
Acceptable noise level minus 3 dBA	Acceptable noise level minus 3 dBA
Acceptable noise level minus 4 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 5 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 6 dBA	Acceptable noise level minus 1 dBA
< Acceptable noise level minus 6 dBA	Acceptable noise level

* ANL = recommended acceptable L_{Aeq} noise level for the specific receiver, area and time of day from **Table 3**

4.2 Assessing Sleep Disturbance

The DECCW's Environmental Criteria for Road Traffic Noise (ECRTN) states that the relationship between maximum noise levels and sleep disturbance is not currently well defined. Criteria for assessing sleep disturbance has not been identified under the INP and hence, sleep arousal is assessed using the guidelines set out in the Environmental Noise Control Manual (ENCM) Chapter 19-3.

To avoid the likelihood of sleep disturbance the ENCM recommends that the $L_{A1(1minute)}$ noise level of the source under consideration should not exceed the background noise level (L_{A90}) by more than 15 dBA when measured outside the bedroom window of the receiver during the night-time hours (10.00 pm to 7.00 am).

5 EXISTING ACOUSTICAL AND METEOROLOGICAL ENVIRONMENT

5.1 General Methodology

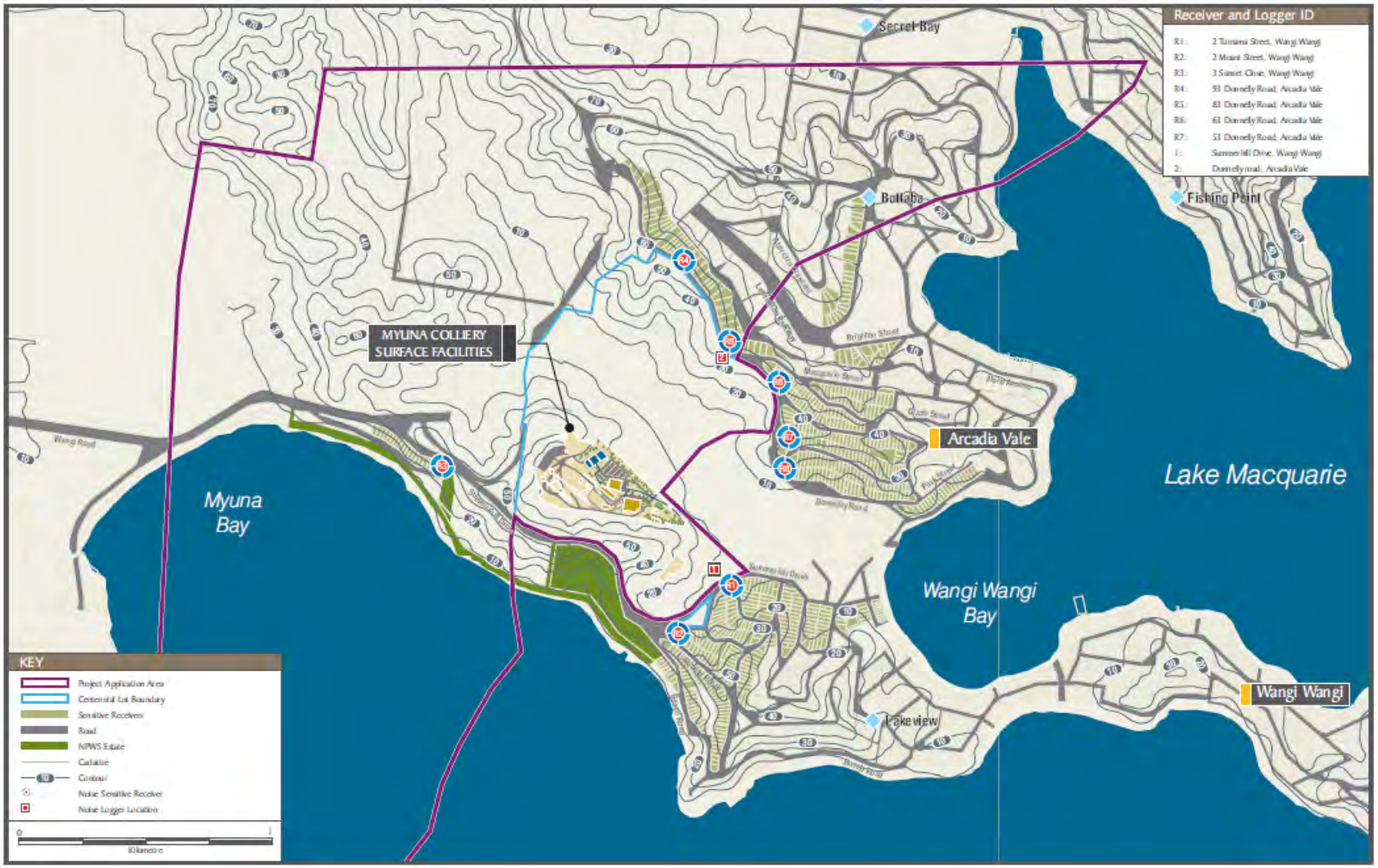
Ambient noise surveys were conducted to characterise and quantify the existing acoustical environment in the area surrounding the Myuna Colliery. A background monitoring survey was undertaken at two (2) residential locations on Donnelly Road, Arcadia Vale and Summerhill Drive, Wangi Wangi, considered representative of the nearest potentially-affected noise-sensitive receivers to the Myuna Colliery. The noise monitoring locations are shown in **Figure 5**.

Noise monitoring at Donnelly Road is considered representative of noise levels along Donnelly Road and in Arcadia Vale; noise levels at Summerhill Drive are considered representative of the acoustic environment of Wangi Wangi.

The background noise monitoring consisted of continuous, unattended noise logging and operator attended noise surveys. The operator attended noise surveys help to define noise sources and the character of noise in the area and are, therefore, used to qualify unattended noise logging results.

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS 1259.2-1990, “Sound Level Meters” and carries current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA.

Figure 5 Ambient Noise Monitoring Locations



Source: AECOM, 2010

5.2 Operator-Attended Noise Monitoring

Operator attended noise measurements were conducted during the day, evening and night-time periods at both noise monitoring locations. The purpose of these surveys was twofold; to qualify the unattended noise logging results and to determine the contribution of existing industrial noise sources (including Myuna Colliery) to the total ambient noise environment.

Each noise survey was conducted over a 15 minute period using a B&K 2270 integrating sound level meter (S/N 2679354). The results of the operator-attended noise measurements are given in **Table 5**. Ambient noise levels given in the table include all noise sources such as road, insects, birds, as well as any industrial operations.

During the operator attended noise surveys the weather conditions were generally warm, dry and calm. During the night-time survey at Donnelly Road, a slight (1-2 m/s) wind was noted blowing from the SW, this would have enhanced Myuna Colliery noise levels at the survey location.

Table 5 Operator Attended Noise Survey Results

Location	Date/ Start time/ Weather	Primary Noise Descriptor (dBA re 20 μPa)					Description of Noise Emission, Typical Maximum Levels LAmax (dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Location 1 Summerhill Drive, Wangi Wangi	**Day** 5/5/2010 10:45am Temp 22 °C Wind <2m/s N	62	58	53	41	49	Dominated by road traffic on Summerhill Rd 55-62 Birds/insects to 50 Leaf rustle to 51 Local residential activity to 47 Aircraft 42 Myuna noise generally not discernible – mine alarm just audible once <35
	Evening 13/5/2010 6.27pm Temp 14 °C Wind Calm	75	57	51	40	50	Road traffic on Summerhill Rd up to 75 People playing sports and shouting at sports ground to 62 Dog barks to 54 Myuna colliery inaudible
	Night 13/5//2010 10.00pm Temp 15 °C Wind Calm	75	71	60	35	58	Road traffic on Summerhill Rd up to 75 Dog barks to 48 Birds and insects to 38 Slight leaf rustle 36 Distant industrial hum just audible, possibly Myuna Colliery Estimated Myuna Colliery contribution <30 dBA LAeq,15min
Location 2 Donnelly Road, Arcadia Vale	**Day** 5/5/2010 11:10am Temp 22 °C Wind <2m/s N	79	73	65	41	61	Dominated by road traffic on Donnelly Rd to 79 Leaf rustle to 45 Distant road traffic from Wangi Road to 45 Myuna occasionally just discernible in lulls of less than 42 Estimated Myuna Colliery contribution 32-36 dBA LAeq,15min
	Evening 13/5/2010 6.55pm Temp 14 °C Wind Calm	77	70	64	42	59	Dominated by road traffic on Donnelly Rd to 77 Distant road traffic from Wangi Road to 44 Insects to 40 Myuna just discernible as distant hum in lulls of less than 42 Estimated Myuna Colliery contribution 36 dBA LAeq,15min
	Night 13/5//2010 10.20pm Temp 15 °C Wind 1-2m/s SW (from mine)	74	67	55	40	54	Dominated by road traffic on Donnelly Rd to 74 Distant road traffic from Wangi Road to 50 Insects to 40 Leaf rustle to 43 Reverse alarm from mine 46 Banging of metal from mine to 57 Myuna fixed plant 40 to 42 Estimated Myuna Colliery contribution 42 dBA LAeq,15min (note that the noise levels were enhanced by the SW wind)

Results of operator-attended noise surveys indicate that local and distant road traffic, the natural environment and residential activity are the main contributors to the ambient noise environment during the all monitoring periods at each monitoring location. Fixed plant from Myuna Colliery operations were audible at Donnelly Road during the daytime, evening and night-time during lulls between road traffic.

However, during the night-time period, noise from the banging of metal at Myuna Colliery was audible at Donnelly Road. Myuna Colliery was inaudible at Summerhill Drive. No other industrial operations, including Eraring Power Station and the Eraring Overland Conveyor were audible throughout the monitoring periods.

5.3 Unattended Continuous Noise Monitoring

Background noise levels were monitored by Heggies. The objective of the background noise survey was to measure $L_{A90(period)}$ and $L_{Aeq(15minute)}$ noise levels at the nearest potentially affected residential locations during the day, evening and night-time periods to enable the determination of the intrusiveness and amenity criteria for the project.

Background noise levels were monitored at two separate locations, considered to be representative of the nearest potentially affected receivers, from Wednesday 5 May 2010 to Thursday 13 May 2010, inclusive. Details of monitoring locations are provided in **Table 6** and **Figure 5**.

Table 6 Ambient Noise Monitoring Locations

Location	Address Location Description	Logger Serial No.
Location 1	Summerhill Drive, Wangi Wangi	194444
	Logger located on Centennial land adjacent to Summerhill Drive.	
Location 2	Donnelly Road, Arcadia Vale	194534
	Logger located on Centennial land adjacent to Donnelly Road.	

ARL Type EL215 noise loggers were used to monitor the ambient noise levels at each location. The noise loggers were programmed to record statistical noise level indices continuously in 15 minute intervals, including L_{Amax}, L_{A1}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and L_{Aeq}. Precautions were taken to minimise influences from extraneous noise sources and reflections from adjacent buildings.

Weather data for the survey period was obtained from the Bureau of Meteorology (BOM) weather station located at Cooranbong (approximately 10.5 km west of the project site). Noise data corresponding to periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 9 knots) were discarded in accordance with INP data exclusion methodology. A summary of the results of the background surveys is given in **Table 7**. Results are displayed graphically in **Appendix A**.

Table 7 Summary of Existing Ambient Noise Levels

Location	Period	Measured Background L_{A90} Noise Level	Estimated Myuna L_{A90} Contribution*	Adopted Rating Background Level (Excluding Myuna)	Measured $L_{Aeq(Period)}$	Estimated Existing Industrial (non-Myuna) Contribution L_{Aeq}
Location 1	Day	35 dBA	<30 dBA	35 dBA	53 dBA	<49 dBA
Summerhill Drive, Wangi Wangi	Evening	34 dBA	<30 dBA	34 dBA	49 dBA	<39 dBA
	Night	30 dBA	<30 dBA	30 dBA	46 dBA	<34 dBA
Location 2	Day	41 dBA	37 dBA	39 dBA	57 dBA	<49 dBA
Donnelly Road, Arcadia Vale	Evening	40 dBA	37 dBA	37 dBA	53 dBA	<39 dBA
	Night	36 dBA	33 dBA	34 dBA	51 dBA	<34 dBA

Note: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am
Morning Shoulder 6.00 am to 7.00 am
On Sundays and Public Holidays, Daytime 8.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 8.00 am
The L_{A90} represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level
L_{Aeq} - The equivalent continuous noise level is defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

* The Myuna Colliery L_{A90} contribution has been estimated with reference to operator attended noise monitoring and noise calculations of continuously operating fixed plant during the relevant time period.

5.4 Effects of Meteorology on Noise Levels

5.4.1 Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration (in accordance with the INP). Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

The closest available weather station to the Project site is Inglewood (8.5 km). The Inglewood weather station was installed in August 2005 and was operational until June 2006 (11 months of data). However this was considered appropriate to use within a TAPM model if other data sets (12 months) were available for the same period.

The Mandalong weather station, located approximately 11.5 km south-west of Myuna Colliery, has a full 12 months of weather data for financial year 2005/2006, and is considered appropriate for inclusion within a TAPM run for development of a synthetic weather file for the Proposed Project.

TAPM has been used to generate a synthetic meteorological file for the calendar year July 2005 to June 2006 for the Project Site, assimilating data for both Inglewood and Mandalong weather stations.

Wind speed and direction data produced by the TAPM run for the period August 2005 to July 2006 was analysed to determine the frequency of occurrence of winds up to speeds of 3 m/s for daytime, evening and night in each season. A summary of the most frequently occurring winds is contained within **Table 8**, **Table 9** and **Table 10**. The percentage occurrence figures provided in bold are those that exceed the 30% threshold.

Table 8 Seasonal Frequency of Occurrence of Wind Speed Intervals - Daytime

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	1.1%	SSW±45	7.1%	8.0%	15.1%
Autumn	3.4%	SW±45	15.5%	11.9%	27.4%
Winter	5.0%	SW±45	19.4%	10.3%	29.8%
Spring	2.7%	WSW±45	6.3%	7.8%	14.1%

Table 9 Seasonal Frequency of Occurrence of Wind Speed Intervals - Evening

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	4.4%	SSW±45	**36.0%**	9.0%	**45.0%**
Autumn	12.0%	S±45	**37.9%**	10.5%	**48.4%**
Winter	10.4%	S±45	**42.0%**	11.7%	**53.7%**
Spring	12.9%	SW±45	**36.5%**	5.6%	**42.2%**

Table 10 Seasonal Frequency of Occurrence of Wind Speed Intervals - Night

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	4.3%	SSW±45	**39.5%**	11.5%	**51.0%**
Autumn	11.2%	SSE±45	**39.8%**	14.6%	**54.4%**
Winter	8.1%	S±45	**37.5%**	25.0%	**62.6%**
Spring	8.9%	S±45	**34.9%**	10.1%	**45.1%**

Seasonal wind records indicate that certain winds, typically from the southern sector, are a feature of the area during the evening and night-time periods. Detailed analysis has indicated the following prevailing winds which have been considered as part of this assessment:

- Evening – ESE, WSW; and
- Night – ESE, SE, SSE, S, SSW, SW, WSW

5.4.2 Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total night-time during winter, or about two nights per week.

Meteorological data was not available from the surrounding weather stations to allow the determination of the percentage occurrence of temperature inversions during winter nights. A worst case analysis was therefore undertaken and the occurrence of temperature inversion during the night-time period has been considered as part of this noise assessment. Default temperature inversion values, as defined in the INP, have been assumed during the night-time period. Further details are provided in **Section 7.1.1**.

6 PROJECT SPECIFIC NOISE CRITERIA

6.1 Operational Noise Design Criteria

The noise emission design criteria for the project have been established with reference to the INP outlined in **Section 4.1** of this report.

The acoustical environment typifies a suburban environment; "*an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry"* (INP). Therefore, the residences in the general area have been assessed as "suburban" receiver types.

The amenity criteria have been established using the results of ambient noise measurements. At both monitoring locations, the existing industrial L_{eq} noise levels are more than 6 dBA below the acceptable noise levels described in **Table 3** therefore, the amenity criteria is equal to the acceptable noise level (refer **Table 4**).

In accordance with the INP, the project specific noise levels reflect the most stringent noise level requirements from the noise levels derived from both the intrusive and amenity criteria. Applying the most stringent requirement as the project specific noise levels ensures that both intrusive noise is limited and amenity is protected.

The resulting operational project specific noise criteria for the project are shown in **Table 11**.

Table 11 Project Specific Noise Criteria

Location	Period	Measured Background Noise Level (L_{A90})	Adopted RBL L_{A90}	Intrusiveness Criteria $L_{Aeq(15minute)}$	Amenity Criteria $L_{Aeq(Period)}$	Project Specific Noise Criteria $L_{Aeq(15min)}$
R1 to R2 – Off Summerhill Drive, Wangi Wangi	Day	35 dBA	35 dBA	40 dBA	55 dBA	**40 dBA**
	Evening	34 dBA	34 dBA	39 dBA	45 dBA	**39 dBA**
	Night	30 dBA	30 dBA	35 dBA	40 dBA	**35 dBA**
* R3 – Sunset Close, Wangi Wangi	Day	-	30 dBA	35 dBA	55 dBA	**35 dBA**
	Evening	-	30 dBA	35 dBA	45 dBA	**35 dBA**
	Night	-	30 dBA	35 dBA	40 dBA	**35 dBA**
R4 to R8 - Donnelly Road, Arcadia Vale	Day	41 dBA	39 dBA	44 dBA	55 dBA	**44 dBA**
	Evening	40 dBA	37 dBA	42 dBA	45 dBA	**42 dBA**
	Night	36 dBA	34 dBA	39 dBA	40 dBA	**39 dBA**

* For the purposes of determining the relevant project specific noise criteria the adopted RBL at this location has been based on the minimum RBL of 30 dBA in accordance with the INP.

6.2 Sleep Disturbance Noise Goals

The relevant sleep disturbance noise goals for each residential area are provided in **Table 12**.

Table 12 Sleep Disturbance Noise Goals

Location	Period	Measured Background Noise Level (L_{A90})	Adopted RBL* L_{A90}	Sleep Disturbance Noise Goal
R1 to R2 – Off Summerhill Drive, Wangi Wangi	Night	30 dBA	30 dBA	45 dBA
R3 – Sunset Close, Wangi Wangi	Night	-	30 dBA	45 dBA
R4 to R8 - Donnelly Road, Arcadia Vale	Night	36 dBA	34 dBA	49 dBA

* For the purposes of determining the relevant sleep disturbance noise goal the adopted RBL has been calculated such that the background noise level excludes the existing contribution of Myuna Colliery.

The Environmental Criteria for Road Traffic Noise (ECRTN) provides further guidance with regard to sleep disturbance and calls upon a number of studies that have been conducted into the effect of maximum noise levels on sleep. The DECCW policy document acknowledges that, at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance. However, the ECRTN provides that maximum internal noise levels below 50 dBA to 55 dBA are unlikely to cause awakening reactions and one or two events per night, with maximum internal noise levels of 65 dBA to 70 dBA (inside dwellings) are not likely to significantly affect health and wellbeing.

7 ASSESSMENT OF NOISE IMPACTS

7.1 Operational Noise Modelling

7.1.1 Operational Noise Modelling Parameters

A computer model was used to predict noise emissions from operation of the project. The operational noise modelling was undertaken using SoundPLAN v7.0 software, developed by Braunstein and Berndt Gmbh in Germany. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model used this map, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

Topographic contours and operational plans were supplied by CMPLfor the purpose of modelling noise from the Proposed Project. Prediction of noise emission levels was carried out under calm and prevailing atmospheric conditions. Atmospheric parameters under which noise predictions were made are given in **Table 13**.

Table 13 Meteorological Parameters Considered for Noise Predictions

	Temperature	Humidity	Wind Speed	Wind Direction	Temperature Inversion
Calm (All periods)	20°C	65%	n/a	n/a	n/a
Prevailing Winds (Evening and night)	10°C	90%	3m/s	ESE, SE, SSE, S, SSW, SW, WSW	n/a
Inversion (Night only)	10°C	90%	n/a	n/a	F Class

Sound power levels of relevant plant and equipment have been obtained from measurements of plant already operating at the site or have been sourced from a Heggies database of similar equipment (refer **Table 2**).

Assumptions made in modelling noise emissions from the subject site include the following:

- All acoustically significant plant and equipment operates simultaneously.
- All conveyors at the site are fully enclosed and were inaudible above the conveyor drives and processing plant during the site visit. Therefore the noise contributions of the conveyors are insignificant in comparison to those of the conveyor drive houses and have not been considered in the noise model.
- The emergency coal stockpile is only anticipated to be in operation approximately one (1) or two (2) days per quarter and as such it has not been considered as part of a typical operational scenario. An assessment of likely noise impacts from the emergency stockpile is considered in **Section 7.1.5**.
- The Eraring Overland Conveyor is owned, operated and maintained by Eraring Power Station and as such does not fall under the Myuna Part 3A application. The impact of the overland conveyor and the Myuna operations has been considered as part of the cumulative noise assessment (refer **Section 7.1.6**).

7.1.2 Noise Management and Mitigation

The model includes the following noise management and mitigation measures during the night-time period:

- All enclosure doors on the rotary breaker, crusher and crusher conveyor drive house will remain closed during the night-time period, specifically:
  - Roller shutter doors on the north east and south west façades of the crusher enclosure; and
  - Wire frame doors on the north east façade and north corner of the rotary breaker to be replaced with solid doors and kept closed at night-time.

In the interests of minimising potential sleep disturbance it is recommended that CMPL educate and involve employees on minimising noise during the night-time period. This may include the following work practices:

- Regularly train workers (such as toolbox talks) to use equipment in ways to minimise noise.
- Operate mobile plant in a quiet, efficient manner.
- Turn off plant when not in use.
- Avoid dropping materials from a height.
- Where possible, schedule the noisiest works, such as moving metal objects, for the daytime period.
- Closing all doors when not in use.

7.1.3 Operational Scenario - Noise Model Summary

The operational scenario modelled during each period is summarised in **Table 14**. A tick (✓) indicates that the equipment is in operation during the relevant period. A cross (×) indicates that the equipment is not in operation during the relevant period. It should be noted that the operational scenario modelled is likely to represent an acoustically worst-case scenario.

Table 14 Operational Scenario Considered in Noise Model

Plant and Equipment	Day	Evening	Night
Mining - Surface Operations			
Drift conveyor drive house	✓	✓	✓
Run of Mine (ROM) bin	✓	✓	✓
Rotary breaker	✓	✓	✓[1]
Crusher conveyor drive house	✓	✓	✓[1]
Crusher	✓	✓	✓[1]
Final product conveyor drive house	✓	✓	✓
Final product bin	✓	✓	✓
Compressor	✓	✓	✓
Forklift	✓	✓	✓
Underground man transport vehicle (entering or exiting portal)	✓	✓	✓
Workshop (i.e. use of grinder/hammering)	✓	✓	✓
Upcast Shaft Ventilation fan	✓	✓	✓

1 – At night-time all doors on the rotary breaker, crusher and crusher conveyor drive house have been assumed to be closed.

7.1.4 Operational Noise Modelling Results and Discussion

Noise emission levels were predicted from the proposed development for the typical operational scenario described in **Table 14** including the noise mitigation and management procedures described in **Section 7.1.2**.

Noise from all sources that contribute to the total noise from the site have been examined to identify characteristics that may cause greater annoyance (for example tonality, impulsiveness etc). The appropriate modifying factors, as outlined in the INP, have been applied where these characteristics are considered to be present. Noise levels predicted at the nearest potentially affected residential locations are provided in **Table 15**. Noise contour maps are provided in **Appendix B1 to B3** for worst case day, evening and night-time meteorological conditions.

Table 15 Proposed Project Predicted Noise Levels - All Plant

Location	Period	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)									Project Specific Noise Criteria ($L_{Aeq,15min}$)
		Calm	ESE	SE	SSE	S	SSW	SW	WSW	Temp Inversion	
R1	Day	<30	-	-	-	-	-	-	-	-	**40 dBA**
	Evening	<30	<30	-	-	-	-	-	<30	-	**39 dBA**
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	**35 dBA**
R2	Day	<30	-	-	-	-	-	-	-	-	**40 dBA**
	Evening	<30	<30	-	-	-	-	-	<30	-	**39 dBA**
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	**35 dBA**
R3	Day	<30	-	-	-	-	-	-	-	-	**35 dBA**
	Evening	<30	<30	-	-	-	-	-	<30	-	**35 dBA**
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	**35 dBA**
R4	Day	35	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	35	35	-	-	-	-	-	40	-	**42 dBA**
	Night	35	32	36	37	37	38	38	37	37	**39 dBA**
R5	Day	37	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	37	34	-	-	-	-	-	42	-	**42 dBA**
	Night	37	31	35	38	39	39	39	39	39	**39 dBA**
R6	Day	37	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	37	31	-	-	-	-	-	42	-	**42 dBA**
	Night	37	<30	32	36	38	38	38	39	38	**39 dBA**
R7	Day	37	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	37	31	-	-	-	-	-	42	-	**42 dBA**
	Night	37	<30	30	34	38	39	39	39	39	**39 dBA**
R8	Day	37	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	37	30	-	-	-	-	-	42	-	**42 dBA**
	Night	37	<30	30	32	36	39	39	39	39	**39 dBA**

Results presented in **Table 15** indicate that operational noise levels are predicted to meet the project specific noise criteria at all modelled residential receivers under calm and prevailing weather conditions with the recommended noise mitigation and management strategies in place.

Since the operational scenario modelled is likely to represent an acoustically worst case scenario, actual operational noise levels are likely to be less than those predicted.

7.1.5 Emergency Stockpile

In the event of break downs or servicing and maintenance of the Eraring Overland Conveyor, Myuna Colliery temporarily stores coal in a dedicated stockpile in the north of the Surface Facilities area. Coal is transferred from the emergency hopper to the stockpile by trucks via a sealed haul road. It is recovered from the stockpile by a front end loader where it is loaded onto trucks and dumped into a CHP reclaim hopper for transportation to Eraring Power Station by the Eraring Overland Conveyor. Emergency stockpiling activities are only anticipated to occur for a maximum period of 3 days per year, with stockpiled coal returned back to the reclaim hopper over a 4 day period.

Notwithstanding this, Heggies has conducted noise calculations to the nearest affected residences with all surface plant in operation as well as a front end loader on the stockpile and trucks transporting coal between the CHP and stockpile area.

Given the proximity of the stockpile to the nearest receivers on Donnelly Road, exceedences of the project specific noise criteria are predicted at receiver R5 during the evening and at all locations on Donnelly Road (R4 to R8) during the night-time due to the operation of the front end loader.

As such, it is recommended that the front end loader does not operate on the stockpile during the evening or night-time periods and, hence, that stockpiled coal is only returned back to the reclaim hopper during the daytime period.

Table 16 presents the predicted noise levels during emergency stockpiling activities including the following assumptions:

- All operational noise mitigation and management procedures described in **Section 7.1.2**.
- Three (3) truck movements to the emergency stockpile per 15 minute period.
- No front end loader operation at the emergency stockpile area during the evening or night-time periods.

Table 16 Predicted Noise Levels during Emergency Stockpiling Activities

Location	Period	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)									Project Specific Noise Criteria ($L_{Aeq,15min}$)
		Calm	ESE	SE	SSE	S	SSW	SW	WSW	Temp Inversion	
R1	Day	37	-	-	-	-	-	-	-	-	**40 dBA**
	Evening	<30	<30	-	-	-	-	-	<30	-	**39 dBA**
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	**35 dBA**
R2	Day	<30	-	-	-	-	-	-	-	-	**40 dBA**
	Evening	<30	<30	-	-	-	-	-	<30	-	**39 dBA**
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	**35 dBA**
R3	Day	<30	-	-	-	-	-	-	-	-	**35 dBA**
	Evening	<30	<30	-	-	-	-	-	<30	-	**35 dBA**
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	**35 dBA**
R4	Day	42	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	35	35	-	-	-	-	-	40	-	**42 dBA**
	Night	35	32	36	37	38	38	38	37	37	**39 dBA**
R5	Day	44	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	37	34	-	-	-	-	-	42	-	**42 dBA**
	Night	37	31	35	38	39	39	39	39	39	**39 dBA**
R6	Day	42	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	37	31	-	-	-	-	-	42	-	**42 dBA**
	Night	37	<30	32	36	38	39	38	39	38	**39 dBA**
R7	Day	42	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	37	31	-	-	-	-	-	42	-	**42 dBA**
	Night	37	<30	30	34	38	39	39	39	39	**39 dBA**
R8	Day	41	-	-	-	-	-	-	-	-	**44 dBA**
	Evening	37	30	-	-	-	-	-	42	-	**42 dBA**
	Night	37	<30	30	32	36	39	39	39	39	**39 dBA**

Results presented in **Table 16** indicate that noise emission levels during the operation of the emergency stockpile area are predicted to meet the project specific noise criteria at all modelled residential receivers under calm and prevailing weather conditions with the recommended noise mitigation and management strategies in place.

Furthermore, emergency stockpiling activities are likely to be worst case noise emissions at the surrounding residential receivers and would not represent typical operational activities at the site.

7.1.6 Cumulative Noise Assessment

Potential cumulative noise impacts from existing and successive developments are embraced by the INP procedures by ensuring that the appropriate noise emission criteria are established with a view to maintaining acceptable noise *amenity* levels for residences.

The cumulative noise impact of the project with other existing industrial noise sources including the Eraring Power Station and Eraring Overland Conveyor has been assessed in the determination of the amenity levels at surrounding potentially affected noise sensitive areas.

7.2 Sleep Disturbance Analysis

As described in **Section 5.2**, during the night-time operator attended noise survey on Donnelly Road maximum noise levels of up to 59 dBA were recorded from activities at Myuna Colliery due to the forklift moving and banging metal objects at the site. These noise levels exceed the recommended sleep disturbance noise goal of 49 dBA on Donnelly Road by 10 dBA.

In the interests of minimising sleep disturbance impacts it is recommended that CMPL educate and involve employees on the importance of minimising noise during the night-time period (refer **Section 7.1.2**).

Further to the above, the likelihood of sleep disturbance from other night-time sources has been assessed. In assessing sleep disturbance from typical night-time activities, L_{Amax} noise levels of acoustically significantly plant and equipment to be used at the subject site (refer to **Table 17**) were used as input to the noise model. L_{Amax} noise level predictions were made at the nearest residential areas under adverse weather conditions at night. Noise events considered include coal falling into the ROM bin and those associated with a forklift drive off or pass-by. The use of the L_{Amax} noise level provides a worst-case prediction since the $L_{A1(1minute)}$ noise level of a noise event is likely to be less than the L_{Amax}.

Table 17 L_{Amax} Sound Power Levels

Source	Maximum Sound Power Level
Forklift drive-off or pass-by	117 dBA
Coal falling into ROM bin	107 dBA

The highest L_{Amax} noise level at any residential area is predicted to occur as a result of forklift pass-by events in the materials yard under the influence of a temperature inversion. External noise levels up to L_{Amax} 43 dBA may occur at residences on Donnelly Road under these circumstances. Hence, predicted noise levels meet the most stringent recommended sleep disturbance noise goal of 49 dBA on Donnelly Road.

Maximum noise levels on Summerhill Drive and Sunset Close, Wangi Wangi are predicted to be below L_{Amax} 30 dBA.

7.3 Road Traffic Noise

The Myuna Colliery is accessed from a private road (old section of Wangi Point Road) which ends at Myuna Colliery. The private road is used by existing staff (as well as limited delivery vehicles) to access Myuna Colliery's Surface Facilities Area which includes a car park with approved capacity of 200 vehicles. A combined total of 350 employees at the Myuna and Cooranbong Collieries was approved in the EIS. Three eight hour shifts are utilised at Myuna Colliery over a 24 hour period.

All coal from Myuna Colliery is transported by overland conveyor to Eraring Power Station. No coal is transported by road.

The proposed Project will not significantly alter the existing traffic and transport network (refer to *Myuna Colliery Extension of Mining Traffic Impact Assessment*, AECOM 2010). Access for deliveries to and from the Surface Facilities Area and staff movements (up to 210 employees) will all be by the existing network. Therefore, there will not be any additional road traffic noise impacts associated with the operation of the Proposed Project.

7.4 Vibration Assessment

It is noted that limited underground shot firing may be required for the proposed Project. Vibration from underground shot firing is predicted to be negligible and below levels of human perception at the nearest residential locations. Notwithstanding this, it is recommended that all shots should be planned and designed to achieve the required outcomes with minimum impacts on the surrounding residential receivers.

Other main vibration generating activities will include the operation of mobile equipment such as the loader and trucks. Given the minimum separation distance of approximately 500m between mining operations and the nearest potentially affected residential locations vibration levels from these activities is predicted to be negligible and below levels of human perception at the nearest residential receivers.

8 CONCLUSION

Heggies has undertaken a Noise Impact Assessment for the Myuna Colliery Extension of Mining Project located on Wangi Road, Wangi Wangi, NSW.

Broadly, the objective of the noise assessment was to identify the potential impacts of noise from the continued operation of the facility and to provide advice with regard to effective mitigation strategies where necessary.

The following noise mitigation and management strategies have been recommended for the proposed Project:

- All enclosure doors on the rotary breaker, crusher and crusher conveyor drive house will remain closed during the night-time period, specifically:
  - Roller shutter doors on the north east and south west façades of the crusher enclosure; and
  - Wire frame doors on the north east façade and north corner of the rotary breaker to be replaced with solid doors and kept closed at night-time.
  - In the interests of minimising sleep disturbance it is recommended that the forklift does not conduct potentially noisy activities, such as moving metal objects around the materials yard, during the night-time period (refer **Section 7.2**).
- Education of employees on minimising noise during the night-time period. This may include the following work practices:
  - Regularly train workers (such as toolbox talks) to use equipment in ways to minimise noise.
  - Operate mobile plant in a quiet, efficient manner.
  - Turn off plant when not in use.
  - Avoid dropping materials from a height.
  - Schedule the noisiest works, such as moving metal objects, for the daytime period.
  - Closing all doors when not in use.

Results presented in **Table 15** indicate that operational noise levels are predicted to 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.

Results presented in **Table 16** indicate noise emission levels during the operation of the emergency stockpile area are predicted to meet the project specific noise criteria at all modelled residential receivers under calm and prevailing weather conditions with the recommended noise mitigation and management strategies in place.

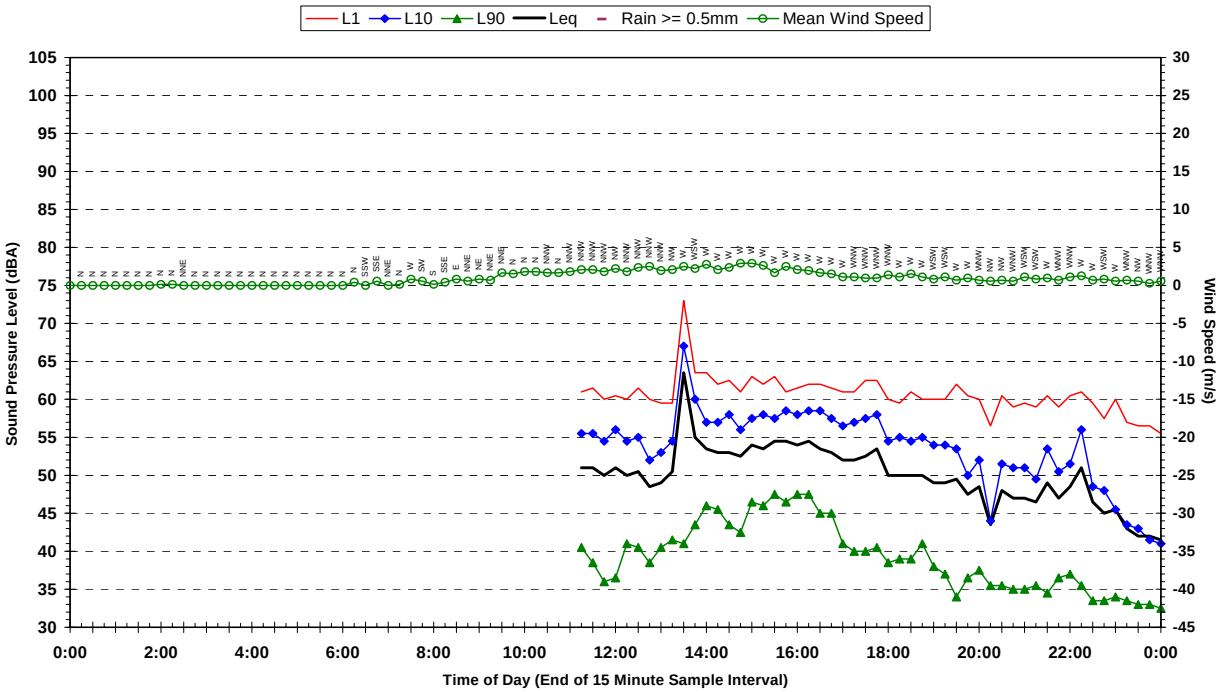
L_{Amax} noise levels are predicted to meet recommended sleep disturbance goals with the recommended management strategies in place.

The project will not significantly alter the existing road traffic network and hence no additional noise impacts are predicted from road traffic associated with the colliery.

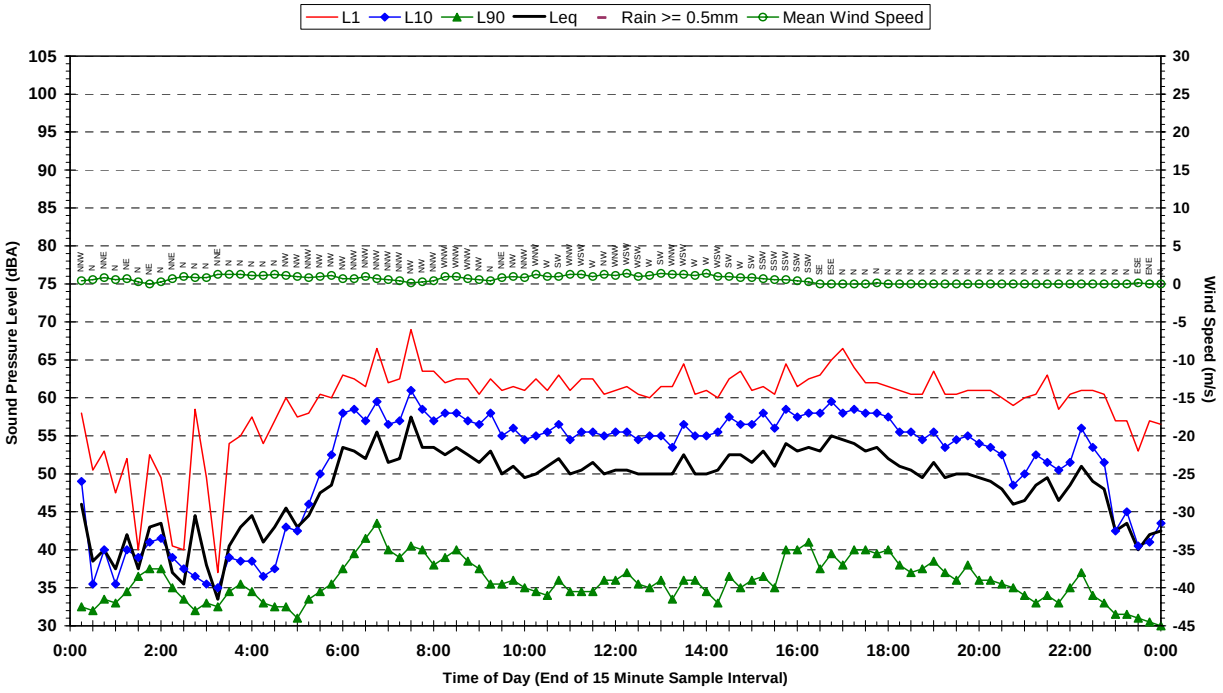
Vibration from underground shot firing is predicted to be negligible and below levels of human perception at the nearest residential locations. Notwithstanding this, it is recommended that all shots should be planned and designed to achieve the required outcomes with minimum impacts on the surrounding residential receivers.

Given the separation distance between mining operations and the nearest potentially affected residential locations vibration levels from the Proposed Project are predicted to be negligible and below levels of human perception at the nearest residential locations.

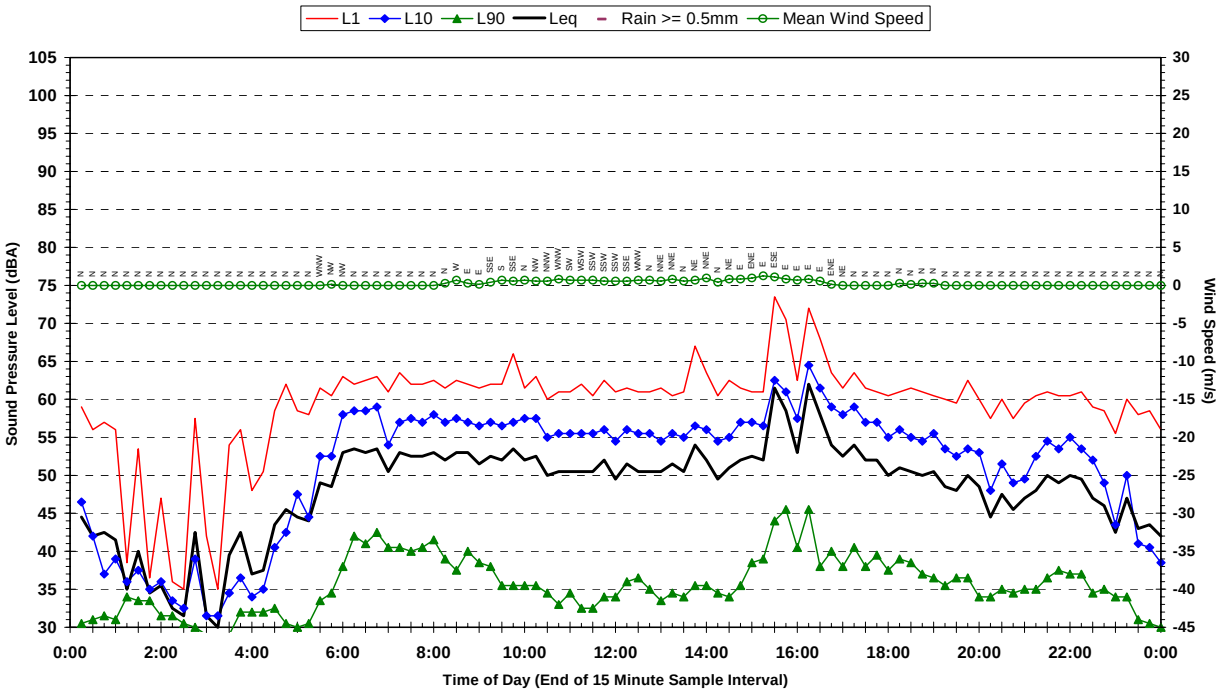
Statistical Ambient Noise Levels
30-2558 Myuna Colliery - Summerhill Drive - Wednesday 5 May 2010



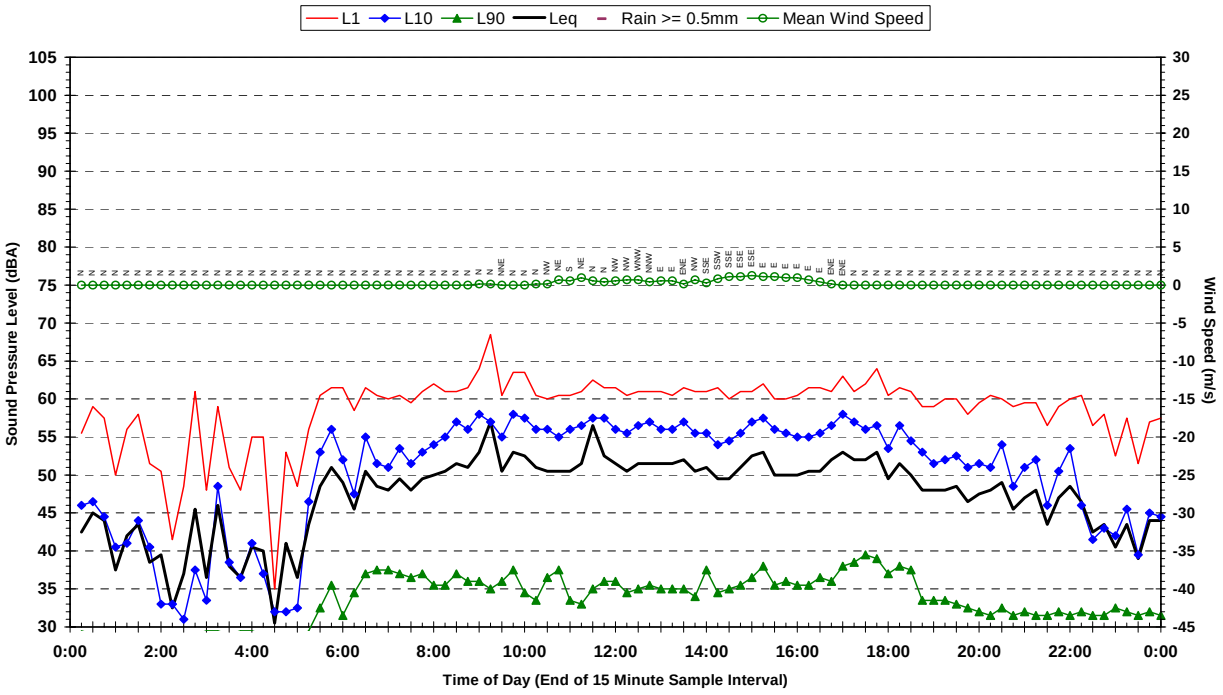
Statistical Ambient Noise Levels
30-2558 Myuna Colliery - Summerhill Drive - Thursday 6 May 2010



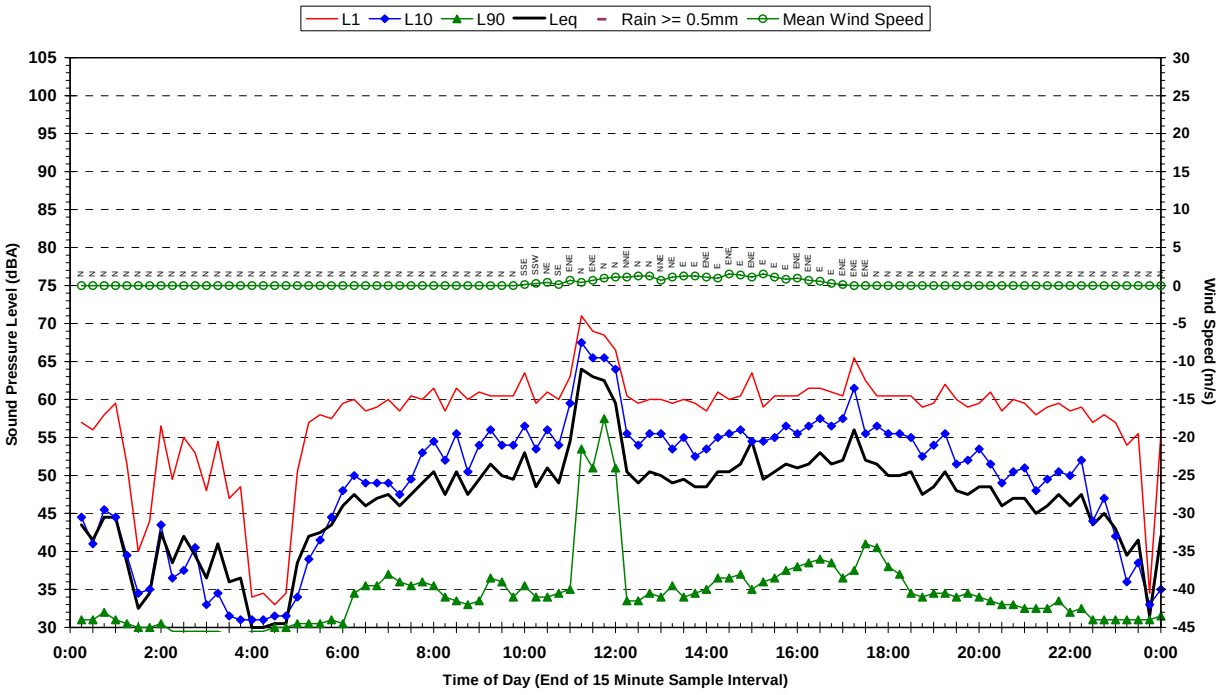
Statistical Ambient Noise Levels
30-2558 Myuna Colliery - Summerhill Drive - Friday 7 May 2010



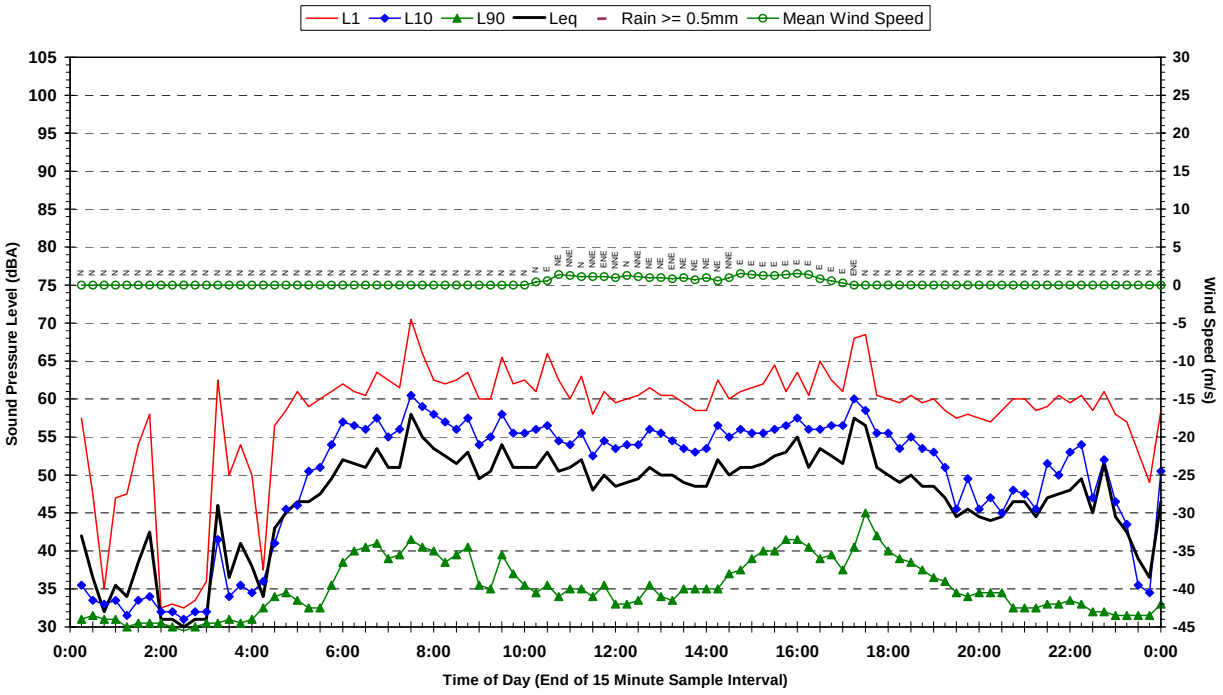
Statistical Ambient Noise Levels
30-2558 Myuna Colliery - Summerhill Drive - Saturday 8 May 2010



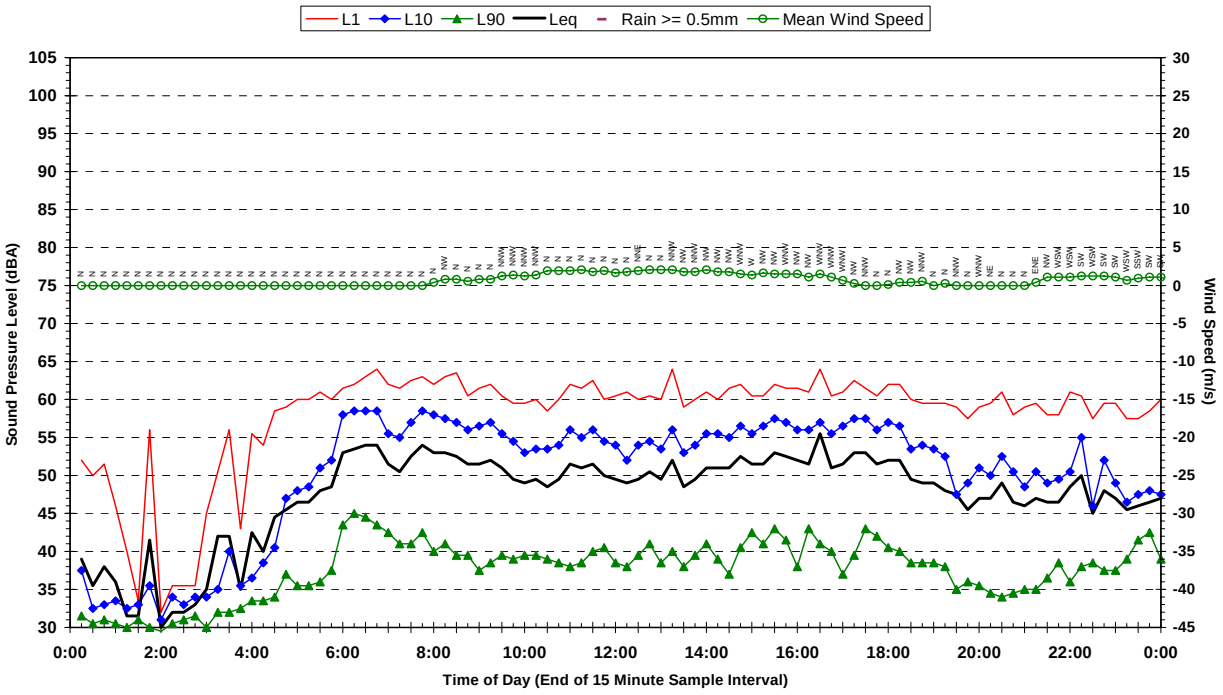
Statistical Ambient Noise Levels
30-2558 Myuna Colliery - Summerhill Drive - Sunday 9 May 2010



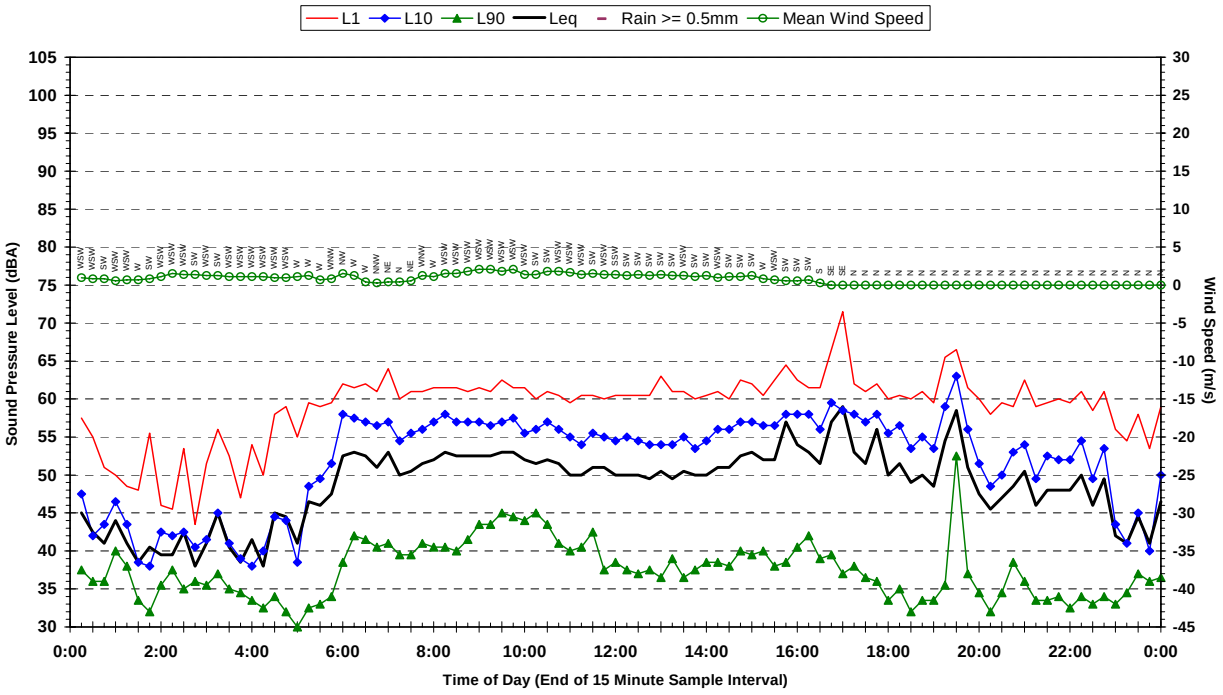
Statistical Ambient Noise Levels
30-2558 Myuna Colliery - Summerhill Drive - Monday 10 May 2010



Statistical Ambient Noise Levels
30-2558 Myuna Colliery - Summerhill Drive - Tuesday 11 May 2010



Statistical Ambient Noise Levels
30-2558 Myuna Colliery - Summerhill Drive - Wednesday 12 May 2010



Statistical Ambient Noise Levels
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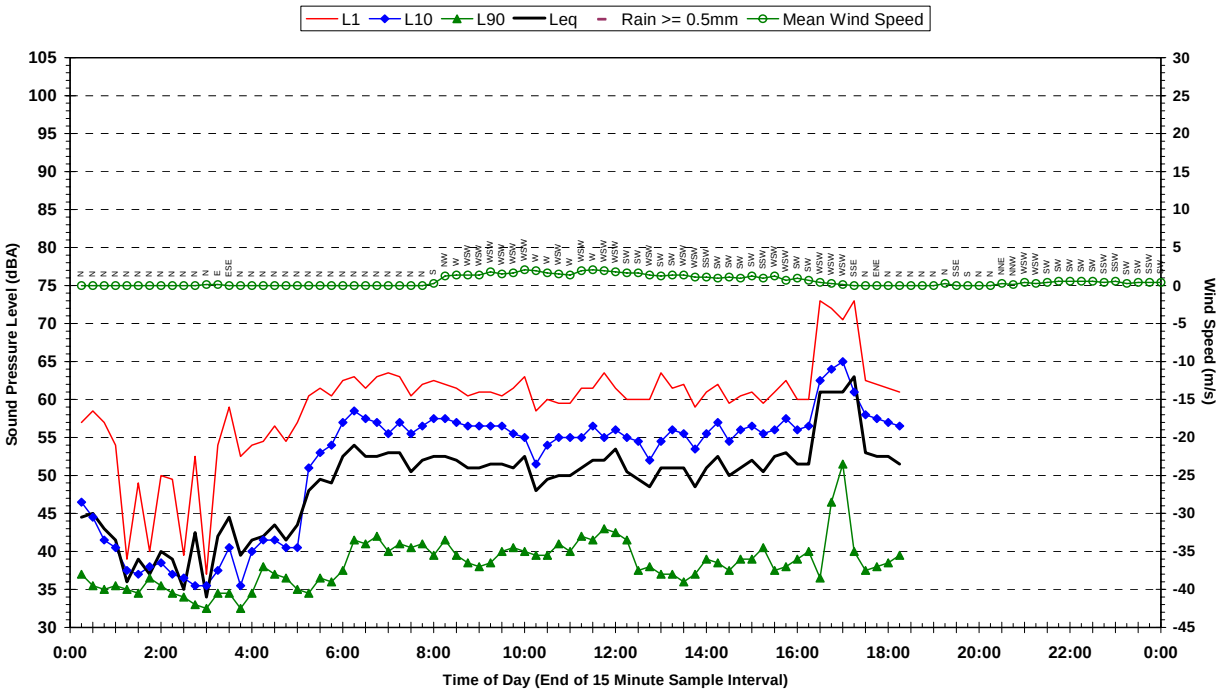

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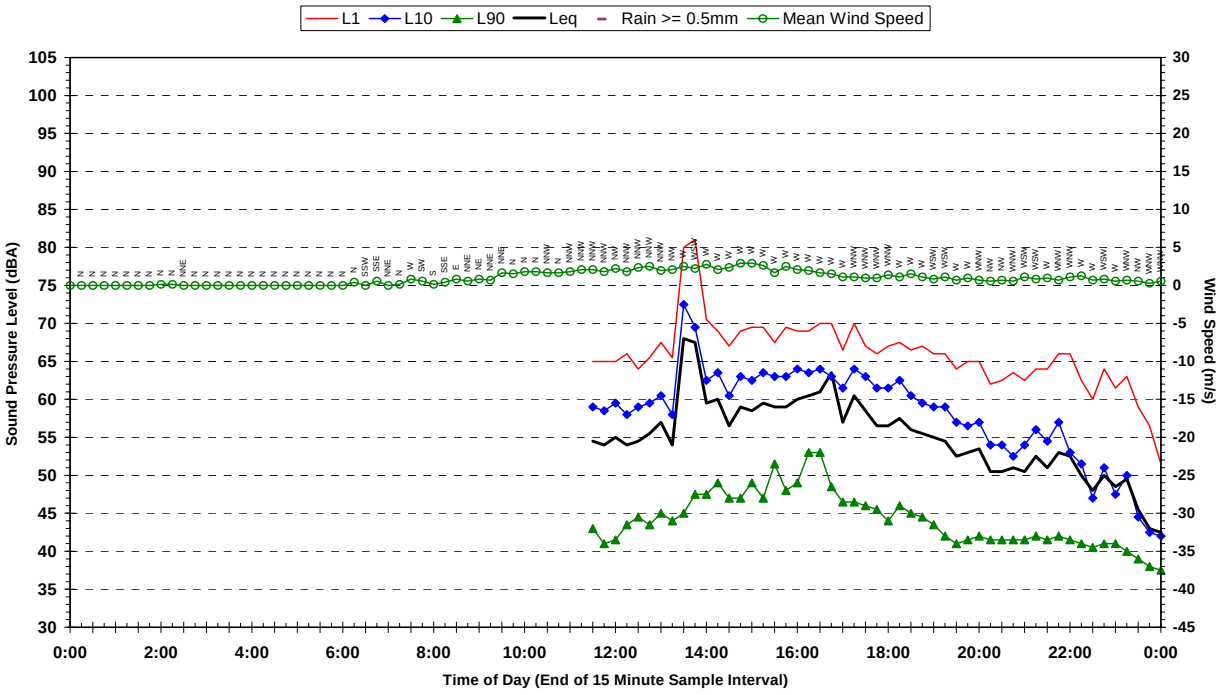

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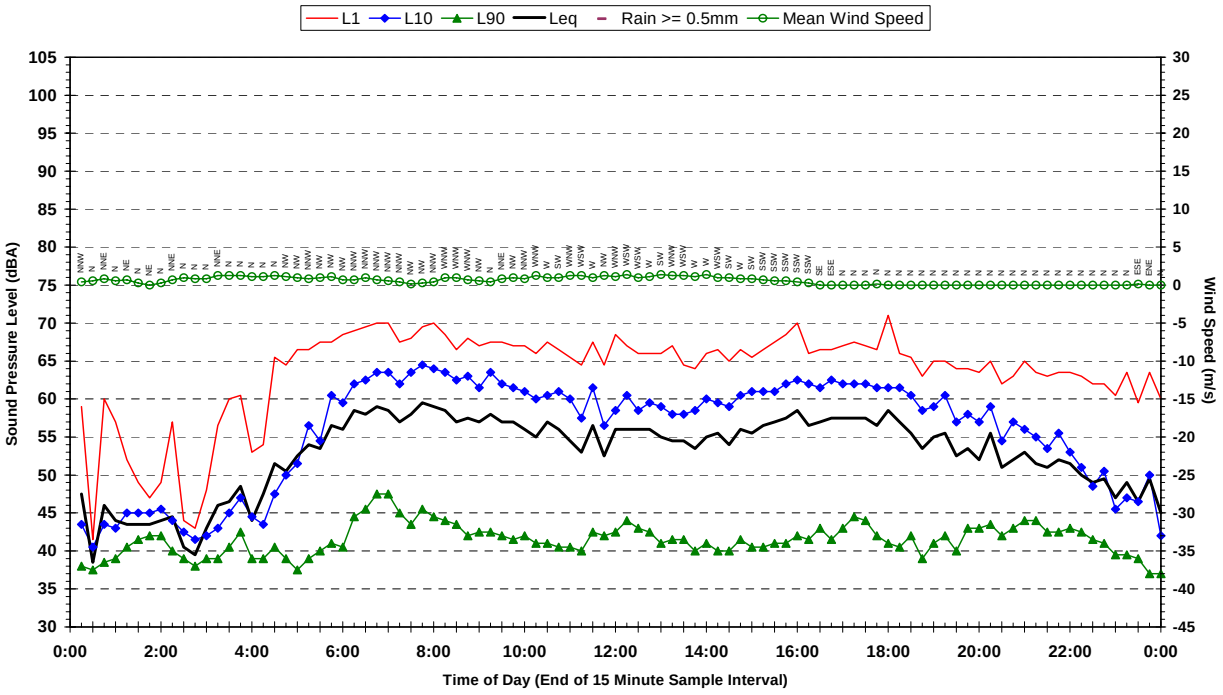

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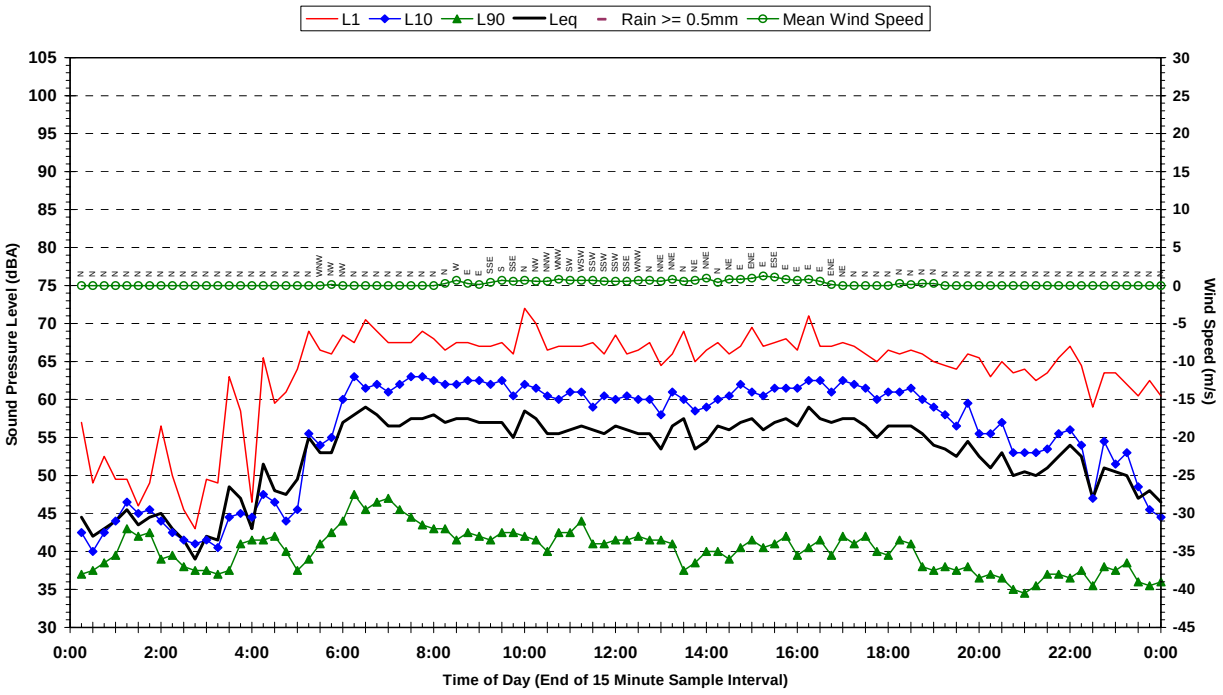

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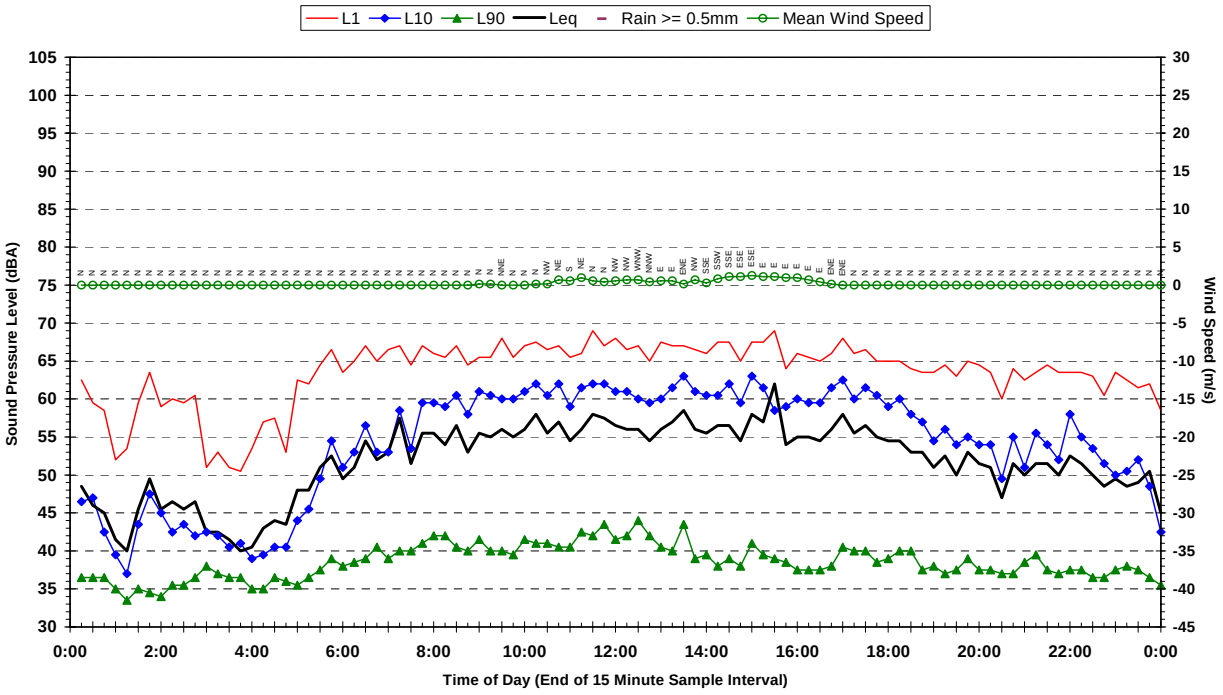

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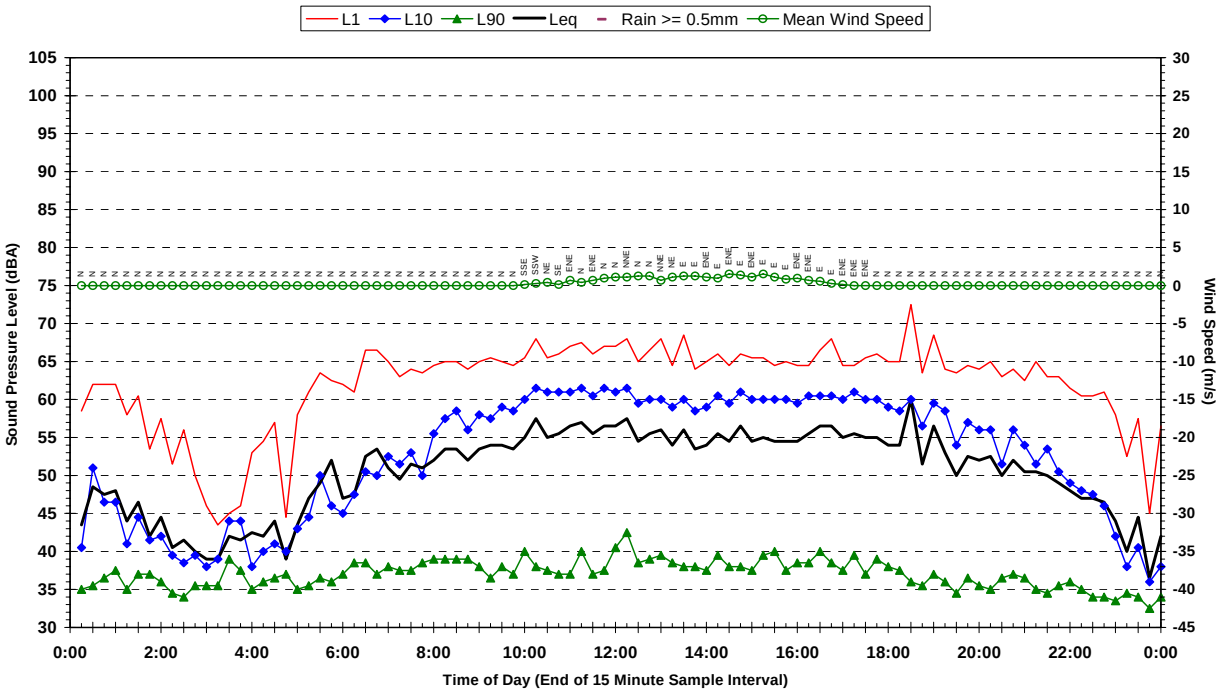

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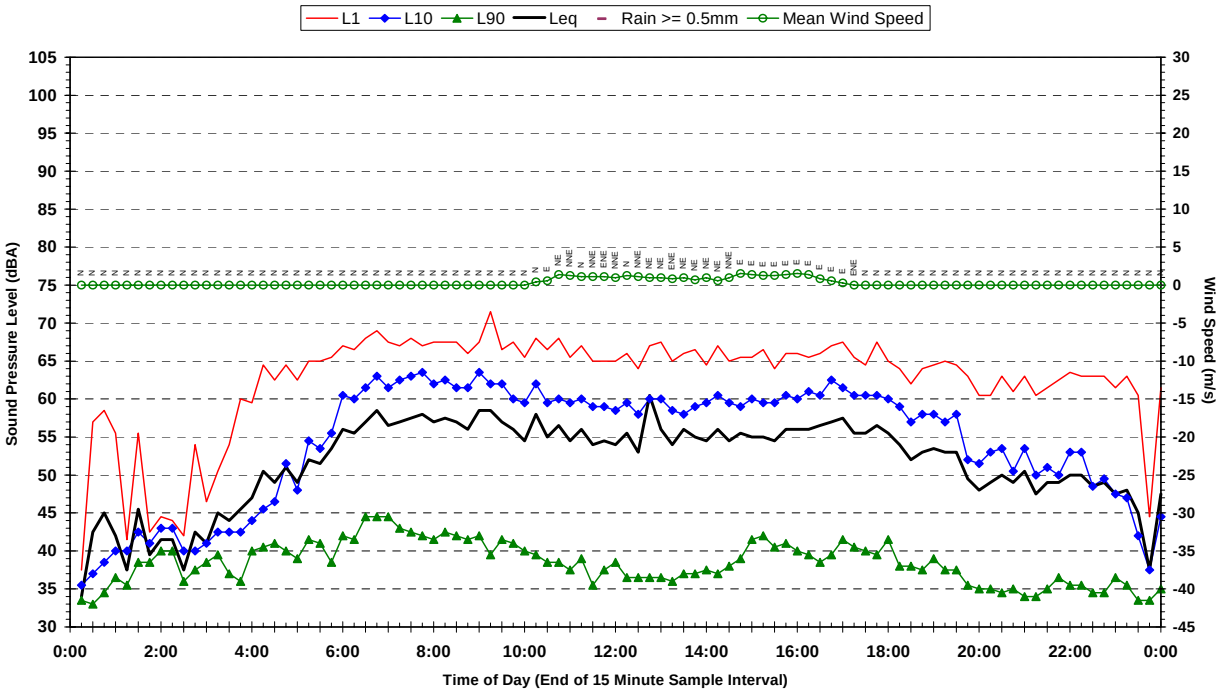

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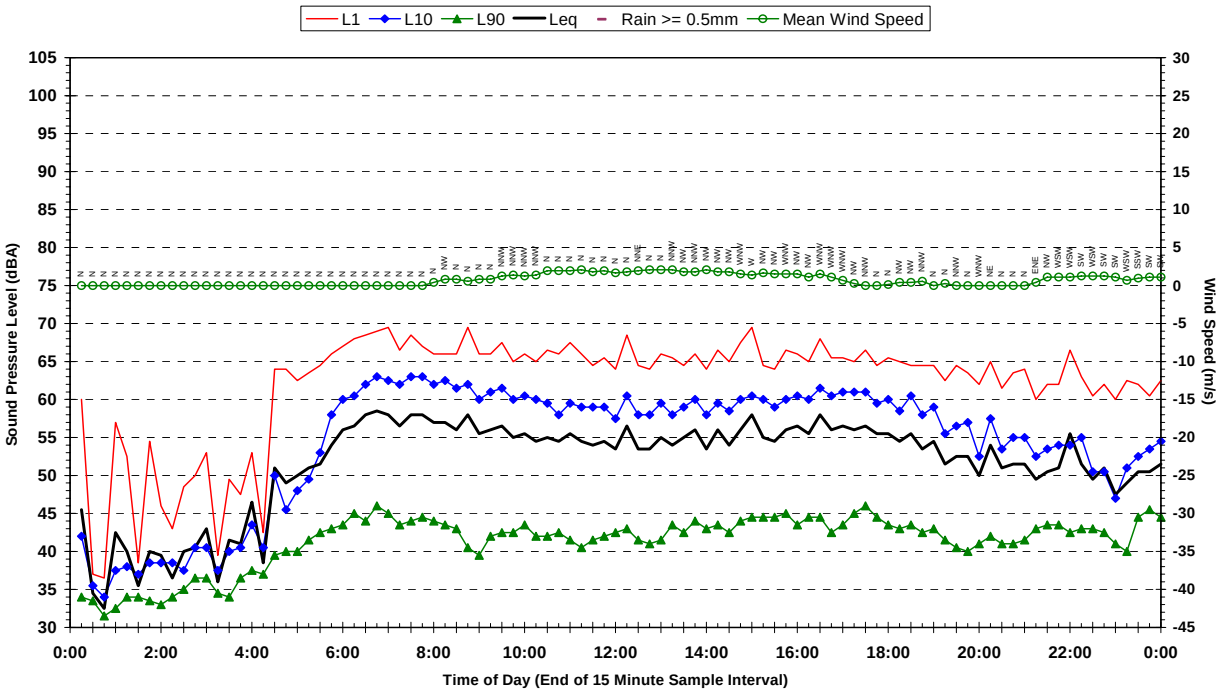

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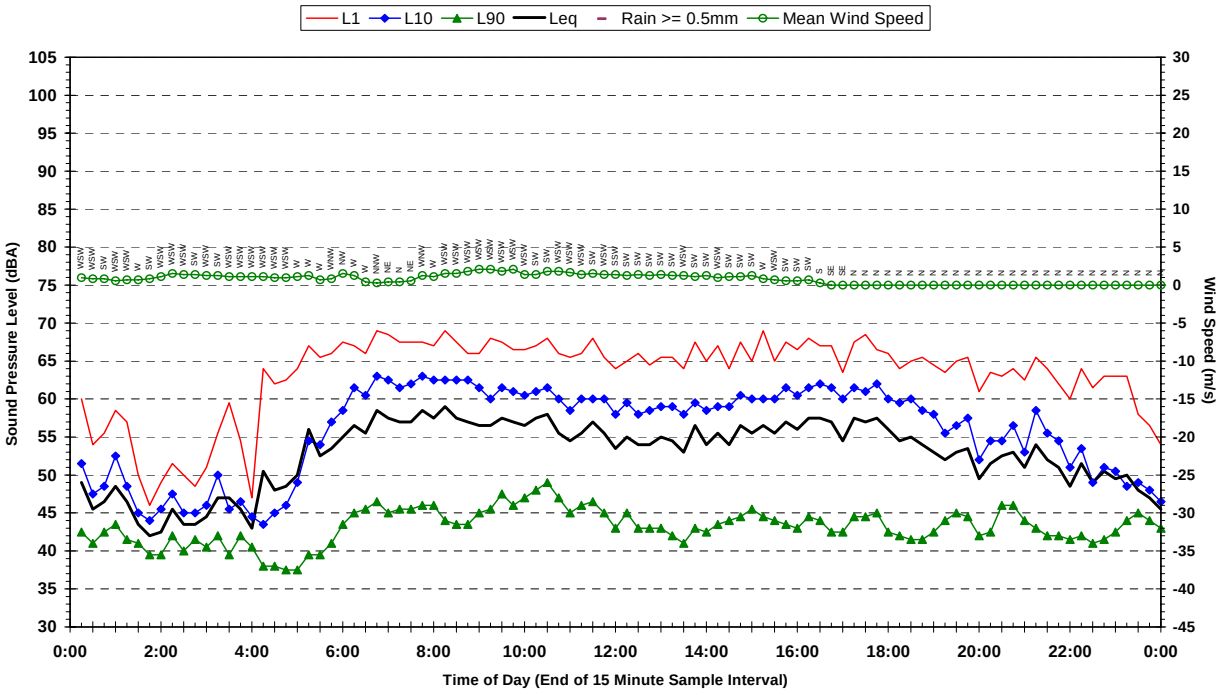

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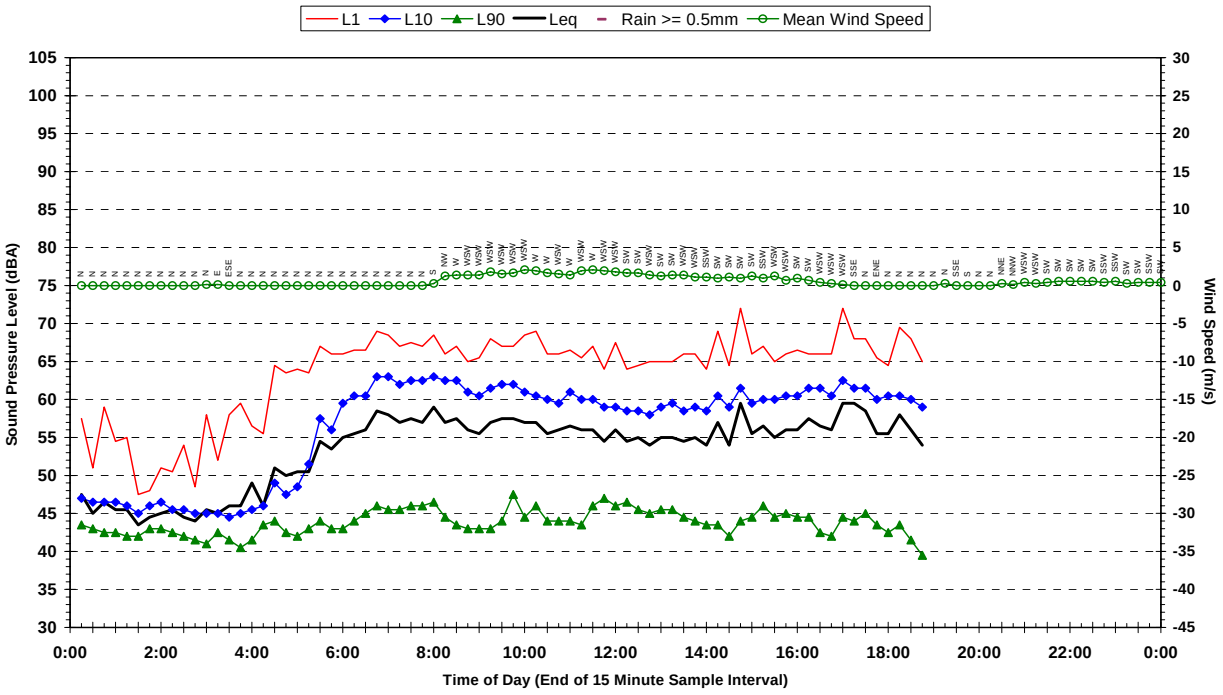

Figure 2 Project Application Area

Source: AECOM, 2010

Appendix I

Aquatic Ecology Assessment (Cardno Ecology Lab, 2010)

Cardno Ecology Lab

Shaping the Future

Marine and Freshwater Studies

Myuna Colliery Extension of Mining

Aquatic Ecology Assessment

Job Number: EL0910077

Prepared for: AECOM

October 2010

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Cover Image: Strapweed (*Posidonia australis)*, Lake Macquarie 11.05.2010. Photographer, Dan Aveling, Cardno Ecology Lab.

Document Control

Job Number	Status	Date	Author		Reviewer	
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EL0910077A	Draft	11 June 2010	K. A. Reeds	KAR	Peggy O'Donnell	POD
EL0910077A	Draft	29 June 2010	K. A. Reeds	KAR	Peggy O'Donnell	POD
EL0910077A	Final	23 August 2010	K. A. Reeds	KAR	Peggy O'Donnell	POD
EL0910077A	Final	22 October 2010	K. A. Reeds	KAR	Peggy O'Donnell	POD

Summary

Myuna Colliery is a small underground coal mine owned and operated by Centennial Myuna Pty Limited (CMPL), a wholly owned subsidiary of Centennial Coal Company Limited (Centennial). Myuna Colliery's Surface Facilities Area is located in Wangi Wangi on the western side of Lake Macquarie, 25 kilometres south-west of Newcastle.

Cardno (NSW) Pty Ltd trading as Cardno Ecology Lab has been commissioned by AECOM to undertake an assessment of impacts on estuarine aquatic ecology from the Myuna Colliery Extension of Mining Project (proposed Project) within the Project Application Area.

The main issue to be considered in the assessment is the potential for subsidence of the bed of Lake Macquarie from subsurface mining to affect estuarine ecosystems. Significant subsidence could destabilise aquatic vegetation and affect estuarine invertebrates that live in the upper layers of the lake bed sediments. Mining to date has not resulted in observable subsidence on the lake bed, but the potential for further coal removal to cause subsidence must be assessed. The aquatic ecology assessment included:

- Background research;
- Field investigations of the current seagrass distribution and deeper un-vegetated soft sediments of the lake bed;
- Assessment of impacts; and
- Identification of appropriate mitigation and/or monitoring for potential impacts where appropriate.

The aquatic ecology assessment was based on predictions of two 'types' of subsidence thresholds for different zones (A and B) within the Project Application Area. The two types are:

- Zone A – Long term stable mining systems generating < 20 millimetres of surface subsidence. Within the context of Lake Macquarie, Zone A includes all land above the High Water Level Subsidence Control Zone and seagrass beds; and
- Zone B – Mining systems generating a maximum of 650 millimetres of surface subsidence. Zone B includes the area beyond the outer edge of seagrass beds and relates more to the levels of deformation that the overburden can tolerate to ensure a fracture connection is not made between Lake Macquarie and the underground workings.

These predictions are based on the subsidence assessment report (Seedsman 2010).

Terms used throughout this report are defined below:

- **Development Consent Mining Area**: Shown in Figure S1 and includes the surface facilities area.
- **Project Application Area**: Encompasses Mining Lease (ML) 1370, a portion of Consolidated Coal Lease (CCL) 762 and the Surface Facilities Area. It comprises an area external to the existing Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area) (Figure S1).
- **Study Area**: The Lake Macquarie estuary including the water area and foreshores
- **Survey Area**: The area surveyed during the aquatic ecology assessment. This includes the Development Consent Mining Area and the Project Application Area as indicated in Figure S1.

Information on the existing conditions within the study area was compiled using Cardno Ecology Labs library of journals and technical reports and the internet. Information on threatened and protected species, populations and ecological communities listed under relevant State and Commonwealth legislation that could occur within the study area was compiled from database searches and review of previous studies. Results of the database

searches showed a total of 17 species of marine mammal, seven species of fish, 22 species of syngnathiforms (seahorses, seadragons, pipefish, pipehorses, ghost pipefishes and sea moths), five species of marine reptiles and 10 species of estuarine bird that could potentially occur within the study area. Of the species that were known to occur there, 11 species had potential to be affected by the proposed Project and required further assessment. These were the:

- Dugong (*Dugong dugon*);
- Loggerhead turtle (*Caretta caretta*),
- Green turtle (*Chelonia mydas*) ; and
- Eight species of estuarine bird.

Assessments of significance under State legislation were carried out for these species to determine whether a Species Impact Statement would be considered necessary.

Assessments of significance were also carried out according to the *Environment Protection Biodiversity and Conservation Act 1999* (EPBC Act) 'significant impact guidelines 1.1' for the dugong (*Dugong dugon*) and loggerhead turtle (*Caretta caretta*), which are matters of National Environmental Significance (NES). Although it was considered unlikely that significant impacts upon these species will occur as a result of the proposed Project, a referral to the Federal Minister will be made in accordance with the requirements of the EPBC Act for a determination as to whether the proposed Project is a controlled action.

Field investigations were carried out on 11 and 12 May 2010 within the extent of the survey area (i.e. the Development Consent Mining Area and the Project Application Area) and involved seagrass habitat mapping and inspection of two deep seabed sites.

Mapping of aquatic vegetation was based on a presumptive map of seagrass distribution within the survey area produced by Industry and Investment NSW in 2008. The aim of the field investigation was to ground truth the presumptive map with a focus on determining the outer edges of the seagrass beds, species present and relative bed density in terms of percentage cover. The field investigation was carried out by boat using a laptop connected to a hand held GPS unit and GIS software which enabled real-time mapping. The boundaries of seagrass beds on the presumptive map were later adjusted to accommodate the findings of field-based ground truthing. Estimates of relative abundance of various seagrass species were made using two categories: low density (< 50 % cover), or high density (> 50 % cover). Any fish observed in the survey area were also recorded. Deeper water habitats of the lake bed within the survey area were investigated by SCUBA divers for evidence of subsidence, presence of benthic macroinvertebrates/macroalgae and the nature of the substratum.

In general, the outer extent of seagrass beds appeared to be limited to within a depth contour of around three metres and rarely did beds extend beyond this limit. Three species were observed within the survey area: eel grass (*Zostera capricorni*), paddle weed (*Halophila ovalis*) and strapweed (*Posidonia australis*). Results indicated that the boundaries of seagrass beds observed during the field investigations were generally very similar to presumptive maps based on previous mapping, although there were some notable differences in places. Species of fish observed included yellowfin bream (*Acanthopagrus australis*), luderick (*Girella tricuspidata*) and whiting (*Sillago* sp.). Juveniles of these species were also observed in association with seagrass habitat.

The seabed at the two deep dive sites consisted of fine, dark, soft silt, which was greater than 30 centimetres deep. The surface of the substratum was relatively flat and bioturbated in places, which indicated the presence of burrowing marine invertebrates such as crabs and polychaetes worms. No macroalgae or marine invertebrates were observed on the surface of the substratum at either site and there were no deepened or uneven surfaces within the 25 square metre areas inspected that could indicate subsidence. Given the nature of the

very fine, soft sediment type any subtle differences in the seabed that could indicate evidence of subsidence would be difficult to detect from the surface.

Results of the field investigations were generally consistent with information compiled in the review of existing information as the same species of seagrass and similar distributions were recorded. Seagrass habitat is extensive throughout shallow nearshore sections of the Project Application Area, however, given that predicted subsidence levels where seagrass beds occur (Zone A), would be negligible (< 20 millimetres), the Project is not considered to have any substantial impact on seagrass habitat. Direct or indirect impacts to fish and threatened species that utilise seagrass habitat are not therefore expected. Saltmarsh and mangrove habitat are not known to occur within or in proximity of the Project Application Area and would not be affected by the Project. Part of the Lake Macquarie State Conservation Area (Point Wolstoncroft), does occur within the Project Application Area, however, no impact to the conservation values of this area (in terms of aquatic ecology) as a result of the Project is expected.

It is possible that subsidence levels predicted to occur within Zone B (< 650 millimetres subsidence) could affect seagrass habitat in adjacent Zone A. This would be mitigated by establishing a Seagrass Management Zone within Mining Zone B. The purpose of the Seagrass Management Zone would be to delineate the area where future seagrass monitoring may be required should secondary mine workings take place in Mining Zone B.

A Seagrass Management Plan would also be prepared in which the aims, triggers and required outcomes of the future seagrass surveys would be outlined. The need for monitoring surveys would be determined on a risk based approach and targeted towards the locations where secondary workings are planned. Any seagrass monitoring surveys carried out would verify the lake-ward edges of seagrass beds and include observations before, during and after mining activity to detect any effects that might warrant more detailed quantitative field investigations.

Source: AECOM

Figure S1: Myuna Colliery Conceptual Mining Zones.

Table of Contents

1 Introduction

Myuna Colliery is a small underground coal mine owned and operated by Centennial Myuna Pty Limited (CMPL), a wholly owned subsidiary of Centennial Coal Company Limited (Centennial). Myuna Colliery's Surface Facilities Area is located in Wangi Wangi on the western side of Lake Macquarie, 25 kilometres south-west of Newcastle.

CMPL undertakes underground mining at Myuna Colliery:

- Within the Development Consent Mining Area; and
- Within Consolidated Coal Lease (CCL) 762 and Mining Lease (ML) 1370 but external to the Development Consent Mining Area, pursuant to the combined operation of Section 74(1) of the Mining Act 1992 (Mining Act) and clause 8K of the *Environmental Planning and Assessment Regulation 2000*.

The Project Application Area is shown on Figure 1 and encompasses ML 1370, a portion of CCL 762 and the Surface Facilities Area. The Project Application Area comprises an area within the boundaries of CCL 762 and ML 1370, but external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area).

The Project will extend mining and coal handling at Myuna Colliery within the Project Application Area and proposes to:

- mine using bord and pillar methods in the Wallarah, Great Northern and Fassifern seams in CCL762 and ML1370, for a further 21 years;
- produce, handle and distribute to Eraring Power Station, up to 2 Mtpa using existing infrastructure;
- continue the use of ancillary infrastructure and services for a further 21 years;
- upgrade the water management system; and
- rehabilitate the surface facilities within 5 years of completion of mining.

Cardno (NSW) Pty Ltd trading as Cardno Ecology Lab has been commissioned by AECOM to undertake an assessment of impacts on estuarine aquatic ecology from the extension of mining at the Myuna Colliery.

The main issue to be considered in the assessment is the potential for subsidence of the lake bed from subsurface mining to affect estuarine ecosystems. Significant subsidence could destabilise aquatic vegetation and affect estuarine invertebrates that live in the upper layers of the lake bed sediments. Mining to date has not resulted in subsidence which has impacted the lake bed. This assessment includes:

- Background research: Compilation of existing information on the aquatic habitats, biota and fisheries of Lake Macquarie and database searches of threatened and protected species, populations and communities likely to occur within the study area;
- Site assessment: Field investigations of the current seagrass distribution and deeper un-vegetated soft sediments of the lake bed, for indications of subsidence within the proposed Project Application Area (Figure 1);
- Assessment of impacts, including cumulative impacts, of the proposed Project on estuarine habitats, threatened and protected species, populations and ecological communities; and
- Identification of mitigation and/or monitoring for potential impacts where appropriate.

Terms used throughout this report are defined below:

- **Development Consent Mining Area**: Shown in Figure 1 and includes the surface facilities area.
- **Project Application Area**: Encompasses ML 1370, a portion of CCL 762 and the Surface Facilities Area. It comprises an area external to the existing Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area) (Figure 1).

- **Study Area**: The Lake Macquarie estuary including the water area and foreshores.
- **Survey Area**: The area surveyed during the aquatic ecology assessment. This includes the Development Consent Mining Area and the Project Application Area.

The aquatic ecology assessment is based on predictions of two types of subsidence thresholds for different zones (A and B) within the Project Application Area as identified in Figure 1. The two types are:

- Mining Zone A – Long term stable mining systems generating < 20 millimetres of surface subsidence. Zone A includes all land above the High Water Level Subsidence Control Zone and seagrass beds; and
- Mining Zone B – Mining systems generating a maximum of 650 millimetres of surface subsidence. Zone B includes the area beyond the outer edge of seagrass beds and relates more to the levels of deformation that the overburden can tolerate to ensure a fracture connection is not made between Lake Macquarie and the underground workings.

These predictions are based on the subsidence assessment report (Seedsman Geotechnics, 2010). Mining operations will continue to be carried out using bord and pillar methods in the Wallarah, Great Northern and Fassifern coal seams, generally consistent with existing mining operations at Myuna Colliery.

2 Relevant Legislation and Policy

2.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act is administered by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) and aims to:

- Provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance (NES);
- Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources;
- Promote the conservation of biodiversity; and
- Provide for the protection and conservation of heritage.

In the aquatic environment, the Act lists the following matters of NES relevant to this study:

- Nationally threatened species and ecological communities; and
- Migratory species.

Threatened fauna and flora are listed in any one of the following categories as defined in Section 179 of the EPBC Act as*:*

- Extinct;
- Extinct in the wild;
- Critically endangered;
- Endangered;
- Vulnerable or;
- Conservation dependent.

Species listed as 'extinct' or 'conservation dependent' are not considered matters of NES (protected matters). Under the EPBC Act any action that has, will have, or is likely to have a significant impact on a matter of NES is required to undergo an assessment and approvals process. Matters of NES cover a range of issues including Ramsar wetlands and migratory species listed under international treaties such as the Australian agreements with Japan (JAMBA), China (CAMBA), Republic of Korea (ROKAMBA), and the Bonn Convention.

2.2 Environmental Planning and Assessment Act 1979 (EP&A Act)

The EP&A Act provides a framework for environmental planning in NSW and includes provisions to ensure that proposals with the potential to significantly affect the environment are subject to detailed assessment. The Act details various planning instruments including State Environmental Planning Policies and Local Environment Plans and specifies which types of developments require development consent.

The objectives of this Act include:

- The proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment;
- The protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats;
- Promoting ecologically sustainable development.

2.3 Threatened Species Conservation Act 1995 (TSC Act)

In NSW, the TSC Act, administered through the NSW Department of Environment and Climate Change and Water (DECCW) includes provisions to declare and protect threatened species,

populations and ecological communities. Species populations and communities identified as 'endangered' 'critically endangered' and 'vulnerable' are listed in Schedules 1, 1A and 2 of the TSC Act, respectively. The TSC Act also lists 'key threatening processes' that may threaten the survival of those species, populations and ecological communities. Marine birds, mammals and reptiles are included in schedules of the TSC Act. In addition, the TSC Act provides for the identification of habitat that is critical to the survival of an endangered species, population or ecological community.

2.4 Fisheries Management Act 1994 (FM Act)

Provisions for the protection of fish and marine plants are administered through the Department of Industry and Investment (I&I NSW) under the FM Act. Threatened species populations and communities identified as 'endangered' 'critically endangered' and 'vulnerable' are listed in Schedules 4, 4A and 5 of the FM Act, respectively. The FM Act also lists 'key threatening processes' that may threaten the survival of those species, populations and ecological communities. Part 2 (19) of the FM Act allows for the declaration of 'protected species', which, though not currently declining, must be protected so they do not become threatened in future. Provisions for the protection of aquatic habitats and aquatic reserves (administered by DECCW) are included under Part 7 of the FM Act. In addition, Division 3 Part 7A of the FM Act provides for the identification of habitat that is critical to the survival of an endangered species, population or ecological community.

2.5 National Parks and Wildlife Act 1974 (NPW Act) and the National Parks and Wildlife Regulation 2002 (NPWR).

Under the NPW Act, the Director-General of the National Parks and Wildlife Service is responsible for the care, control and management of all national parks, historic sites, nature reserves, reserves, Aboriginal areas and State game reserves. State conservation areas, karst conservation reserves and regional parks are also administered under the Act. The Director-General is also responsible under this legislation for the protection and care of native fauna and flora, and Aboriginal places and objects throughout NSW. The *National Parks and Wildlife Regulation* which came into effect on 1 September 2002, governs various activities under the *National Parks and Wildlife Act 1974*, including:

- The regulation of the use of national parks and other areas administered by the NPWS (Part 2);
- The preservation of public health in Kosciuszko National Park (Part 3);
- Licences and certificates (Part 4);
- The protection of fauna (Part 5) including the protection of certain types of marine mammals (Division 3A);
- The exemption of Aboriginal people from the restrictions imposed by various sections of the Act on the hunting of certain animals and the gathering of certain plants (Part 6);
- Boards of management and plans of management in relation to Aboriginal land (Part 7); and
- Advisory committees constituted under section 24 of the National Parks and Wildlife Act 1974 (Part 8).

2.6 Mining Act 1992 (Mining Act)

Primary regulatory control of mining is exercised by I&I NSW through the provisions of the Mining Act and the conditions attached to mining leases granted under the provisions of that Act. I&I's subsidence management policy and approvals process introduced in 2004 has the objective of improving the assessment, management and regulation of subsidence effects due to underground coal mining (NSW DPI 2006). The policy and approvals process requires mining operators to prepare a Subsidence Management Plan (SMP) to provide for the protection of important natural and built features.

2.7 Coastal Protection Act 1979

The objectives of this Act include:

- To protect, enhance, maintain and restore the environment of the coastal region, its associated ecosystems, ecological processes and biological diversity and its water quality;
- To encourage, promote and secure the orderly and balanced utilisation and conservation of the coastal region and its natural and man-made resources, having regard to the principles of ecologically sustainable development; and
- To recognise and foster the significant social and economic benefits to the State that result from a sustainable coastal environment, including:
    - Benefits to the environment; and
    - Benefits to urban communities, fisheries, industry and recreation.

2.8 NSW Policy for the Conservation of Fish, Marine Vegetation and Aquatic Habitats

The following general policies are identified in the 'Policy and Guidelines for Aquatic Habitat Management and Fish Conservation' (Smith and Pollard1999):

"a) Fish and their aquatic habitats are important natural resources, and impacts on these resources must be assessed, in all development and planning procedures, using a precautionary approach.

b) Aquatic habitats must be protected when the habitat is important to maintain biodiversity at the ecosystem, species or genetic levels or is required to maintain harvestable fish populations.

c) Habitats of protected or threatened fish must be afforded special protection.

d) Protected areas (such as Aquatic Reserves and Marine Parks) and critical fish habitats should be given priority consideration in the development of plans, in assessing the impacts of developments, and in determining applications.

e) Terrestrial areas adjoining freshwater, estuarine and coastal habitats should be carefully managed in order to minimise land-use impacts on these aquatic habitats. As a precautionary approach, foreshore buffer zones at least 50 metres wide should be established and maintained, with their natural features and vegetation preserved. Such buffer zones may need to be fenced or marked by signs. The width of these buffer zones may need to be increased to 100 metres or more where they are adjacent to ecologically sensitive areas.

f) Pollution of waterways should be avoided by:

- identification of point-source and diffuse pollutant discharges;
- prevention or minimisation of such discharges;
- effective treatment of any continuing discharges;
- disposal of wastes to alternative land sites, or to processing facilities.

g) Free passage should be maintained for migratory fish species. Unlicensed barriers should be removed or fish passage facilities installed.

h) Alien, exotic or introduced fish species should not be released into any waterway without the approval of NSW Fisheries.

i) Where developments or activities are likely to affect fish or fish habitats, NSW Fisheries needs to be provided with sufficient information to assess their impacts, including: contact details; type, purpose and time of activity; location (map and photographs);habitat type and area affected; monitoring and proposed environmental compensation.

j) Environmental compensation needs to be integrated into the planning process. Where, despite mitigation, a significant environmental impact is unavoidable, environmental compensation should be provided. This would normally require the creation of new habitat (of

the type lost) and on a 2:1 basis to account for the indirect as well as the direct impacts of development.

k) Degraded aquatic habitats should be rehabilitated, wherever possible, to repair past environmental damage.

l) Environmental monitoring is needed to determine if the assessment of the environmental impacts of a development were accurate. Monitoring needs to be undertaken in a scientifically rigorous manner, with impact and multiple control sites, surveys over time and statistical analyses. As a general rule, a change of 20 % in a biological indicator (e.g. abundance, richness, biomass) one year after the impact should be regarded as a major impact and require environmental compensation".

3 Existing Information

3.1 Regional Context

Lake Macquarie is located 15 kilometres south of Newcastle and 150 kilometres north of Sydney. It is the largest coastal lake in New South Wales, with an open water area of 115.1 square kilometres and a perimeter of 196.15 kilometres (OzCoasts 2010). The lake is surrounded by residential and industrial development including a Sewage Treatment Plant (West Wallsend) and power stations. Despite this, its overall condition is scored as 'very good' according to the NSW State of the Catchments Draft Technical Report (NSW Department of Planning 2008), this is based on seven indicators; Chlorophyll a and turbidity, area of macroalgae, seagrass and mangrove and the estuarine fish community index. The lake is also used for a wide range of recreational activities such as recreational fishing, boating, water-skiing and bathing. There are approximately 2149 berths for vessels and four ramps within the estuary (OzCoasts 2010). Many camping and caravan reserves provide holiday and semi-permanent accommodation for visitors to the area.

An environmental management plan has been development for the Lake Macquarie estuary (Syme *et al.* 1997) and identifies a number of issues which are being addressed. This includes measures to reduce high pollutant loads entering the estuary (including metal contaminants), erosion and sedimentation control, managing damage to seagrass beds from moorings and addressing declining recreational catch rates and conflict between excessive seagrass growth and navigation/recreational uses.

3.2 Physical Conditions

Lake Macquarie is a wave-dominated estuary, which means the estuary has a high sediment trapping efficiency, naturally low turbidity and salt wedge/partially mixed circulation where there is likely to be sedimentation. The total catchment area is 786 square kilometres (OzCoasts 2010) and falls under the jurisdiction of the Hunter-Central Rivers Catchment Management Authority (CMA). The estuary is 24 kilometres long, from north to south and 3.2 kilometres at its widest point from east to west.

The lake bed is generally flat, averaging 7 metres in depth but is deeper (approximately 11 metres) off Pulbah Island. Swansea Channel, a tidal inlet of approximately 4 kilometres in length, connects the lake to the ocean. Tidal ventilation through Swansea Channel is restricted - for a spring tidal range of 1.25 metres at the entrance, the associated range within the lake is approximately 0.06 metres. The mean lake level is typically super-elevated 0.07 metres above mean sea level. It has been estimated that only 1 % of the lake volume exchanges with ocean waters during an average tidal cycle (OzCoasts 2010).

The water quality within Lake Macquarie is affected by surface run-off and point source discharges. Water quality has been monitored in Lake Macquarie since 1983 by the Hunter Water Corporation. Results of this monitoring have been summarised by Syme *et al*. (1997) as part of the Lake Macquarie Estuary Management Study. Urban run-off was considered to be the largest influence to water quality as it contributed to a significant proportion of nutrient input and sediment nutrient release rate. Construction sites and urban development were also considered to contribute to large sediment loads, siltation and turbidity. Sewage, powerboat engines and sedimentation caused from erosion also contributed to decreased water quality.

Water temperatures within Lake Macquarie are typical of temperate NSW estuaries although the temperatures of embayments receiving discharges from the major power stations at the southern periphery have been shown to be higher than elsewhere in the estuary by 0.5 – 1.0°C (WBM 1996). Mean annual salinity is between 32 – 34 parts per thousand (ppt). Mean annual pH ranges between 8.1 and 8.4, typical of temperate estuarine water bodies. Dissolved oxygen (DO) levels are found to be typical at full saturation (WBM 1996).

3.3 Aquatic Vegetation

Aquatic vegetation, such as seagrasses, mangroves and saltmarsh are ecologically important components of aquatic ecosystems as they are highly productive, stabilise sediments and provide food and habitat for many species of fish and invertebrates of commercial significance (Bell and Pollard 1989; Larkum *et al.* 1989; Smith and Pollard 1999). For this reason, there are provisions under Part 7 of the FM Act for the protection of marine vegetation (including seagrass, mangroves and macroalgae) and it is an offence to remove or harm certain types of marine vegetation. A permit is generally required for this intent, although this is exempt under Part 3A (Section 75U) of the EP&A Act. Further information on these habitats is provided in the following Sections.

3.3.1 Seagrass

Seagrass beds often support a rich variety of animals and algae and act as sources of food (mainly indirectly via epiphytes and detritus) and shelter for numerous species (Keough and Jenkins 1995 in Creese *et al*. 2009). They also baffle water currents, causing them to release their sediment loads, thus maintaining water quality (Smith and Pollard 1999) and help prevent erosion by stabilising sediments and assisting in the removal of nutrients from the water (Smith *et al*.1997). Loss of seagrass can result in the destabilisation of sediments, removal of potential nursery habitats for fishes, and a decrease in primary productivity of estuaries. Depending on the species of seagrass, recovery of beds from disturbances can be slow. For all these reasons, seagrass beds are seen as critically important biogenic habitats in estuaries and consequently their distribution patterns and changes in their size over time have been documented as a means of monitoring the ecological health of estuaries (Williams *et al.* 2007, Roper *et al*. 2009).

In Lake Macquarie, the majority of the foreshore area is fringed by seagrass beds with four species occurring; eel grass (*Zostera capricorni*), paddle weed (*Halophila ovalis*), *Ruppia* sp. and strapweed (*Posidonia australis*) (Figure 3). *Zostera* is the most dominant of these within the estuary.

Seagrass communities have been surveyed in Lake Macquarie for over 50 years (Wood 1959; West *et al.* 1985; King and Hodgson 1986; King and Barclay 1986; Robinson 1987; Wellington 2002, The Ecology Lab 2003; 2007; 2008, Creese *et al*. 2009). Initial studies were part of a response to a decline in fish stocks (Wood 1959) reflecting a growing awareness of the importance of seagrass habitat to various commercial and recreational fish species. Since then seagrass monitoring in Lake Macquarie has been a continuation of surveys by fisheries management agencies (West *et al.* 1985, Creese *et al*. 2009) or related to the potential effects of power plant operations (e.g. thermal impacts) on seagrass beds (King and Hodgson 1986; King and Barclay 1986; Robinson 1987; Wellington 2002; The Ecology Lab 2003). The latest available seagrass maps for Lake Macquarie have been produced by Industry and Investment NSW (I&I) in response to targets set by the NSW Natural Resource Commission to improve the condition of estuaries and coastal lake ecosystems by 2015. These maps have been used as the basis for the current study (see Section 4).

Seagrass communities in Lake Macquarie appear to have declined since the earliest survey in 1953 (King and Barclay 1986). Wood (1959) estimated the area of seagrass at 25.48 square kilometres, whereas surveys conducted in the 1980s calculated the total areas to be 13.39 square kilometres (West *et al*. 1985) and 14.17 square kilometres (King and Barclay, 1986) respectively. Researchers attributed this decrease to a rise in turbidity caused by human activity (King and Hodgson 1986). However, from 2000–2004, there has been a general increase in the cover of seagrasses in Lake Macquarie, believed to be due to a reduction in light attenuation following a period of lower freshwater inputs. According to Creese *et al.* (2009) the total area of seagrass in Lake Macquarie was 15.311 square kilometres. This is the third largest estuarine seagrass area in NSW (OzCoasts 2010).

The overall degree of change in the distribution and extent of seagrass beds is difficult to assess as seagrasses exhibit a high degree of natural seasonal variation and there may also be

differences in sampling methodology during different surveys. King and Hodgson (1986) found that winter seagrass biomass is usually significantly greater than summer biomass therefore some surveys could relate to seasonal change rather than long term changes. Sampling programs should therefore be developed to account for seasonal variation. WBM (1996) and Australian Water and Coastal Studies (1995) identified a number of potential threats to seagrass within Lake Macquarie which included:

- Scouring from swing moorings;
- Physical damage from jetskis and boating;
- Smothering from high sedimentation;
- Nutrient enrichment;
- Haul netting;
- Thermal discharges; and
- Shading from foreshore development (e.g. pontoon, jetties etc.).

3.3.2 Mangrove

The term 'mangrove' is a description of an estuarine habitat but also refers to the trees that grow in these habitats. Mangrove trees are just like ordinary trees, with roots, stems and leaves, but they have adapted to live in saltwater. They live in soft muddy sediments in more sheltered areas. As mud is generally low in oxygen, the roots of the mangrove trees are quite shallow and close to surface oxygen. This also means that the root system must be extensive to prove a stable base for the tree (Chapman and Underwood 1995). Large numbers of mangrove trees often occur together and are described as mangrove forests.

Mangroves grow along the shores of most NSW estuaries, with the general exception of those that are intermittently opened and closed (West *et al.* 1985). Mangroves often occur seaward of saltmarshes and are subject to regular tidal inundation. As well as stabilising shorelines, mangroves are thought to contribute significantly to estuarine productivity, trap sediment and pollutants (Burchmore *et al*. 1993) and provide important nursery habitat for many species (Smith and Pollard 1999). NSW mangrove forests consist of only two species, river mangrove (*Aegiceras corniculatum*) and grey mangrove (*Avicennia marina*), although *A. marina* is most commonly found in Lake Macquarie. Mangroves are found in areas throughout Lake Macquarie with a significant area within Swansea channel. A total mangrove area of 1.130 square kilometres has been recorded within Lake Macquarie (Creese *et al.* 2009).

3.3.3 Saltmarsh

Saltmarshes are estuarine habitats that occur high on the shore, typically just above the mean high water mark. Saltmarshes are often found behind, or close to mangrove forests and occur in soft, water-logged sediments. Saltmarsh habitats consist of small succulent plants, grasses, rushes, sedges and herbaceous plants; including *Baumea juncea*, *Juncus krausii*, *Sarcocornia quinqueflora*, *Sporobolus virginicus* and *Suaeda australis* (Morrisey 1995). Like mangroves, saltmarshes are believed to have important physical and biological functions in estuarine ecosystems. Because of their close proximity to the land, saltmarshes are often threatened by human development. It has been estimated that 50 % of the saltmarshes of NSW have been destroyed since 1788 (Morrisey 1995). Estuarine saltmarsh found within Lake Macquarie consists of the herbs *Sarcocornia quinqueflora* ssp. *Quinqueflora* sp., *Einadia hastata*, *Salmolus repens* and *Suaeda australis* and the grasses *Zoysia macrantha* and *Sporobulus virginicus*. Creese *et al*. 2009 recorded a total saltmarsh area of 0.752 square kilometres in Lake Macquarie.

3.4 Benthic Assemblages

The most comprehensive study of the benthic invertebrate communities of Lake Macquarie was conducted by MacIntyre (1959) between 1953 and 1956 (AWACS 1995). 400 sampling sites within Lake Macquarie were analysed. MacIntyre divided the bed into three zones: seagrass

beds (occupying 23.5 % in 1956), mud slopes around the lake perimeter (16 %) and mud basins (60.5 %). A survey of fossil shell assemblages (Roy 1981) found that mussel and cockle shells were the dominant dead shell component of the muddy bed of Lake Macquarie.

The Ecology Lab (1991) undertook a study to describe the benthic communities in the vicinity of ash-dam discharge outlets in Lake Macquarie. Within this study, Lake Petite, was sampled as a control location. The most common taxa found were polychaetes (Opheliidae and Spionidae), along with dead bivalves (Tellinidae) and mud whelks (Batillariidae). The Ecology Lab (2008) also undertook a baseline survey of benthic assemblages using a ponar grab at Bardens Bay (north – eastern area of Lake Macquarie) where a total of 24 samples were collected. A relatively diverse assemblage of invertebrates were recorded, including 17 different families of polychaete worms (dominated by cirratulids, capitellids and magelonids), nine families of crustaceans including amphipods, tanaids, cumaceans, decapods and copepods and 14 families of gastropod and bivalve molluscs. The diversity and abundance of species found in these surveys would be fairly typical of that expected in a temperate NSW estuary.

3.5 Fisheries Resources

Approximately 232 species of fish have been recorded in Lake Macquarie (Lake Macquarie City Council 2006a) from various different surveys. Abundant fish populations were observed in the vicinity of seagrass beds during baselines investigations conducted near Bardens Bay (The Ecology Lab 2008). Species of fish observed included yellowfin bream (*Acanthopagrus australis*), luderick (*Girella tricuspidata*), whiting (*Sillago* sp.) and mullet (Family Mugilidae). Many small juveniles of these and other species were observed associated with the seagrass beds. Syngnathids (i.e. pipefish and seahorses) commonly occur within seagrass beds and may be permanent residents all year round whereas many fish species only spend a small part of their life-history, often juvenile stages within the shelter of the seagrass beds. Swansea channel (Figure 2) harbours a large number of different species of fish due to the diverse habitat it provides including weed beds, rocky reefs, soft substratum and artificial structure.

After many years of public discussion and consultation with various interest groups, commercial fishing ended in Lake Macquarie on 1 May 2002, with the lake being declared a Recreational Fishing Haven (Steffe *et al*. 2005). The commercial fishing annual catch in 2001 was approximately 300 tonnes.

Recreational fishing is improving as fish stocks respond to the removal of commercial fishing (Steffe *et al*. 2005) and the significant increase in water quality that has come from a concerted environmental program undertaken by the State government and Lake Macquarie Council (Office of the Lake Macquarie Catchment Coordinator 2009).

I&I NSW undertook two daytime recreational fishing surveys – one before the Recreational Fishing Haven zoning (pre-RFH) between March 1999 and February 2000 and one survey after (post-RFH) between December 2003 and November 2004 (Steffe *et al*. 2005). The two recreational fishing surveys provide evidence of a relatively productive recreational fishery in Lake Macquarie, indicated that that the post-RFH recreational fishery was very different to the fishery that had existed prior to the implementation of the RFH. The recreational harvest of dusky flathead (*Platycephalus fuscus*), tailor (*Pomatomus saltatrix*), sand whiting (*Sillago cilliata*), trumpeter whiting (*Sillago maculata*) and large-toothed flounder (*Pseudorhombus arsius*), by number and weight had increased significantly during the post-RFH survey year. The recreational harvest of common squid (*Loligo* sp.), yellow-finned leatherjacket (*Meuschenia trachylepis*) and sand mullet (*Myxus elongatus*), however, had decreased significantly during the post-RFH survey year by number and weight.

Recreational angling effort in Lake Macquarie was lower in winter and spring compared to that of summer and autumn and overall was greatest in the northern part of the lake where greater angling effort occurs from boats (Virgona 1983). As Lake Macquarie has little tidal movement, there are few places where fish naturally gather on the tides to feed (Ross 1995). For this reason the fast flowing Swansea Channel is a popular recreational fishing location (refer to Figure 2). The fish caught by recreational fishers in Lake Macquarie are similar to other

estuaries in NSW and are dominated by eight species (NSW DPI 2001). These are yellowfin bream (*Acanthopagrus auratus*) dusky flathead (*Platycephalus fuscus*), luderick (*Girella tricuspidata*), snapper (*Pagrus auratus*), tailor (*Pomatomus saltatrix*), tarwhine (*Rhabdosargus sarba*), whiting (Sillaginidae) and leatherjackets (Monacanthidae). The first four species have life-history stages generally dependent on estuaries for all their main ecological requirements, whereas the latter four species are dependent on estuarine habitats as juveniles only.

3.6 Threatened and Protected Species, Populations and Ecological Communities

3.6.1 Overview

There are provisions in both State and Commonwealth legislation to ensure that threatened species, populations and communities are considered in relation to proposed developments. The TSC Act), the EPBC Act and the FM Act, were consulted as required in both the Threatened Species Assessment Guidelines (DECC 2007) and the Draft Guidelines for Threatened Species Assessment (DECC 2005) for development applications assessed under Part 3A of EP&A Act.

For the FM Act, TSC Act and EPBC Act to have relevance there must be likelihood that one or more threatened species occur in or encroach upon the study area which could then be potentially impacted upon by the proposed Project.

3.6.2 Database Searches

Database records from I&I, the NSW National Parks and Wildlife Service 'Atlas of NSW Wildlife', 'Bionet' and the EPBC protected matters reporting tool were searched for threatened species, populations or endangered ecological communities identified as likely to occur in within the study area (Appendix 3). These records were accessed in May 2010 with the exception of the Bionet records that were accessed in 2008. Results of the database searches showed a total of 17 species of marine mammal, seven species of fish, 22 species of syngnathiforms (seahorses, seadragons, pipefish, pipehorses, ghost pipefishes and sea moths), five species of marine reptiles and 10 species of estuarine bird could *potentially* occur within the study area (Table 1).

From these searches, only species *known* to occur within the study area (i.e. for which there have been recorded sightings) were:

1. Marine mammals:
    - Dugong (*Dugong dugon*); and
    - Southern right whale (*Eubalaena australis*).
2. Fish:
    - Grey nurse shark (*Carcharias taurus*);
    - Estuary Cod (*Epinephelus coiodes*);
    - Eastern blue devil fish (*Paraplesiops bleekeri*)
    - Green sawfish (*Pristis zijstron*);
    - Australian grayling (*Prototroctes maraena*); and
    - Weedy seadragon (*Phyllopteryx taeniolatus*).
3. Marine reptiles:
    - Loggerhead turtle (*Caretta caretta*); and
    - Green turtle (*Chelonia mydas*).
4. Estuarine birds:
    - Great knot (*Calidris tenuirostris*);
    - Lesser sand plover (*Charadrius mongolus*);
    - Black-necked stork (*Ephippiorhyncus asiaticus*);
    - Sooty oystercatcher (*Haematopus fuliginosus*);

- Pied oystercatcher (*Haematopus longirostris*);
- Black bittern (*Ixobrychus flavicollis*);
- Painted snipe (*Rostratula benghalensis australis*);
- Terek sandpiper (*Xenus cinereus*).

The dugong (*Dugong dugon*) is listed as endangered under State legislation and is listed as migratory under the Commonwealth EPBC Act. The three recorded sightings of dugongs occurred in Swansea Channel and offshore. Dugongs are highly migratory, which means Australia shares populations with other neighbouring countries. In Australia, dugongs inhabit the warm shallow coastal waters of northern Australia from the QLD/NSW border in the east to Shark Bay on the WA coast, and are usually found in shallow waters protected from large waves and storms where they graze on seagrass meadows. Dugongs are subject to a range of human threats in Australia, including entanglement in nets, loss and degradation of important habitat such as seagrass meadows, and collisions with boats (also known as boat strikes).

The single record of the southern right whale (*Eubalaena australis*) was in offshore waters near Redhead and it is considered very unlikely for large cetaceans such as the southern right whale to occur within Lake Macquarie itself.

The grey nurse shark (*Carcharias taurus*), estuary cod (*Epinephelus coiodes*) and eastern blue devil fish (*Paraplesiops bleekeri*) mostly inhabit coastal waters with rocky reef habitats (beyond the estuary) and it would be unlikely that they would occur beyond Swansea Channel (Figure 2). If these species of fish did occur within the study area, it would be very unlikely that they would be adversely affected by impacts associated with the proposed Project.

The Australian grayling (*Prototroctes maraena*) is primarily a freshwater fish and highly unlikely to have a remaining population in this area of NSW.

The green sawfish is presumed extinct with the last recorded sighting in NSW from over 30 years ago from Yamba (northern NSW). The species is therefore very unlikely to occur within the study area.

Syngnathiforms (seahorses, seadragons, pipefish, pipehorses, ghost pipefishes and sea moths) are 'protected' under the FM Act. It is likely that seahorses and pipefish, including the weedy seadragon (Family Syngnathidae) occur in seagrass habitat throughout the study area.

The loggerhead turtle (*Caretta caretta*) has two recorded sightings within Lake Macquarie. Adult and large juvenile loggerhead turtles (> 70 centimetres carapace length) are known to forage in seagrass meadows and undertake reproductive migrations to subtropical beaches in southern QLD and WA from October and nest until February (DEWHA 2008a). The green turtle (*Chelonia mydas*) has 82 recorded sightings within Lake Macquarie. This species is typically found in tropical and subtropical waters of Australia (Great Barrier Reef, Gulf of Carpentaria and NW Shelf in WA), however, individuals do stray into temperate waters such as Lake Macquarie. Juvenile green turtles (30 – 40 centimetres carapace length) are known to feed in seagrass meadows and undertake reproductive migrations to subtropical beaches from October, and nest until March (DEWHA 2008b). Both of these turtle species take approximately 30 years to reach sexual maturity. All marine turtle species are experiencing serious threats to their survival. The main threats are pollution and changes to important turtle habitats, especially coral reefs, seagrass beds, mangrove forests and nesting beaches. Other threats include accidental drowning in fishing gear, over-harvesting of turtles and eggs and predation of eggs and hatchlings by foxes, feral pigs, dogs and goannas.

The estuarine birds listed above are generally wading birds that use their slender bills for probing intertidal soft sediments for aquatic invertebrates (e.g. crustaceans, molluscs and polychaete worms), small fish and vegetation. They are usually most active at low tide when this foraging area is exposed. Pied and sooty oystercatchers (*Haematopus longirostris* and *Haematopus fuliginosus)* occupy rocky shore and beach habitat, using their flattened bills to pry limpets from rocks and open bivalves (Pizzey and Knight 1997). The painted snipe (*Rostratula benghalensis australis*) tends to forage in shallow freshwater wetlands but has been recorded within the study area (two records). Over the last three decades, Australia has played an

important role in international efforts to conserve migratory birds of the East Asian - Australasian Flyway (the Flyway). This work includes bilateral migratory bird agreements, which provide a formal framework for cooperation between two countries relating to the conservation of migratory birds. Two pertinent agreements are the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA). The great knot (*Calidris tenuirostris*), lesser sand plover (*Charadrius mongolus*), painted snipe (*Rostratula benghalensis australis*) and terek sandpiper (*Xenus cinereus*), fall under these agreements. These agreements oblige the Australian government, as a signatory to these agreements, to undertake a range of actions on behalf of the species listed. These include the preservation and enhancement of important habitats, establishment of sanctuaries and other facilities for the protection and management of migratory birds and their habitats and preventing damage to migratory birds and their habitats.

Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions is considered an 'endangered ecological community' under an amendment to the TSC Act in 2004. Recent habitat maps of the study area indicate that coastal saltmarsh does occur within the study area, but has not been mapped within the Project Application Area, or in close proximity to these boundaries and has therefore not been considered further in the assessment (refer to Figure 2).

3.6.3 Assessments of Significance

Of the 18 species listed above that are 'known' to occur within the study area, for reasons described above, there are only 11 that have potential to be affected by the proposed Project. These are the dugong (*Dugon dugon*), the loggerhead turtle (*Caretta caretta*), the green turtle (*Chelonia mydas*) and the eight species of estuarine bird. Assessments of significance have been carried out for these species and are shown in Appendix 1 and 2. Under NSW legislation, the assessment of significance is a qualitative analysis of the likely impacts to help determine whether further assessment, by means of a species impact statement, is required.

For matters that are of NES, an assessment of significance is required according to EPBC Act 'significant impact guidelines 1.1' to determine whether the action proposed is likely to have a significant impact and whether a referral should be submitted to the Environment Minister. If a referral is made, the Minister makes a decision as to whether the proposal is a controlled action (i.e. subject to the assessment and approvals process under the EPBC Act).

Potential matters of NES relevant to this study include:

- Threatened species and ecological communities listed under the EPBC Act; and
- Migratory species protected under international agreements.

Results of the assessments are discussed in Section 5.3.4.

No Key Threatening Processes (KTPs) were identified that could occur, or be exacerbated as a result of the Project that could potentially affect a threatened species and were therefore not considered for further assessment.

3.7 Areas of Conservation Significance

3.7.1 State Conservation Areas

State Conservation Areas (SCAs) are reserved under the NP&W Act to protect and conserve areas that contain significant or representative ecosystems, landforms or natural phenomena or places of cultural significance, that are capable of providing opportunities for sustainable visitor use and enjoyment, the sustainable use of buildings and structures or research and that are capable of providing opportunities for uses permitted under other provisions of the Act.

The bushland and open space of Lake Macquarie State Conservation Area, established in 1996, lines 16 kilometres of foreshore in six different sections around the lake (DECCW 2008).

Lake Macquarie SCA supports a diverse assemblage of flora and fauna including over 400 species of native plants, some of which are endangered. The pied oystercatcher (*Haematopus longirostris*), which is listed as 'vulnerable' under the TSC Act is known to occur within the SCA. Point Wolstoncroft which is within the Project Application Area is part of the SCA.

3.7.2 Nature Reserves

Nature reserves are areas of predominantly untouched land in a natural condition and are considered to have high conservation value. Their primary purpose is to protect and conserve outstanding, unique or representative ecosystems, native plant and animal species or natural phenomena. Nature reserves are generally terrestrial, but may have associated marine components. Pulbah Island Nature Reserve protects some of the remaining natural bushland on Lake Macquarie. The island is popular for walking, fishing, swimming, boating, bird watching. Specific objectives for the Pulbah Island Nature Reserve (NR) (DECC 2009) include:

- Protection of visual and aesthetic values;
- Conservation of biodiversity, with emphasis on protection of significant
- Vegetation communities;
- Protection of the Aboriginal cultural values of the island; and
- Promotion of community involvement in the management of the NR.

Pulbah Island occurs outside though near the boundary of the Project Application Area (Figure 1).

3.7.3 Wetlands

Wetlands cover a wide range of habitats, including lakes, lagoons, estuaries, rivers, floodplains, swamps, bogs, billabongs, marshes and coral reefs. Wetlands can be fresh, brackish or saline and include seagrass beds, mangroves and saltmarshes as described in Section 3.3. Saline wetlands adjoin the lake or ocean and contain only saltwater and the main vegetation communities are mangrove and saltmarsh. Examples of these wetlands in Lake Macquarie are Swansea Bridge, Black Neds Bay, Five Islands, Stingaree Point and Galgabba Point. Freshwater wetlands are filled by creek and groundwater systems and support reed swamp and rushes. They are often surrounded by paperbarks, swamp mahogany and tea-tree. Examples of these wetlands are Jewells Swamp and parts of Belmont Lagoon. Brackish wetlands can change between salt and fresh water depending on the water flowing into the wetlands. They are usually surrounded by Swamp She-oaks and paperbarks. Examples of this type of wetland are Muddy Lake, Toronto Wetlands and wetlands around Cockle Creek (Lake Macquarie City Council 2006b and DEWHA 2010). No areas of saltmarsh or mangrove are known to occur within the Project Application Area.

3.8 Impacts of Underground Mining on Estuarine Ecosystems

The principal physical impact resulting from underground coal mining is subsidence i.e. lowering of the surface above areas that are mined (Booth *et al.* 1998, Holla and Barclay 2000). Subsidence caused by underground mining is the main cause of impacts to aquatic ecosystems (Cardno Ecology Lab 2009b).

Studies that have documented the effects of coal extraction on the aquatic biota of estuarine ecosystems are limited, but have been documented in a strategic review of impacts of potential underground mining in the Wyong Local government Area (NSW DoP 2008).

According to the review, a number of subsidence events have occurred in the Newcastle coalfield in the late 1980s and early 1990s, resulting in four incidents of unplanned inundation of the foreshores of Lake Macquarie and Lake Munmorah, to the south of Lake Macquarie. Subsidence beneath the lakes was since controlled by the use of 'bord and pillar' mining, partial pillar extraction and restricting the width of the longwall panels. Despite this, extraction beneath parts of Lake Munmorah and Budgewoi Lake (from 140 – 180 metres depth cover) has resulted in unplanned subsidence of up to 1 metre along sections of foreshore at Lake Munmorah (at Colongra Swamp on the Lake's western shore) and Buff Point (on the northern shore of

Budgewoi Lake). Duchatel (1998) reported on the effects of mine subsidence to the foreshores and freshwater wetland at Colongra (Lake Munmorah). Approximately four hectares of wetland foreshore was subsided by 900 millimetres allowing saline water to flow into the freshwater swamp behind the more elevated foreshore. Widespread mortality of plants and associated wildlife was predicted and management strategies to deal with the problem were recommended (Roberts 2000). The Colongra Swamp area has recently been listed as part of a Nature Reserve.

Subsidence has also occurred along the foreshore at Chain Valley Bay in Lake Macquarie, resulting in inundation of saltwater and the loss of riparian vegetation along the subsided shoreline (NSW DoP 2008).

The Tuggerah Lakes Estuary Process Study (Roberts 2000) identifies subsidence an as important issue affecting aquatic habitats, with particular reference to the potential effects on fringing wetland habitats such as seagrass beds. The main concern with regard to seagrass is the potential to alter the mean depth of seagrass habitat. Given that there is suitable substratum available, the depth limit and extension of seagrass beds, has been found to be constrained by light attenuation underwater (Duarte 1991) which decreases with depth. The depth limit of seagrass beds is not established as a sharp threshold, but involves the gradual decline in abundance from the depth where maximum biomass is observed to their depth limit. Increased depth (e.g. as a result of mining subsidence) is therefore considered to lead to a decrease in the distribution of seagrass and alter assemblages of benthic macroinvertebrates (Roberts 2000).

It is notable that the methods of mining employed at Myuna Colliery have been designed for minimal surface subsidence in order that:

- Surface structures (and sensitive habitats) are not damaged;
- Tidal waters do not encroach upon existing land surfaces; and
- Tidal waters do not inundate mine workings as a result of fracturing of the strata beneath the lake bed.

This has been achieved successfully at Myuna throughout the life of the mine over 28 years (Seedsman Geotechnics 2010).

4 Field Investigations

4.1 Methodology

4.1.1 Seagrass Mapping

During the development approvals process, it is important to know the distribution of aquatic vegetation due to their protected status under relevant legislation. Mapping of aquatic vegetation was based on geo-referenced, ortho-rectified aerial photographs and previous seagrass mapping of Lake Macquarie carried out by I&I NSW (Creese *et al*. 2008) to create a 'presumptive map' of seagrass distribution within the survey area (i.e. the Development Consent Mining Area and Project Application Area). The aim of the field investigation was to ground truth the presumptive map with a focus on determining:

- The outer edges of the seagrass beds,
- Species present; and
- Relative bed density in terms of percentage cover.

The field investigation was carried out by boat using a laptop connected to a hand held GPS unit and GIS software which enables real-time mapping. Mapping began in the northern half of the survey area, working south, following the contour of the outer edge of the seagrass beds as indicated on the presumptive map. The outer edge of the seagrass bed was then investigated by diver on snorkel to determine the actual point where the seagrass bed ended every 200 – 300 metres. In areas where visibility was good and surface conditions were calm, this was done from the boat using an underwater viewing tube. Species present and the relative density were noted at each ground truthing location. Where visibility was very poor or there was a large discrepancy between the presumptive map and our observations, a diver undertook a line transect from the shore to the edge of the seagrass bed using an underwater scooter. This allows the diver to cover large distances and conserve energy. The GPS position and observations made at each ground-truthing point were logged on the real-time mapper. The boundaries of seagrass beds on the presumptive map were later adjusted to accommodate the findings of field-based ground truthing.

Estimates of relative abundance of various seagrass species were made using two categories: low density (< 50 % cover), or high density (> 50 % cover). GPS coordinates were later plotted onto the aerial photograph using MapInfo Professional (version 10) and the boundaries of each vegetation type were drawn as mentioned above. The area of each vegetation type within the study area was calculated and recorded on a spreadsheet. In conjunction with the seagrass surveys, any fish observed were recorded.

4.1.2 Seabed Inspection

Deeper water habitats of the lake bed within the survey area were investigated by SCUBA divers. Two different sites as indicated on Figures 3 and 4 were surveyed. Note that these sites were outside the proposed Project Application Area, but are representative of the substratum within the Project Application Area. An area of approximately 25 square metres was surveyed at each site. Observations included searches for evidence of subsidence, evidence of and/or presence of benthic macroinvertebrates and macroalgae and the nature of the substratum.

4.2 Results

Field investigations took place on the 11 – 12 May 2010. Weather conditions during field investigations were fair with a light – moderate wind from the northwest/west, with winds tending to be stronger in the morning. Conditions in the preceding weeks had been dry with very little rain (Bureau of Meteorology 2010). Visibility beneath the surface ranged between 1.0 – 3.5 metres. Tides over the sampling period were low (0.56 metres) at 12:14 am and high (1.35

metres) at 6:06 am on 11.May 2010 and low (0.46 metres) at 12:59 am and high (1.34 metres) at 6:51 am on 12.May 2010.

4.2.1 Seagrass Mapping

In general, the outer extent of seagrass beds appeared to be limited to within a depth contour of around three metres. Rarely did beds extend beyond this limit. Three species were observed within the survey area: eel grass (*Zostera capricorni*), paddle weed (*Halophila ovalis*) and strap weed (*Posidonia australis*). For the purpose of mapping relevant to the scale of the investigation, seagrass habitat was classified using the following six categories:

- High density (> 50 % cover) *Zostera;*
- Low density (< 50 % cover) *Zostera;*
- High density (> 50 % cover) *Zostera*/*H. Ovalis;*
- Low density (< 50 % cover) *Zostera*/*H. Ovalis;*
- High density (> 50 % cover) *H. Ovalis; and*
- High density (> 50 % cover) *P. australis*/ *Zostera.*

High density *Zostera* (Plate 1a) was the dominant seagrass habitat type throughout the survey, with a total area of 235.9 hectares recorded (Figure 3). The seagrass habitat comprised of high density *Zostera* and *H. ovalis* was the second largest habitat observed (22.5 hectares), followed by low density *Zostera* and *H.ovalis* (10.7 hectares)(Plate 2a). All other seagrass habitat types covered an area less than 10 hectares.

The northern half of the survey area (Figure 4) was dominated by high density *Zostera* which occurred in a narrow strip from Fishermans Point in the north to the eastern point of Wangi Wangi. High density *Zostera* and *P. australis* was also present on east facing inlets of Wangi Wangi (total area 1.7 hectares)(Plate 2b). A single continuous bed of low density *Zostera* and *H. ovalis* occurred within Myuna Bay with a narrow fringe of dense *H. ovalis* occurring at the outer edge of this bed. Seagrass on the southern shore of Wangi Wangi was notably sparse compared to foreshores elsewhere, with some fragmented patches of low density *Zostera* and *H. ovalis* and one bed of low density *Zostera* (Figure1).

A large bed of dense *Zostera* occurred on the eastern foreshore of the survey area near Swansea, where there is a shallow shoal just south of Swansea Channel.

The southern half of the survey area (Figure 5) was again dominated by a narrow fringe of high and low density *Zostera* with the exception of Cams Point where there both of *Zostera* and *H. ovalis* were present. A fringe of high density *Zostera* was present on Pulbah Island, but not on the southern foreshore, outside the Project Application Area. Between the large bed of high density *Zostera* (near Swansea channel) and Cams Point, there is a fragmented strip of low density *Zostera*. Defining the outer edge of this bed was difficult due to the poor visibility (from the northwesterly windchop) and because of the irregularity of the outer edge. A relatively continuous bed of high and low density *Zostera* was mapped between Diamond Drill Point and Summerland Point. The entire foreshore around the Morisset Peninsula consisted of a relatively continuous fringe of high density *Zostera*.

Results indicated that the boundaries of seagrass beds observed during the field investigations were generally very similar to presumptive maps based on I&I NSW (Creese *et al.* 2008), with a few notable differences. For example, the presumptive map indicated an area of *Zostera* between Summerland Point and Pelican Rock in the southern half of the survey area, although on inspection, this consisted only of low relief reef and mussel beds (Figure 6). Similarly, an area of *P. australis* was observed at the eastern tip of Wangi Wangi which had not been mapped previously. This highlights the need for verification by ground-truthing.

Yellowfin bream (*Acanthopagrus australis*), luderick (*Girella tricuspidata*) and whiting (*Sillago* sp.) were observed among seagrass beds within the survey area. Many small juveniles of these and other species were also observed in association with seagrass beds. Pipefish, seahorses and other small cryptic species commonly occur within seagrass beds and are often attached to algae, however no such species were observed during the survey, as they are usually cryptic.

4.2.2 Seabed Inspection

Seabed inspections took place at two locations within the northern half of the survey area on 12 May 2010 to a depth of eight metres (Figures 3 and 4). Site one was located approximately 1 kilometre north of Morisset Peninsula and Site two just north of the northernmost point of Pulbah Island. Both sites were within the extent of previous Myuna workings (December 2009) as indicated on Figures 1 and 4. The nature of the seabed at both Sites consisted of the same fine, dark, soft silt, which was greater than 30 centimetres deep (Plate 3a and 3b). The surface of the substratum was relatively flat and bioturbated in places, which indicated the presence of burrowing marine invertebrates such as crabs and polychaetes worms (Plate 3a). No macroalgae or marine invertebrates were observed on the surface of the substratum at either Site. There were no deepened or uneven surfaces within the 25 square metre areas inspected at either site that could be indicative of subsidence. Given the nature of the very fine, soft sediment type any subtle differences in the seabed that could indicate evidence of subsidence would be difficult to detect.

4.2.3 Other Habitats

Subtidal rocky reef habitat was observed within the survey area and mostly occurred at exposed rocky headlands, for example, at Summerland Point (Figure 6). Subtidal rocky reef habitat occurred within and adjacent to seagrass beds as shown in Plate 1a and was often dominated by mussel beds. No areas of mangrove or saltmarsh habitat were observed within the survey area or within the Project Application Area during the field investigations.

5 Assessment of Impacts

5.1 Description of Proposal

The Project will extend mining at Myuna Colliery within the Project Application Area, comprising an area external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area) but within the boundaries of CCL 762 and ML 1370.

The Project Application Area encompasses the coal measures and three seams previously mined at Myuna Colliery and as such include some existing workings and areas requiring new workings to be developed. Access to new areas will be from the existing workings.

The Project's mining operations will continue to be carried out using bord and pillar methods in the Wallarah, Great Northern and Fassifern coal seams generally consistent with the manner in which CMPL undertakes current mining operations at Myuna Colliery. The mining layout to be implemented within the three seams in any given area of the Project Application Area will be determined during detailed mine planning and development of a geotechnically engineered mine design. The mine design will address the various mine constraints, including (at least) the High Water Level Subsidence Control Zone; the 40 metres of solid rock head and the coal pillar factor of safety. For any areas where secondary extraction is proposed to be undertaken, CMPL will seek approval from I&I.

Further, all existing infrastructure and services at the Surface Facilities Area will be utilised to service the Project.

Mining within the Project Application Area will be designed to remain below two levels of subsidence as shown conceptually on Figure 1. The two zones include:

- Zone A – Long term stable mining systems generating < 20 millimetres of surface subsidence (i.e. no noticeable surface impact); and
- Zone B – Mining systems generating a maximum of 650 millimetres of surface subsidence.

A conceptual mine plan has been developed for the Project based on environmental sensitivity of the surface as shown in Figure 1. Zone A level of negligible subsidence is proposed under sensitive areas such as residential areas, State Conservation Areas, foreshore areas and seagrass beds. Zone B level of subsidence is proposed under the less sensitive areas of Lake Macquarie.

The aquatic ecology assessment is based on subsidence predictions for Mining Zones A and B within the Project Application Area as identified in Figure 1.

5.2 Physical Impacts Associated with Mine Subsidence

As described in Section 3.8 the principal physical impact resulting from underground coal mining is subsidence i.e. lowering of the surface above areas that are mined (Booth *et al*. 1998, Holla and Barclay 2000). Mining under tidal watercourses can result in a number of potential impacts which are discussed in the following Sections. The extent of any such impacts are, however, dependent on mine design, geological conditions, surface topography and the distance between the mine workings and the surface, which in turn, will limit the magnitude and nature of subsidence.

5.3 Impacts to Aquatic Habitats and Biota

5.3.1 Seagrass Beds

Field investigations carried out as part of this study (Figures 3-5) and previous habitat mapping carried out within Lake Macquarie (Creese *et al*. 2009) show that seagrass beds fringe the majority of the foreshore within the survey area and Project Application Area. The outer extent

of seagrass beds within the survey area was considered to be mainly constrained by the depth to which sufficient light can penetrate the water column. Consequently, deepening of the Lake bed as a result of subsidence could reduce the area of existing seagrass habitat. The severity of the potential impact would depend on the size of the area affected, which, in turn would be dependent on the topography of the seabed at the point of subsidence. Impacts are likely to be greater for areas of gradually sloping flat seabed or shoal (e.g. south of Swansea Channel) rather than on steeply sloping areas where there is a narrow fringe of seagrass.

Where there is potential for subsidence at the margin of seagrass beds, or within them, slumping of sediments could cause destabilisation of plants in surrounding areas and the area of seagrass affected would be larger than the immediate area subsided. Furthermore, there would be little compensatory growth landward of where subsidence occurs as much of the shoreline inshore of existing seagrass beds would be unsuitable for seagrass growth.

Seagrasses are important nursery grounds for fish and sources of food and shelter for other fish and invertebrates (Section 3.3.1). Loss of seagrass is therefore likely to have indirect effects on those organisms that utilise seagrass habitat, which include some threatened and protected species. Seagrasses are also important for nutrient cycling and trapping sediments and pollutants. Isolated and even relatively small losses to seagrass could result in fragmentation and affect the connectivity between seagrass beds.

Based on subsidence levels of < 20 millimetres for Mining Zone A, impacts to seagrass beds could result in a minor reduction in seagrass area within the Project Application Area, although more subtle morphological and photo-adaptive changes such as reduced biomass, decreased productivity and longer shoot lengths (e.g. Abal *et al*. 1994) at the outer edges are more likely. Obvious and observable impacts to seagrass habitat would be unlikely unless impacts were very widespread throughout the Project Application Area. Any localised impacts of subsidence are likely to be negligible.

Given that much of the existing land-use that surrounds Lake Macquarie is urbanised and industrial, any increases in nutrient levels, sedimentation or pollutants as a result of minor seagrass loss would be virtually impossible to detect against background levels. Any cumulative impacts to water quality as a result of the proposal would be negligible.

Subsidence levels < 650 millimetres (Mining Zone B) could potentially affect seagrass habitat in adjacent Mining Zone A. The outer edge of the seagrass beds represents the boundary between Zone A and Zone B. If subsidence of up to 650 millimetres occurred in Zone B directly adjacent to where there are seagrass beds, then subsidence could still affect seagrass in Zone A as there would be a transitional area where subsidence would be less than 650 millimetres, but potentially greater than 20 millimetres. The consequence of this could be increased depth and subsequent loss of seagrass at the outer edges of Zone A, although the extent of this would again depend on the topography of the seabed as described earlier in this Section. An angle of draw of 26.5° will be established during mining to transition between Mining Zones A and B to limit subsidence to a maximum of 20 millimetres at the boundary of Zone A. Results of the Subsidence Report (Seedsman Geotechnics 2010) indicate that this angle of draw would result in maximum tilts and strains at the boundary of Zone A of 7 millimetres per metre. Measures to address this issue are discussed in Section 6.

5.3.2 Benthic Assemblages

The average depth of Lake Macquarie is 7 metres. The lake bed is relatively flat and in the deeper areas surveyed as part of this study it consisted of fine, dark, soft silt. Previous studies indicate that similar sediment composition would be expected throughout the deeper parts of the estuary with mud slopes and seagrass beds occupying the shallower perimeter. The diversity and abundance of species found in previous surveys by the Ecology Lab was typical of that expected in a temperate NSW estuary and included polychaete worms, crustaceans and molluscs. Localised subsidence of up to 650 millimetres predicted for Mining Zone B (beyond the outer edge of the mapped seagrass beds) would be likely to result in an alteration in species composition due to depth changes. Serious detrimental impacts on benthic soft sediment

assemblages within the Project Application Area would be unlikely. Given the large area of similar habitat within Lake Macquarie, any localised changes to soft sediment assemblages as a result of subsidence would have minimal environmental impact.

Other habitats present within the survey area included low relief subtidal rocky reef, with mussel beds and macroalgae e.g. *Sargassum* sp. that occurs off exposed headlands and was occasionally interspersed with seagrass beds. These habitats would occur within Zone A where subsidence is predicted not to exceed 20 millimetres. It is unlikely that species assemblages associated with this habitat would be lost as a result of the increase in depth, however, it is possible that species composition of these assemblages could be altered, whereby species adapted for deeper water outcompete other species. This would be unlikely to result in any detectable impact within the Project Application Area.

5.3.3 Fisheries Resources

Fish would not be directly impacted by the proposed Project. The extensive seagrass beds within Lake Macquarie do, however, provide an important nursery habitat for many species of economically important fish including yellowfin bream (*Acanthopagrus auratus*), luderick (*Girella tricuspidata*), whiting (*Sillago* sp.) and mullet (Mugilidae). Subsidence that results in a reduction in the area of seagrass beds within the Project Application Area could have an indirect impact on juvenile fish (and crustaceans) which utilise seagrass habitat by limiting the resource available. However, given that subsidence in Mining Zone A does not exceed 20 millimetres and impacts to seagrass in Zone A would be negligible, no impacts to fisheries resources are expected within the Project Application Area. Furthermore an increase in water depth due to subsidence of up to 650 millimetres within Zone B is not likely to have any direct impacts on fisheries resources within the Project Application Area.

5.3.4 Threatened and Protected Species, Populations and Ecological Communities

Assessments of Significance (State Legislation)

Assessments of significance were undertaken for the following species known to occur within the study area that have potential to be affected by the proposal:

- Dugong (*Dugong dugon*);
- Loggerhead turtle (*Caretta caretta*);
- Green turtle (*Chelonia mydas*); and
- Estuarine birds (assessed as a group).

Results of the assessments are given in Appendix 1. The dugong (*Dugong dugon*), green turtle (*Chelonia mydas*) and loggerhead turtle (*Caretta caretta*) have all been recorded in Lake Macquarie and are known to feed on, or forage within seagrass habitat. Any potential reduction in seagrass has the potential to affect these species. However, given that dugongs rarely occur within Lake Macquarie (there are only two records of the species occurring within Swansea Channel and not within the Project Application Area), the proposed Project is not considered to affect a viable population. Any individual dugongs that could occur as far south as Lake Macquarie are likely to be vagrants and not part of a resident population.

Marine turtles, particularly green turtles (*Chelonia mydas*) are not uncommon within Lake Macquarie and are likely to feed on seagrass within the Project Application Area. Loggerhead turtles (*Caretta caretta*) do not feed on seagrass but forage within seagrass habitat for other prey species.

This area of habitat is not, however, critical to the species survival and any potential impacts on seagrass habitat would not limit the availability of seagrass as a food source for these species.

There are eight species of estuarine bird that have been recorded within the study area that could potentially be affected by alteration of habitat as a result of subsidence related to the proposal. The predicted level of subsidence (< 20 millimetres) in foreshore areas is not,

however, considered likely to have an effect on the habitat utilised by these species, such that it would cause any observable alteration to their behaviour or habitat requirements.

The proposal is not, therefore, considered to affect any of these species such that a species impact statement is recommended.

Assessment of Significance (Commonwealth Legislation)

The dugong (*Dugong dugon*) is also listed under the EPBC Act as 'migratory' and the loggerhead turtle (*Caretta caretta*) listed as both 'migratory' and 'endangered'. Five species of estuarine bird are also listed under the EPBC Act and international agreements for the protection of migratory birds. As these species are matters of NES an assessment of significance was undertaken according to EPBC Act 'significant impact guidelines 1.1'. Results of the assessments are given in Appendix 2. Based on this assessment the proposed Project is considered unlikely to have a significant impact on matters of NES.

Although it is unlikely that significant impacts upon matters of NES will occur as a result of the proposed Project, a referral to the Federal Minister will be made in accordance with the requirements of the EPBC Act for a determination as to whether the proposed Project is a controlled action.

Other Listed and Protected Species

Seahorses, pipefish and sea dragons (Syngnathidae) are 'listed' under the EPBC Act and 'protected' under the FM Act and although these species are not subject to assessments of significance, they require consideration in relation to the proposed Project. Seahorses and pipefish occur in seagrass beds (Kuiter 2000) and could therefore be indirectly affected as a result of any impact to seagrass habitat. No protected species were observed within the Project Application Area during the site inspection. It is unlikely that the potential minor impacts to seagrass described in Section 5.3.1 would affect populations of these species as there would be extensive seagrass and soft sediment habitats for these species to assimilate into if there were any minor alteration of immediate habitat.

5.3.5 Areas of Conservation Significance

Point Wolstoncroft is part of the Lake Macquarie State Conservation Area (SCA) and occurs within the Project Application Area. The Pulbah Island Nature Reserve occurs outside though adjacent to the boundary of the Project Application Area (Figure 1). The values of these conservation areas mostly relate to terrestrial habitats although the recreational fishing value of these areas is important to their amenity. As described in Section 5.4.3 the proposal is not considered to have a notable impact on fisheries resources and therefore potential impacts on areas of conservation significance (in terms of aquatic ecology) are very unlikely and have not been considered further in this assessment.

As described in Section 3.9 there have been documented events where unplanned subsidence of up to 1 metre has occurred in parts of Lake Munmorah, Budgewoi Lake and Lake Macquarie resulting in the inundation of foreshores by salt water and loss of riparian vegetation. These events occurred over 10 years ago and there has been no reported incidence that has affected riparian and/or foreshore habitat since. No such impacts have occurred at Myuna Colliery over the 28 years of operation (Seedsman Geotechnics 2010).

Mangrove and saltmarsh habitat (Section 3.3) was not mapped during field studies undertaken for this report, however, the most recent vegetation maps (Creese *et al.* 2008) indicate that neither of these habitats occur within the Development Consent Mining Area, Project Application Area or within close proximity to the boundary of these areas (Figure 2). Even if these habitats were found to occur within or in proximity to the Development Consent Mining Area and Project Application Area, the predicted level of subsidence within Mining Zone Type 'A' (which would encompass the intertidal area to the outer edge of the mapped seagrass habitat) would be unlikely to substantially affect these generally salt tolerant species. The proposed Project is therefore not considered to impact upon existing areas of estuarine wetland.

6 Mitigation Measures

The outer (seaward) boundary of seagrass beds as mapped in this study would represent the outer boundary of Mining Zone A (subsidence < 20 millimetres). Mining would be undertaken with an angle of draw of 26.5^{o} at the transition between Mining Zone A and B to limit subsidence at the boundary of Mining Zone A to a maximum of 20 millimetres. In order to mitigate potential surface impacts from subsidence as predicted in Mining Zone B (< 650 millimetres), affecting seagrass habitat in Mining Zone A, a Seagrass Management Zone would be established within Zone B. The purpose of the Seagrass Management Area would be to delineate the area where future seagrass monitoring may be required should secondary mine workings take place in mining Zone B that could affect seagrasses.

As seagrass distribution is strongly influenced by depth and does not occur in water greater than 5 metres (within the Project Application Area), the extent of the Seagrass Management Area would include the area from the edge of the existing seagrass beds out to the five metre contour over the majority of the Project Application Area. Where seagrass beds occur at the edge of the five metre contour the Seagrass Management Area extends out to approximately the six metre depth contour to allow a sufficient buffer. Figure 7 indicates the full extent of the Seagrass Management Area as described.

A Seagrass Management Plan would be prepared in which the aims, triggers and required outcomes of the future seagrass surveys would be outlined. The need for monitoring surveys would be determined by a risk based approach and targeted towards the locations where secondary workings are planned. Any seagrass monitoring surveys carried out would verify the lake-ward edges of seagrass beds and include observations before, during and after mining activity to determine if there has been any discernable effects that might warrant more detailed quantitative field investigations.

7 Acknowledgements

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9 Tables

Table 1: Threatened species, populations and ecological communities known or predicted to occur in the study area.

Table 1: Species known or predicted to occur in the study area as listed under the NSW *Fisheries Management Act 1994* (FM Act), the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). PE = presumed extinct, CE = critically endangered, E = endangered, V = vulnerable, CD = Conservation Dependant, M = migratory, L = listed, Cet = cetacean and P = protected. Source: NSW threatened species database and the EPBC Database environmental reporting tool (accessed May 2010).

Scheduled Species	Common Name	Status under TSC/FM Act	Status under EPBC Act
1. Marine Mammals:			
Cetaceans			
Balaenoptera acutorostrata	Dwarf minke whale	P	Cet
Balaenoptera musculus	Blue whale	E	Cet, E, M
Balaenoptera edeni	Bryde's whale	P	Cet, M
Caperea marginata	Pygmy right whale	P	Cet, M
Delphinus delphis	Common dolphin	P	Cet
Dugong dugon	Dugong	E	Cet, M
Eubalaena australis	Southern right whale	V	Cet, E, M
Grampus griseus	Risso's dolphin	P	Cet
Lagenorrhycus obscurus	Dusky dolphin		Cet, M
Megaptera novaeangliae	Humpback whale	V	Cet, V, M
Orcinus orca	Killer whale		Cet, M
Physeter macrocephalus	Sperm whale	V	Cet, M
Stenella attenuata	Spotted dolphin	P	Cet
Tursiops aduncus	Long-beaked bottle nosed dolp	P	Cet, M
Tursiops truncatus	Bottlenose dolphin	P	Cet
Arctocephalus pusillus doriferus	Australian fur-seal	V	L
Arctocephalus forsteri	New Zealand fur-seal	V	L
2. Fish			
Carcharodon carcharias	Great white shark	V	V, M
Carcharias taurus (East Coast)	Grey nurse shark	CE	CE
Epinephelus coioides	Estuary cod	P	
Paraplesiops bleekeri	Eastern blue devil fish	P	
Pristis zijsron	Green sawfish	PE	
Prototroctes maraena	Australian grayling	P	
Rhincodon typus	Whale shark		M, V
Acentronura tentaculata	Hairy pygmy pipehorse	P	L
Festucalex cinctus	Girdled pipefish	P	L
Filicampus tigris	Tiger pipefish	P	L
Heraldia nocturna	Upside-down pipefish	P	L
Hippichthys penicillus	Beady pipefish	P	L
Hippocampus abdominalis	Eastern potbelly seahorse	P	L
Hippocampus whitei	White's seahorse	P	L
Histiogamphelus briggsii	Briggs' crested pipefish	P	L
Lissocampus runa	Javelin pipefish	P	L
Maroubra perserrata	Sawtooth pipefish	P	L
Notiocampus ruber	Red pipefish	P	L
Phyllopteryx taeniolatus	Weedy seadragon	P	L
Solegnathus spinosissimus	Spiny pipehorse	P	L

Continued

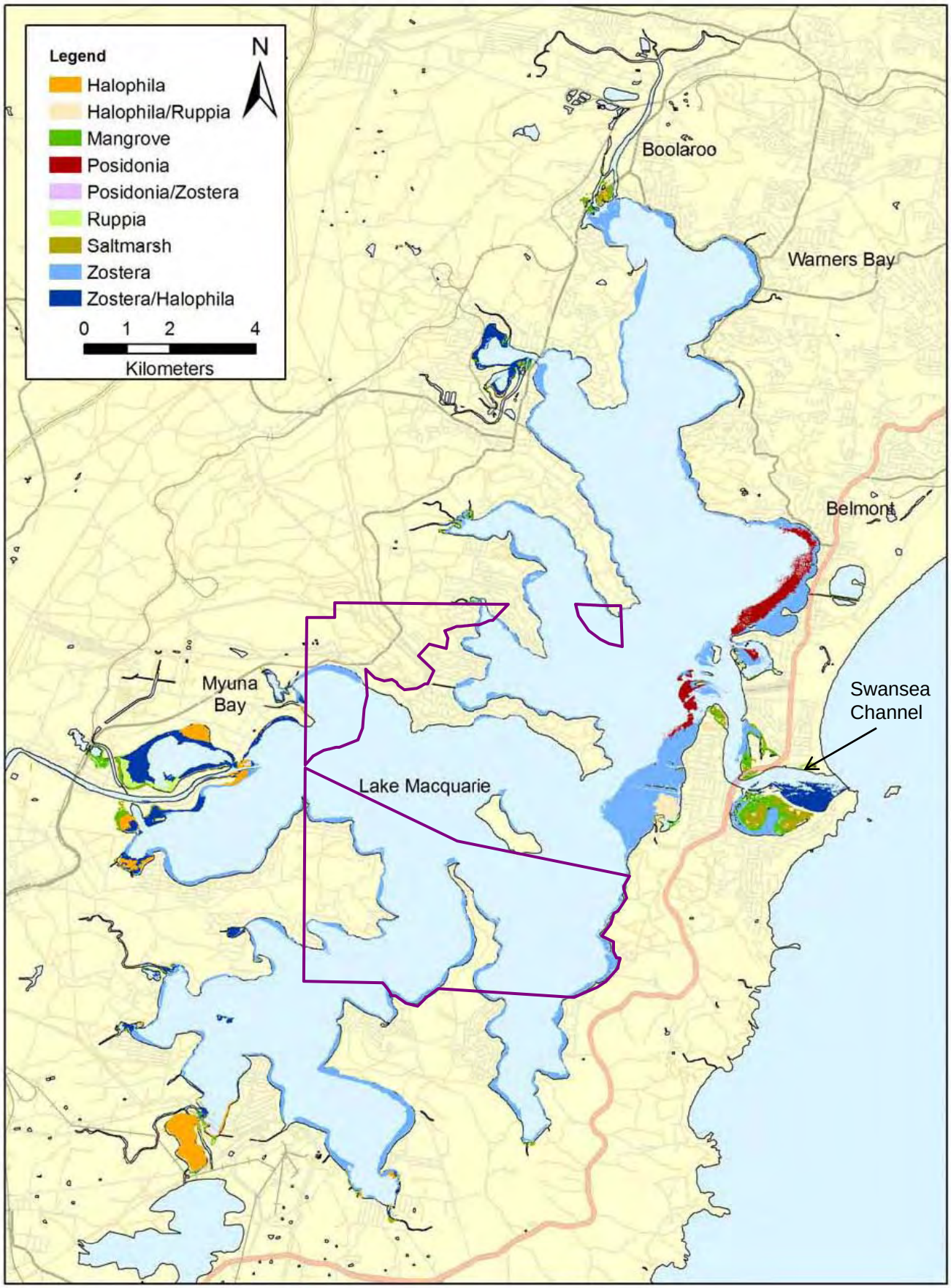
Table 1: Continued.

Scheduled Species	Common Name	Status under TSC/FM Act	Status under EPBC Act
2. Fish Continued.			
Solenostomus cyanopterus	Blue-finned ghost pipefish	P	L
Solenostomus paegnius	Rough-snout ghost pipefsh	P	L
Solenostomus paradoxus	Harlequin Ghost pipefish	P	L
Stigmatopora argus	Spotted pipefish	P	L
Stigmatopora nigra	Wide-bodied pipefish	P	L
Syngnathoides biaculeatus	Double-ended pipehorse	P	L
Trachyrhamphus bicoarctatus	Short-tailed pipefish	P	L
Urocampus carinirostris	Hairy pipefish	P	L
Vanacampus margaritifer	Mother-of-pearl pipefish	P	L
3. Marine Reptiles			
Caretta caretta	Loggerhead turtle	E	E,M
Chelonia mydas	Green turtle	V	
Dermochelys coriacea	Leatherback turtle	V	E, M
Natator depressus	Flatback turtle	P	V, M
Pelamis platurus	Yellow-bellied seasnake		L
4. Estuarine Birds			
Calidris tenuirostris	Great knot	V	L, M
Charadrius leschenaultii	Greater sand plover	V	M
Charadrius mongolus	Lesser sand plover	V	M
Ephippiorhyncus asiaticus	Black-necked stork	E	L
Haematopus fuliginosus	Sooty oystercatcher	V	
Haematopus longirostris	Pied oystercatcher	V	
Ixobrychus flavicollis	Black bittern	V	
Rostratula benghalensis australi	Painted snipe	E	V
Xenus cinereus	Terek sandpiper	V	L, M
5. Endangered Ecological Communities			
Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East corner bioregions			

10 Figures

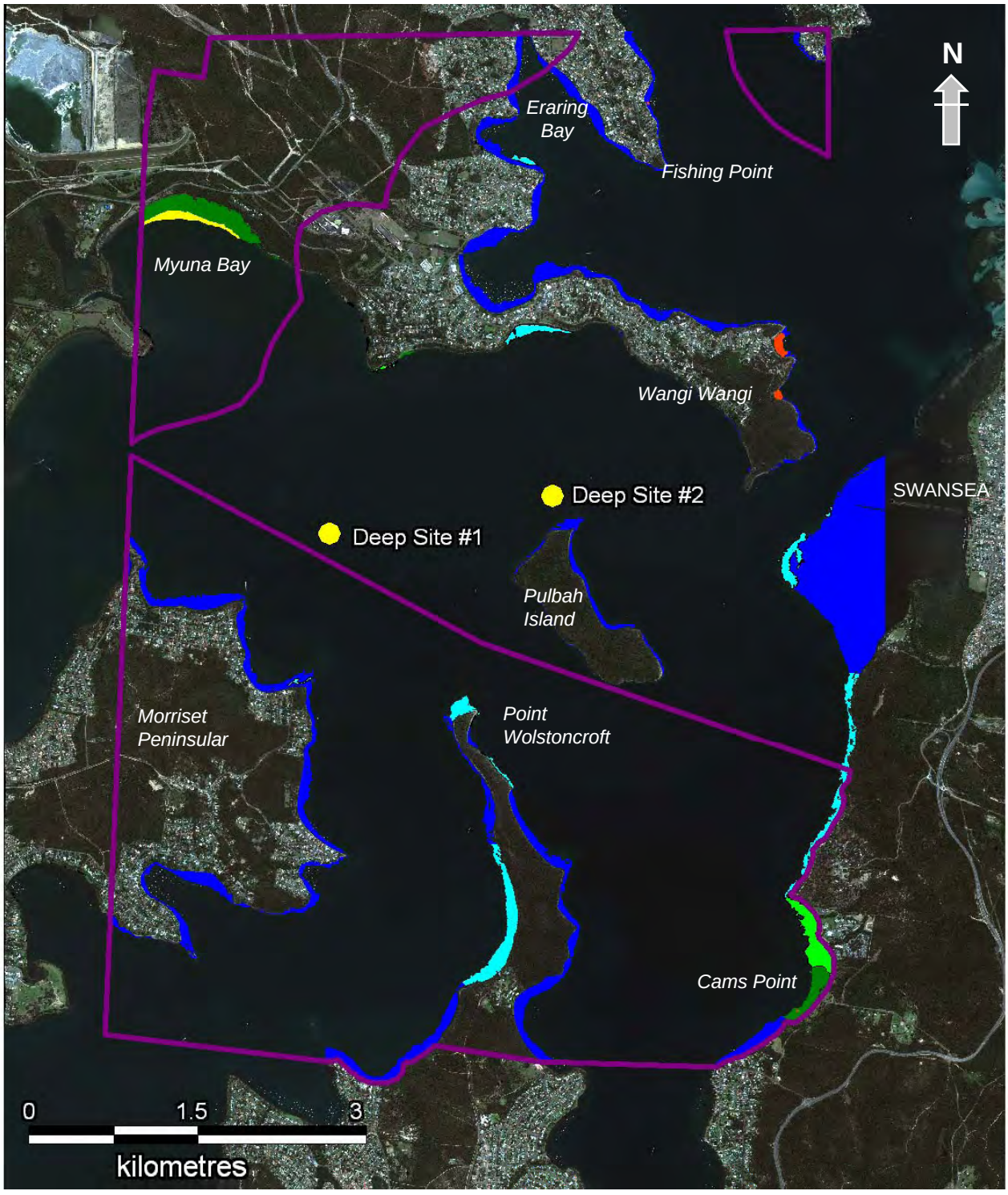
Source: AECOM

Figure 1: Myuna Colliery Conceptual Mining Zones. State Conservation Areas (SCAs) are outlined in green.



Source: Creese *et al.* (2008)

Figure 2: Marine habitat maps of the study area. Purple line indicates the Project Application Area boundary (indicative only).



Source: AECOM

KEY

- High density *Zostera*
- Low density *Zostera*
- High density *Zostera & H.ovalis*
- Low density *Zostera & H. ovalis*
- High density *Zostera & P. australis*
- High density *H. ovalis*
- Project Application Area
- Dive Sites

Figure 3: Overview of habitats mapped in the seagrass survey area, Lake Macquarie. .

KEY

Source: AECOM

- High density *Zostera*
- High density *Zostera & H.ovalis*
- High density *Zostera & P. australis*
- Project Application Area
- *Low density Zostera*
- Low density *Zostera & H. ovalis*
- High density *H. ovalis*
- Dive Sites

Figure 4: Detailed view of habitats and dive sites investigated in the northern half of the seagrass survey area, Lake Macquarie.

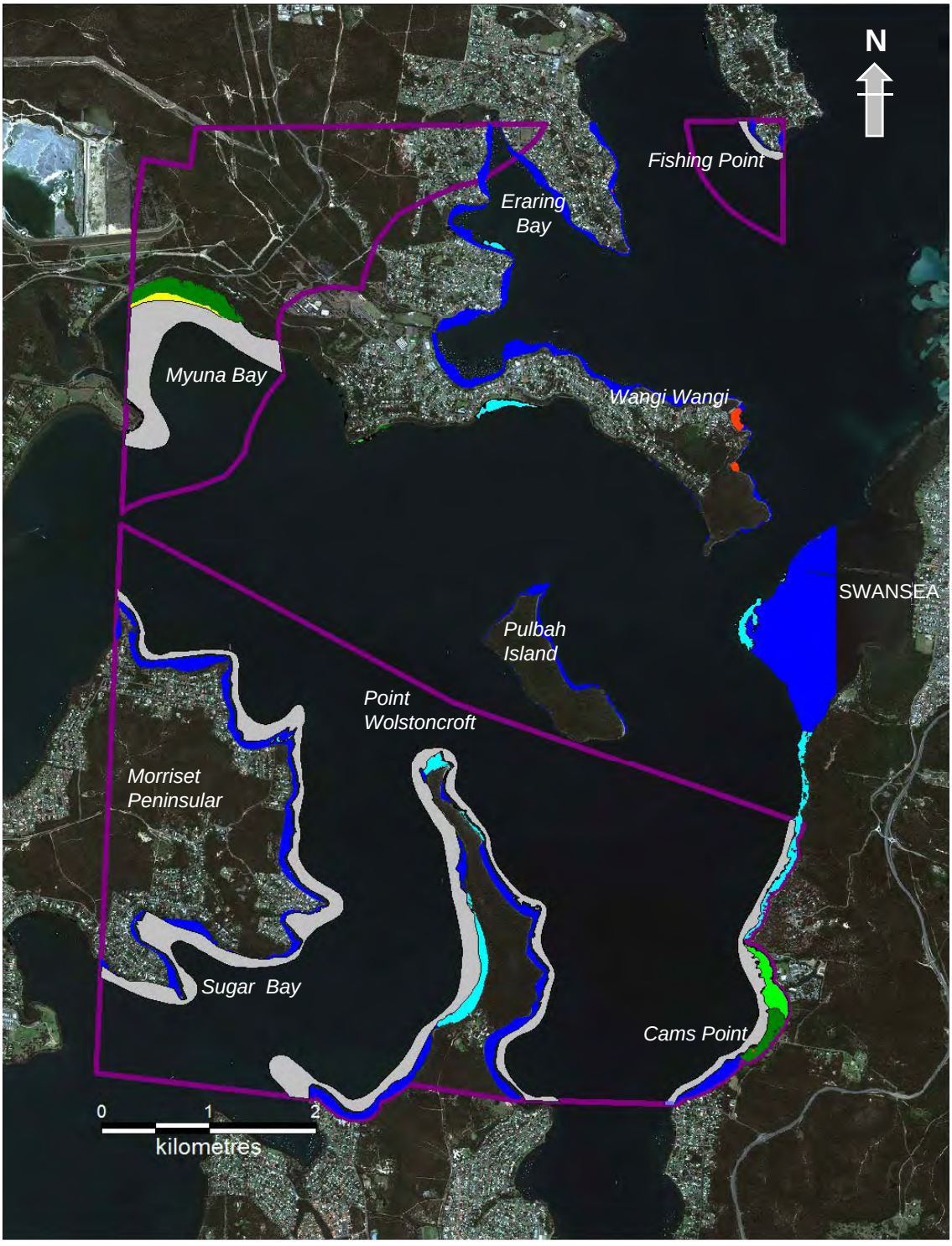
KEY

Source: AECOM

- High density *Zostera*
- Low density *Zostera*
- High density *Zostera & H.ovalis*
- Low density *Zostera & H. ovalis*
- High density *Zostera & P. australis*
- High density *H. ovalis*
- Project Application Area
- Dive Site

Figure 5: Detailed view of habitats in the southern half of the seagrass survey area, Lake Macquarie.

Figure 6: Example of difference between presumptive seagrass habitat map and actual seagrass habitat as field validated along the southern border of the study area. In presumptive maps the pink area was mapped to contain seagrass, but was found to contain mussel beds.



KEY

Source: AECOM

- High density *Zostera*
- Low density *Zostera*
- High density *Zostera & H.ovalis*
- Low density *Zostera & H. ovalis*
- High density *Zostera & P. australis*
- High density *H. ovalis*
- Seagrass Management Zone
- Project Application Area

Figure 7: Seagrass Management Zone, Lake Macquarie.

11 Plates

Plate 1:(a) High density *Zostera* habitat bordering a rocky outcrop near the shoreline and **(b)** high density *H. ovalis* habitat observed on 11 – 12 May 2010 within Lake Macquarie.

Plate 2:(a) Low density *Zostera* and *H. ovalis* habitat and **(b)** high density *Zostera* and *P. australis* habitat observed on 11 and 12 May 2010 within Lake Macquarie.

Plate 3:(a) Bioturbated seabed at Deep Site 1 and **(b)** fine, dark, soft silt sediment observed at Deep Sites 1 and 2 on 12 May 2010 within Lake Macquarie.

(a)

(b)

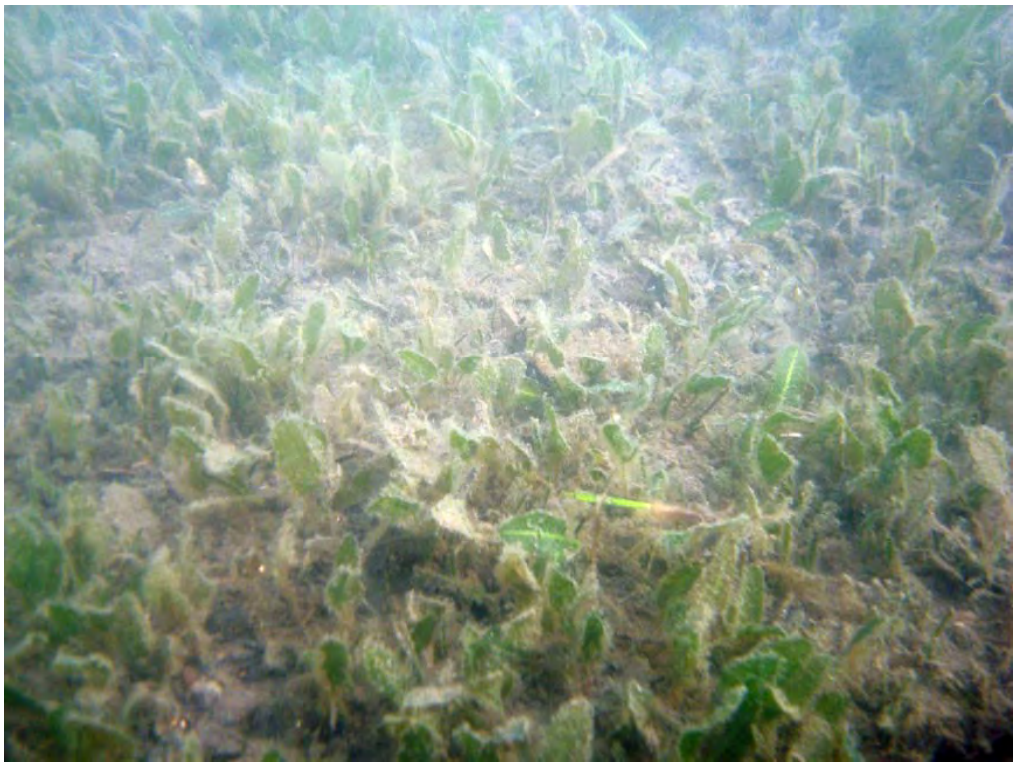


Plate 1: (a) High density *Zostera* habitat bordering a rocky outcrop near the shoreline and **(b)** high density *H. ovalis* habitat observed on 11 – 12 May 2010 within the survey area.

(a)

(b)

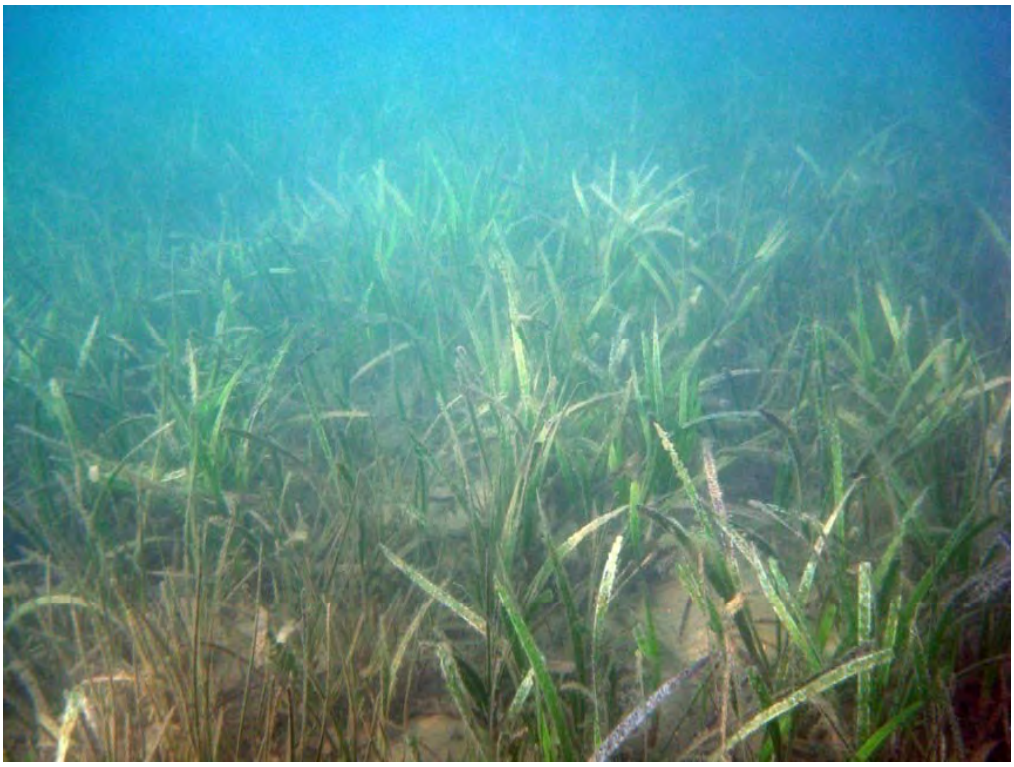
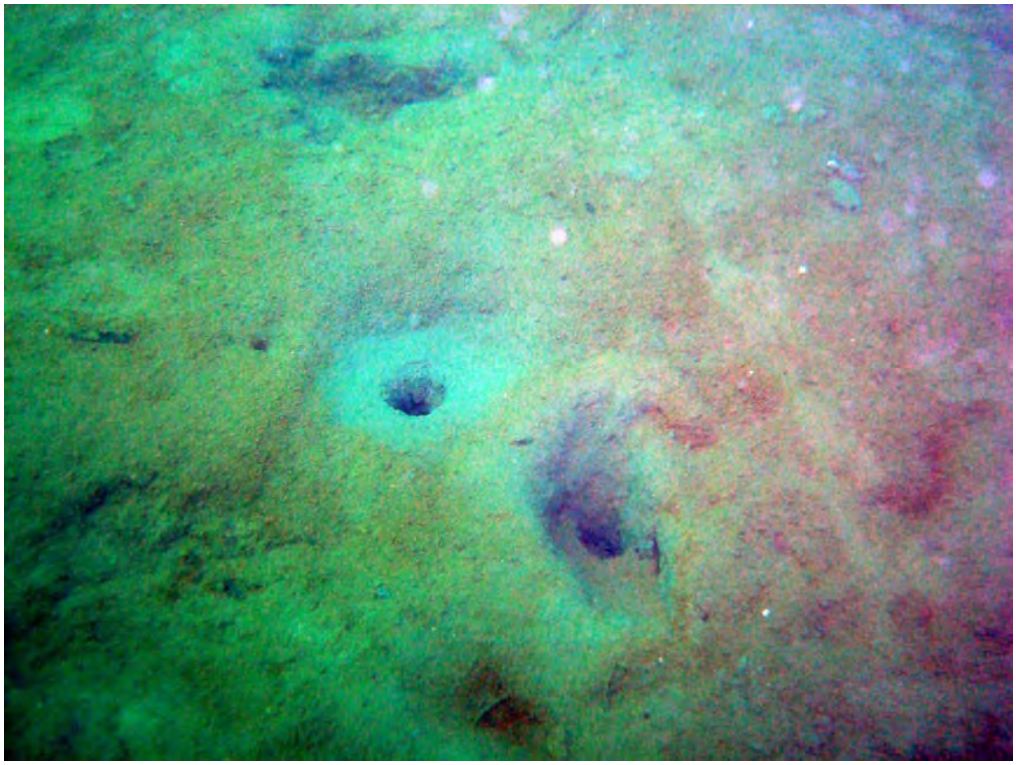


Plate 2: (a) Low density *Zostera* and *H. ovalis* habitat and **(b)** high density *Zostera* and *P. australis* habitat observed on 11 and 12 May 2010 within the survey area.

(a)



(b)

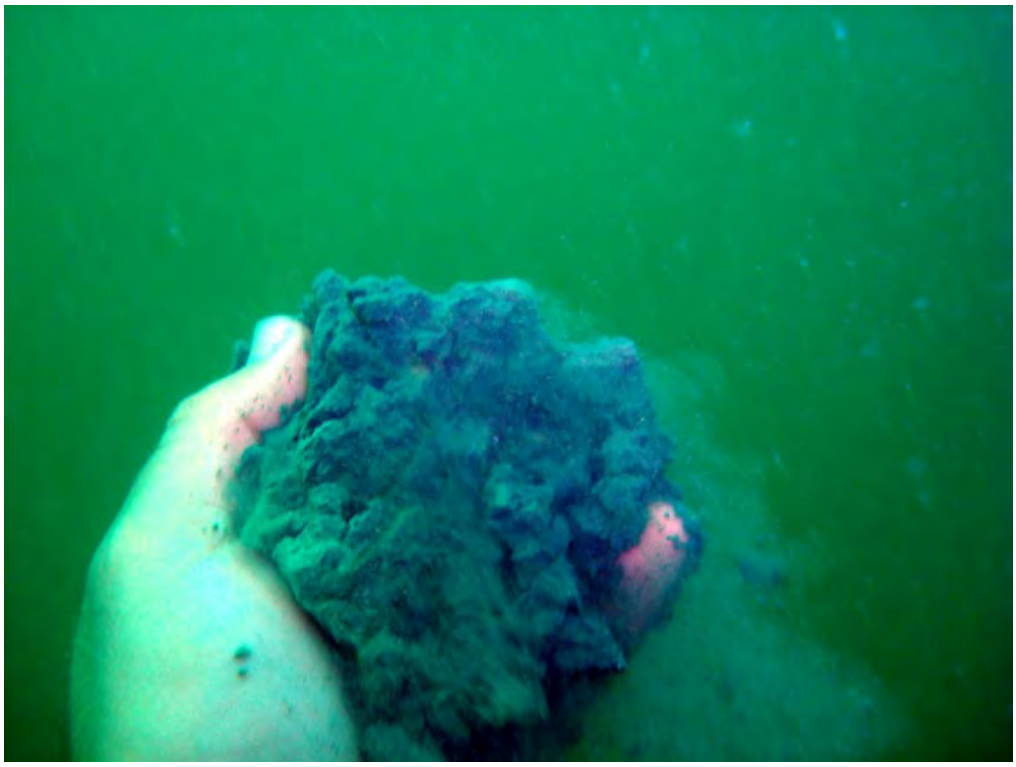


Plate 3: (a) Bioturbated seabed at Deep Site 1 and **(b)** fine, dark, soft silt sediment observed at Deep Sites 1 and 2 on 12 May 2010 within the survey area.

12 Appendices

Appendix 1: 'Assessment of Significance' for threatened species, populations and communities protected under the TSC and FM Act.

Appendix 2: 'Assessment of Significance' for threatened species, populations and communities protected under the EPBC Act.

Appendix 3: Results of Threatened Species Database Searches.

Appendix 1. 'Assessment of Significance' for threatened species, populations and communities protected under the TSC and FM Act.

Dugong (*Dugong dugon*)

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Dugongs prefer warmer waters, ranging from tropical to warm temperate seas, typically extending on the east coast as far south as the Qld/NSW border. They are most commonly found in shallow protected waters where they graze on large amounts of seagrass. The Dugong does not breed in NSW, however habitat and resources within the state remain important to visiting individuals (DECCW 2008a). The Dugong is threatened by coastal development and poor catchment management leading to siltation and the loss of seagrass beds. Isolated Dugong populations are vulnerable to local extinction as a result of losing seagrass beds after stochastic events such as floods or cyclones. The Dugong is also threatened by incidental mortality in commercial gillnets, entanglement in shark nets and collisions with boats (Smith 2001). Although there is seagrass habitat in the study site, dugongs have not been recorded within the protected waters of Lake Macquarie (with only 2 records from Swansea Channel). On this basis, it is unlikely that a viable local population of any dugongs would occur in the area and their life cycles would not be adversely affected or be placed at risk of extinction by the proposal.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Under the TSC Act, dugongs are considered to be endangered in NSW. Notwithstanding this, the impacts of the proposal on the seagrass habitat would be minor and there is no population of dugongs known to inhabit Lake Macquarie. The occurrence of individuals within the study area would be rare vagrants.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or
ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

No endangered populations of dugong have been identified in the State legislation.

d) In relation to the habitat of a threatened species, population or ecological community:
i) the extent to which habitat is likely to be removed or modified as a result of the action proposed; and
ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and
iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Small areas of seagrass habitat could become fragmented and isolated as a result of the subsidence, although the extent of the overall impact is likely to be very minor in terms of scale. Such minor impacts to seagrass are not considered to affect the long term survival of a dugong population and would not affect the occasional vagrants that have been reported to occur in Lake Macquarie on rare occasions.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).
No dugong critical habitat occurs within or near to the study areas and would therefore not be affected by the proposal.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
There is an approved Status Report and Action Plan (UNEP) for Australia and other countries. The proposal would not, however, affect any of the proposed action plans.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
'Alteration of habitat following subsidence due to longwall mining' is a KTP under the TSC Act and is directly related to the proposal for the continuation of mining within Lake Macquarie. The proposal is not, however, expected to alter seagrass habitat such that any observable impact could be detected and could adversely affect the dugong.

Conclusion: Given that dugongs would rarely occur within Lake Macquarie and that the potential impacts on seagrass habitat would be minimal, the proposal is not considered to affect a threatened population of dugongs such that a Species Impact Statement is recommended. Management and monitoring as described in Section 6 should be carried out to ensure minimal impact to seagrass habitat.

Marine Turtles

There are two listed marine turtles: green turtle (*Chelonia mydas*); and loggerhead turtle (*Caretta caretta*) that have been recorded from Lake Macquarie. They are grouped here because they have similar distribution and many similar ecological requirements.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Both listed marine turtles prefer warmer waters, ranging from tropical to warm temperate seas. For a large part of their life cycle, marine turtles are pelagic, particularly loggerheads, while green turtles tend to stay in coastal waters and may even take up residence in some areas.
Both of these turtle species are vulnerable to hunting through much of their range. They are most vulnerable when they come ashore to nest – at this time adults, eggs and hatchlings are subject to direct harvesting, predation by natural fauna, feral animals and pets and various forms of human disturbance. By-catch of marine turtles in fisheries, marine debris, coastal development, loss of habitat and deterioration of water quality are also a significant threats to the species. Lake Macquarie is outside the nesting range of both of these species and existing disturbances to the local beaches (e.g. humans, pets, and feral animals) would make it almost impossible for nesting in the area. Moreover, although these turtles (in particular the green turtle) are not uncommon in the area, it is unlikely that there is a viable local population within the existing mining consent and project application area. On this basis, it is unlikely that a viable local population of any marine turtles would be placed at risk of extinction by the proposal.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No endangered populations of marine turtles are identified in the legislation.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed; and

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The extensive seagrass beds within the existing mining consent and project application area theoretically provide habitat for marine turtles. The extent of the potential impact on seagrass habitat is likely to be minor. It is possible, that small areas could become fragmented and isolated as a result of the subsidence, however, it is unlikely that the study area constitutes an important habitat for these species and would not affect the long-term survival of the individuals that occur within Lake Macquarie.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

No listed critical habitat for marine turtles occurs within or in the vicinity of the study area.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is an approved Recovery Plan for Marine Turtles in Australia (Environment Australia 2003). The proposal would not, however, affect any of the recovery actions proposed under the plan.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

'Alteration of habitat following subsidence due to longwall mining' is a KTP under the TSC Act and is directly related to the proposal for the continuation of mining within Lake Macquarie. The proposal is not, however, expected to alter seagrass habitat such that any observable impact could be detected and could adversely affect marine turtles that occur in the study area.

Conclusion: Marine turtles, particularly green turtles are not uncommon within Lake Macquarie and are likely to utilise seagrass habitat within the existing mining consent and project application area. This area of habitat is not, however, critical to the species survival and any potential impacts on seagrass habitat would be minimal. The proposal is not therefore, considered to affect a threatened population of marine turtle such that a Species Impact Statement is recommended. Management and monitoring as described in Section 6 should be carried out to ensure minimal impact to seagrass habitat.

Estuarine Birds

There are eight species of estuarine bird listed under State legislation that have been recorded within the study area:
Great knot (*Calidris tenuirostris*);
Lesser sand plover (*Charadrius mongolus*);
Black-necked stork (*Ephippiorhyncus asiaticus*);
Sooty oystercatcher (*Haematopus fuliginosus*);
Pied oystercatcher (*Haematopus longirostris*);
Black bittern (*Ixobrychus flavicollis*);
Painted snipe (*Rostratula benghalensis australis*); and
Terek sandpiper (*Xenus cinereus*).
They are grouped here because they have similar distribution and many similar ecological requirements.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Shore birds or 'waders' are those birds commonly found on coastal shores, including beaches, rocky shores, mudflats, tidal wetlands and lagoons. These include plovers and sandpipers, stone-curlews, snipes and oystercatchers among others (Birds Australia 2009). Wading birds feed on marine invertebrates (including molluscs, worms and crustaceans), small fish that live within intertidal sand and mudflats. Small reptiles, earthworms, seeds and vegetation may also form part of their diet. Waders feed in the shallows or over exposed mud by probing their long slender bills into the substratum. Bill length, legs, body-structure, size and foraging techniques may subtly or markedly differ between groups of waders (Pizzey and Knight 1997). Important nesting areas may include sandbanks, sandpits, islands in estuaries, mangroves and riparian vegetation adjacent to the waterway. Nesting often takes place close to the ground which can make these birds vulnerable to disturbance. Subsidence as a result of continued mining activity has potential to alter the profile of foreshores and wetlands and intertidal habitat utilised by estuarine birds. The predicted extent of subsidence is not, however, considered to have an adverse effect on the habitat or resources of these species such that a viable local population could be put at risk of extinction. Furthermore it is unlikely that the proposal would cause any observable alteration to the behaviour or habitat values of estuarine birds within the study area.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

No endangered populations of estuarine birds are identified in the legislation.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or
ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:
i) the extent to which habitat is likely to be removed or modified as a result of the action proposed; and

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and
iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.
Intertidal foreshores and wetlands within the existing mining consent and project application area provide suitable habitat for a number of estuarine birds. The extent to which this habitat could be altered as a result of subsidence from the proposed continuation of mining operations would be negligible to none. It would be highly unlikely that habitat could become fragmented or isolated as a result of the proposal. Furthermore, there is no habitat of importance to the long-term survival of a species within the existing mining consent and project application area.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).
No listed critical habitat for estuarine birds is known to occur within the study area.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
There is no approved recovery plan for species of estuarine bird relevant to the proposal.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
'Alteration of habitat following subsidence due to longwall mining' is a KTP under the TSC Act and is directly related to the proposal for the continuation of mining within Lake Macquarie. The proposal is not, however, expected to alter habitat such that estuarine birds that occur in the study area would be affected.

Conclusion: A number of threatened species of estuarine bird have been recorded within Lake Macquarie and are likely to utilise intertidal and foreshore habitat within the study area. The proposal is not, however, considered to affect a threatened species of estuarine bird such that a Species Impact Statement is recommended.

Appendix 2. 'Assessment of Significance' for threatened species, populations and communities protected under the EPBC Act.

Dugong (*Dugong dugon*)

Status: migratory.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species;

No area of habitat that supports an ecologically significant proportion of a dugong population would be affected by the proposal. Dugongs would rarely occur in the study area and the few that have been recorded within the study area are likely to be vagrants from more northern populations. The area of habitat potentially affected is also not critical habitat and does not occur in an area where the species is declining.

- result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species; or

The proposal is not considered to result in invasive species becoming established in an area of habitat important for the dugong.

- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

Impacts of mining related subsidence could potentially have minor affects on seagrass habitat (within the existing mining consent and project application area) which is a source of food for the dugong. Given the negligible level of predicted subsidence (< 20 mm) and that dugong rarely occur within the study area, the lifecycle of an ecologically significant proportion of the population would not be affected.

Conclusion:

The proposal would not result in a significant impact on this species, or its necessary habitat requirements.

Loggerhead Turtle (*Caretta caretta*)

Status: endangered

Seven of the nine criteria provided under the EPBC Act 'Significant Impact Guidelines'' for an endangered species are very similar to criteria used to assess these species under the assessment of significance under State legislation (Appendix 1). Hence, it is not considered that the proposal would:

- Lead to a long-term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline; or
- Interfere substantially with the recovery of a species.

In addition, it is not expected that the proposal would:

- Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat;

or

- Introduce disease that may cause the species to decline.

Conclusion:
The proposal would not result in a significant impact on this species, or its necessary habitat requirements.

Estuarine Birds

Status: migratory
Three species of estuarine birds that are known to occur within the study area are listed as 'migratory' under the EPBC Act. These are the great knot (*Calidris tenuirostris*); lesser sand plover (*Charadrius mongolus*) and terek sandpiper (*Xenus cinereus*). They are grouped here because they have similar ecological requirements.
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species;

Subsidence as a result of continued mining activity has potential to alter the profile of foreshores and wetlands and intertidal habitat utilised by estuarine birds. The predicted extent of subsidence is not, however, considered to have an adverse effect on the habitat or resources of these species such that a local population could be put at risk. Furthermore, it is unlikely that the proposal would cause any observable alteration to the behaviour or habitat values of estuarine birds within the study area.

In addition, it is not expected that the proposal would:

- result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species; or

or

- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

Conclusion:
The proposal is not considered to result in a significant impact on these species, or their necessary habitat requirements.

Painted snipe (*Rostratula benghalensis australis*)

Status: vulnerable
An assessment for estuarine birds as a group has been carried out using an 'Assessment of Significance' under State legislation (Appendix 1). Six of the nine criteria provided under the EPBC Act for a listed vulnerable species are very similar to criteria used to assess these species under the State Assessment of Significance. Hence, it is not considered that the proposal would:

- Lead to a long-term decrease in the size of an important population of a species;
- Reduce the area of occupancy of an important population;
- Fragment an existing important population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of an important population; or

- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline.

In addition, it is not expected that the proposal would:

- Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- Introduce disease that may cause the species to decline; or
  The proposal would not result in the introduction of disease that could result in the decline of a species of estuarine bird.
  or
- Interfere substantially with the recovery of a species.
  The primary factor in the decline of the Australian Painted Snipe has probably been a loss and alteration of wetland habitat (DEWHA 2008b)). The two major sources of this have been the drainage of wetlands and the diversion of water to agriculture and reservoirs, the latter process reducing flooding and precluding the formation of temporary shallow wetlands. Potential impacts of subsidence from longwall mining within the study area would be negligible are not considered to substantially interfere with the recovery of the species.

Conclusion:
The proposal is not considered to result in a significant impact on these species, or their necessary habitat requirements.

Appendix 3. Results of Threatened Species Database Searches.

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Species
Search
View all species
Find by type of species
Find by geographic region
Find by habitat
Find by habitat & region

Wyong CMA sub-region

Below is a list of the 128 threatened species found in the Wyong sub-region. You can also see a list of:

- threatened algae
- threatened animals
- threatened communities
- threatened fungi
- threatened plants
- see this complete list categorised by vegetation type

Ecological Communities.

Threatened species known or predicted to occur in the Wyong CMA sub-region Export this list

Scientific Name	Common Name	Type of species	Level of Threat	Known or Predicted to occur
Acacia bynoeana	Bynoe's Wattle	Plant > Shrubs	Endangered	Known
Angophora inopina	Charmhaven Apple	Plant > Trees	Vulnerable	Known
Anseranas semipalmata	Magpie Goose	Animal > Birds	Vulnerable	Known
Astrotricha crassifolia	Thick-leaf Star-hair	Plant > Shrubs	Vulnerable	Predicted
Botaurus poiciloptilus	Australasian Bittern	Animal > Birds	Vulnerable	Known
Burhinus grallarius	Bush Stone-curlew	Animal > Birds	Endangered	Known
Caladenia porphyrea	*Caladenia porphyrea*	Plant > Orchids	Endangered	Known
Caladenia tessellata	Tessellated Spider Orchid	Plant > Orchids	Endangered	Known
Calidris alba	Sanderling	Animal > Birds	Vulnerable	Known
Calidris tenuirostris	Great Knot	Animal > Birds	Vulnerable	Known
Callistemon linearifolius	Netted Bottlebrush	Plant > Shrubs	Vulnerable	Known
Calyptorhynchus banksii	Red-tailed Black-cockatoo	Animal > Birds	Vulnerable	Known
Calyptorhynchus lathami	Glossy Black-cockatoo	Animal > Birds	Vulnerable	Known
Caretta caretta	Loggerhead Turtle	Animal > Reptiles	Endangered	Known
Cercartetus nanus	Eastern Pygmy-possum	Animal > Marsupials	Vulnerable	Known
Chalinolobus dwyeri	Large-eared Pied Bat	Animal > Bats	Vulnerable	Known
Chamaesyce psammogeton	Sand Spurge	Plant > Herbs and Forbs	Endangered	Known
Charadrius leschenaultii	Greater Sand-plover	Animal > Birds	Vulnerable	Known
Charadrius mongolus	Lesser Sand-plover	Animal > Birds	Vulnerable	Known
Circus assimilis	Spotted Harrier	Animal > Birds	Vulnerable	Known
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Animal > Birds	Vulnerable	Known
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Predicted
Corybas dowlingii	Red Helmet Orchid	Plant > Orchids	Endangered	Known
Crinia tinnula	Wallum Froglet	Animal > Amphibians	Vulnerable	Known
Cryptostylis hunteriana	Leafless Tongue Orchid	Plant > Orchids	Vulnerable	Known
Cynanchum elegans	White-flowered Wax Plant	Plant > Epiphytes and climbers	Endangered	Known
Darwinia glaucophylla	*Darwinia glaucophylla*	Plant > Shrubs	Vulnerable	Known
Dasyurus maculatus	Spotted-tailed Quoll	Animal > Marsupials	Vulnerable	Known
Dermochelys coriacea	Leathery Turtle	Animal > Reptiles	Vulnerable	Known
Diuris bracteata	*Diuris bracteata*	Plant > Orchids	Endangered	Known
Diuris praecox	Rough Double Tail	Plant > Orchids	Vulnerable	Known
	Epacris purpurascens			

Epacris purpurascens var. purpurascens	var. purpurascens	Plant > Shrubs	Vulnerable	Known
Ephippiorhynchus asiaticus	Black-necked Stork	Animal > Birds	Endangered	Known
Eucalyptus camfieldii	Camfield's Stringybark	Plant > Mallees	Vulnerable	Known
Eucalyptus oblonga - endangered population	*Eucalyptus oblonga* (Narrow-leaved Stringybark) population at Bateau Bay	Plant > Endangered Populations	Endangered Population	Known
Eucalyptus parramattensis subsp. decadens	*Eucalyptus parramattensis* subsp. *decadens*	Plant > Trees	Vulnerable	Known
Eucalyptus parramattensis subsp. parramattensis - endangered population	*Eucalyptus parramattensis* subsp. *parramattensis* population in the Wyong and Lake Macquarie LGAs	Plant > Endangered Populations	Endangered Population	Known
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Animal > Bats	Vulnerable	Known
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Freshwater wetlands on coastal floodplains	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Ganoderma insignis	Variable Midge Orchid	Plant > Orchids	Endangered	Known
Glossopsitta pusilla	Little Lorikeet	Animal > Birds	Vulnerable	Predicted
Grantiella picta	Painted Honeyeater	Animal > Birds	Vulnerable	Known
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	Plant > Shrubs	Vulnerable	Known
Haematopus fuliginosus	Sooty Oystercatcher	Animal > Birds	Vulnerable	Known
Haematopus longirostris	Pied Oystercatcher	Animal > Birds	Vulnerable	Known
Helioporus australiacus	Giant Burrowing Frog	Animal > Amphibians	Vulnerable	Known
Hibbertia procumbens	Spreading Guinea Flower	Plant > Shrubs	Endangered	Known
Hieraaetus morphnoides	Little Eagle	Animal > Birds	Vulnerable	Known
Hoplocephalus bitorquatus	Pale-headed Snake	Animal > Reptiles	Vulnerable	Known
Hoplocephalus bungaroides	Broad-headed Snake	Animal > Reptiles	Endangered	Known
Hoplocephalus stephensii	Stephens' Banded Snake	Animal > Reptiles	Vulnerable	Known
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Irediparra gallinacea	Comb-crested Jacana	Animal > Birds	Vulnerable	Known
Ixobrychus flavicollis	Black Bittern	Animal > Birds	Vulnerable	Known
Kerivoula papuensis	Golden-tipped Bat	Animal > Bats	Vulnerable	Known
Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion	Kincumber Scribbly Gum Forest	Community > Threatened Ecological Communities	Critically Endangered Ecological Community	Known
Lathamus discolor	Swift Parrot	Animal > Birds	Endangered	Known
Limicola falcinellus	Broad-billed Sandpiper	Animal > Birds	Vulnerable	Known
Limosa limosa	Black-tailed Godwit	Animal > Birds	Vulnerable	Known
Litoria aurea	Green and Golden Bell Frog	Animal > Amphibians	Endangered	Known
Litoria brevipalmata	Green-thighed Frog	Animal > Amphibians	Vulnerable	Known
Litoria littlejohni	Littlejohn's Tree Frog	Animal > Amphibians	Vulnerable	Known
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Predicted
Lophoictinia isura	Square-tailed Kite	Animal > Birds	Vulnerable	Predicted
Low woodland with heathland on indurated sand at	Low woodland with heathland on indurated sand at	Community > Threatened Ecological	Endangered Ecological Community	Known

Norah Head	Norah Head	Communities		
Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion	Lower Hunter Spotted Gum - Ironbark Forest	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Macropus parma	Parma Wallaby	Animal > Marsupials	Vulnerable	Known
Maundia triglochinoides	*Maundia triglochinoides*	Plant > Herbs and Forbs	Vulnerable	Known
Melaleuca biconvexa	Biconvex Paperbark	Plant > Trees	Vulnerable	Known
Melaleuca groveana	Grove's Paperbark	Plant > Shrubs	Vulnerable	Predicted
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Animal > Birds	Vulnerable	Known
Miniopterus australis	Little Bentwing-bat	Animal > Bats	Vulnerable	Known
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	Animal > Bats	Vulnerable	Known
Mixophyes balbus	Stuttering Barred Frog	Animal > Amphibians	Endangered	Known
Mixophyes iteratus	Giant Barred Frog	Animal > Amphibians	Endangered	Known
Mormopterus norfolkensis	Eastern Freetail-bat	Animal > Bats	Vulnerable	Known
Myotis macropus (formally Myotis adversus)	Large-footed Myotis	Animal > Bats	Vulnerable	Known
Neophema pulchella	Turquoise Parrot	Animal > Birds	Vulnerable	Known
Nettapus coromandelianus	Cotton Pygmy-goose	Animal > Birds	Endangered	Known
Ninox connivens	Barking Owl	Animal > Birds	Vulnerable	Known
Ninox strenua	Powerful Owl	Animal > Birds	Vulnerable	Known
Oxyura australis	Blue-billed Duck	Animal > Birds	Vulnerable	Known
Pandion haliaetus	Osprey	Animal > Birds	Vulnerable	Known
Petaurus australis	Yellow-bellied Glider	Animal > Marsupials	Vulnerable	Known
Petaurus norfolcensis	Squirrel Glider	Animal > Marsupials	Vulnerable	Known
Petrogale penicillata	Brush-tailed Rock-wallaby	Animal > Marsupials	Endangered	Known
Petroica boodang	Scarlet Robin	Animal > Birds	Vulnerable	Known
Petroica phoenicea	Flame Robin	Animal > Birds	Vulnerable	Known
Phascolarctos cinereus	Koala	Animal > Marsupials	Vulnerable	Known
Planigale maculata	Common Planigale	Animal > Marsupials	Vulnerable	Known
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Animal > Birds	Vulnerable	Known
Potorous tridactylus	Long-nosed Potoroo	Animal > Marsupials	Vulnerable	Known
Prostanthera askania	Cut-leaf Mint-bush	Plant > Shrubs	Endangered	Known
Prostanthera junonis	Somersby Mintbush	Plant > Shrubs	Endangered	Known
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	Animal > Rodents	Vulnerable	Known
Pseudophryne australis	Red-crowned Toadlet	Animal > Amphibians	Vulnerable	Known
Pteropus poliocephalus	Grey-headed Flying-fox	Animal > Bats	Vulnerable	Known
Ptilinopus magnificus	Wompoo Fruit-dove	Animal > Birds	Vulnerable	Known
Ptilinopus regina	Rose-crowned Fruit-dove	Animal > Birds	Vulnerable	Known
Ptilinopus superbus	Superb Fruit-dove	Animal > Birds	Vulnerable	Known
Pyrrholaemus sagittatus	Speckled Warbler	Animal > Birds	Vulnerable	Known
Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	River-Flat Eucalypt Forest on Coastal Floodplains	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Rostratula benghalensis	Painted Snipe	Animal > Birds	Endangered	Predicted
Rutidosis heterogama	Heath Wrinklewort	Plant > Herbs and Forbs	Vulnerable	Known

Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Animal > Bats	Vulnerable	Known
Scoteanax rueppellii	Greater Broad-nosed Bat	Animal > Bats	Vulnerable	Known
Senecio spathulatus	Coast Groundsel	Plant > Herbs and Forbs	Endangered	Known
Stagonopleura guttata	Diamond Firetail	Animal > Birds	Vulnerable	Known
Sterna albifrons	Little Tern	Animal > Birds	Endangered	Known
Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp oak floodplain forest	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp sclerophyll forest on coastal floodplains	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Syzygium paniculatum	Magenta Lilly Pilly	Plant > Trees	Endangered	Known
Tetratheca glandulosa	*Tetratheca glandulosa*	Plant > Shrubs	Vulnerable	Known
Tetratheca juncea	Black-eyed Susan	Plant > Shrubs	Vulnerable	Known
Thelymitra sp. 'Adorata' (B. Brarwhite 3411030) J. Jeanes ined.	Wyong Sun Orchid	Plant > Orchids	Critically Endangered	Known
Themeda australis	*Themeda* Grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Thylogale stigmatica	Red-legged Pademelon	Animal > Marsupials	Vulnerable	Predicted
Turnix maculosa	Red-backed Button-quail	Animal > Birds	Vulnerable	Known
Tyto novaehollandiae	Masked Owl	Animal > Birds	Vulnerable	Known
Tyto tenebricosa	Sooty Owl	Animal > Birds	Vulnerable	Known
Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion	Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Varanus rosenbergi	Rosenberg's Goanna	Animal > Reptiles	Vulnerable	Known
Vespadelus troughtoni	Eastern Cave Bat	Animal > Bats	Vulnerable	Known
Xanthomyza phrygia	Regent Honeyeater	Animal > Birds	Endangered	Known
Xenus cinereus	Terek Sandpiper	Animal > Birds	Vulnerable	Known
Zannichellia palustris	*Zannichellia palustris*	Plant > Aquatic plants	Endangered	Known

Last updated: 01/09/2005

Hunter/Central Rivers - marine zone CMA sub-region

Below is a list of the 40 threatened species found in the Hunter/Central Rivers - marine zone sub-region. You can also see a list of:

- threatened algae
- threatened animals
- threatened communities
- threatened fungi
- threatened plants
- see this complete list categorised by vegetation type

Threatened species known or predicted to occur in the Hunter/Central Rivers - marine zone CMA sub-region

Export this list

Scientific Name	Common Name	Type of species	Level of Threat	Known or Predicted to occur
Arctocephalus forsteri	New Zealand Fur-seal	Animal > Marine Mammals	Vulnerable	Known
Arctocephalus pusillus doriferus	Australian Fur-seal	Animal > Marine Mammals	Vulnerable	Known
Balaenoptera musculus	Blue Whale	Animal > Marine Mammals	Endangered	Predicted
Calidris alba	Sanderling	Animal > Birds	Vulnerable	Known
Calidris tenuirostris	Great Knot	Animal > Birds	Vulnerable	Known
Caretta caretta	Loggerhead Turtle	Animal > Reptiles	Endangered	Known
Charadrius leschenaultii	Greater Sand-plover	Animal > Birds	Vulnerable	Known
Charadrius mongolus	Lesser Sand-plover	Animal > Birds	Vulnerable	Known
Chelonia mydas	Green Turtle	Animal > Reptiles	Vulnerable	Known
Dermochelys coriacea	Leathery Turtle	Animal > Reptiles	Vulnerable	Known
Diomedea antipodensis	Antipodean Albatross	Animal > Birds	Vulnerable	Known
Diomedea exulans	Wandering Albatross	Animal > Birds	Endangered	Known
Diomedea gibsoni	Gibson's Albatross	Animal > Birds	Vulnerable	Known
Dugong dugon	Dugong	Animal > Marine Mammals	Endangered	Known
Esacus neglectus	Beach Stone-curlew	Animal > Birds	Critically Endangered	Known
Eubalaena australis	Southern Right Whale	Animal > Marine Mammals	Vulnerable	Known
Fregetta grallaria	White-bellied Storm-petrel	Animal > Birds	Vulnerable	Predicted
Gygis alba	White Tern	Animal > Birds	Vulnerable	Known
Haematopus fuliginosus	Sooty Oystercatcher	Animal > Birds	Vulnerable	Known
Haematopus longirostris	Pied Oystercatcher	Animal > Birds	Vulnerable	Known
Limicola falcinellus	Broad-billed Sandpiper	Animal > Birds	Vulnerable	Known
Limosa limosa	Black-tailed Godwit	Animal > Birds	Vulnerable	Known
Macronectes giganteus	Southern Giant-Petrel	Animal > Birds	Endangered	Known
Macronectes halli	Northern Giant-Petrel	Animal > Birds	Vulnerable	Predicted
Megaptera novaeangliae	Humpback Whale	Animal > Marine Mammals	Vulnerable	Known
Pandion haliaetus	Osprey	Animal > Birds	Vulnerable	Known
Phoebetria fusca	Sooty Albatross	Animal > Birds	Vulnerable	Known
Physeter macrocephalus	Sperm Whale	Animal > Marine Mammals	Vulnerable	Known
Procelsterna cerulea	Grey Ternlet	Animal > Birds	Vulnerable	Known
Pterodroma leucoptera leucoptera	Gould's Petrel	Animal > Birds	Vulnerable	Known
Pterodroma neglecta	Kermadec Petrel	Animal > Birds	Vulnerable	Known
Pterodroma nigripennis	Black-winged Petrel	Animal > Birds	Vulnerable	Known

Pterodroma solandri	Providence Petrel	Animal > Birds	Vulnerable	Known
Puffinus assimilis	Little Shearwater	Animal > Birds	Vulnerable	Known
Puffinus carneipes	Flesh-footed Shearwater	Animal > Birds	Vulnerable	Known
Sterna albifrons	Little Tern	Animal > Birds	Endangered	Known
Sterna fuscata	Sooty Tern	Animal > Birds	Vulnerable	Known
Thalassarche cauta	Shy Albatross	Animal > Birds	Vulnerable	Known
Thalassarche melanophris	Black-browed Albatross	Animal > Birds	Vulnerable	Known
Xenus cinereus	Terek Sandpiper	Animal > Birds	Vulnerable	Known

Last updated: 01/09/2005

Species
Search
View all species
Find by type of species
Find by geographic region
Find by habitat
Find by habitat & region

Wyong CMA sub-region

Below is a list of the 14 threatened communities found in the Wyong sub-region. You can also see a list of:

- threatened algae
- threatened animals
- threatened communities
- threatened fungi
- threatened plants
- see this complete list categorised by vegetation type

Threatened species known or predicted to occur in the Wyong CMA sub-region Export this list

Scientific Name	Common Name	Type of species	Level of Threat	Known or Predicted to occur
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Predicted
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Freshwater wetlands on coastal floodplains	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Kincumber Scribbly Gum Forest in the Sydney Basin Bioregion	Kincumber Scribbly Gum Forest	Community > Threatened Ecological Communities	Critically Endangered Ecological Community	Known
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Community > Threatened Ecological Communities	Endangered Ecological Community	Predicted
Low woodland with heathland on indurated sand at Norah Head	Low woodland with heathland on indurated sand at Norah Head	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion	Lower Hunter Spotted Gum - Ironbark Forest	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	River-Flat Eucalypt Forest on Coastal Floodplains	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp oak floodplain forest	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp sclerophyll forest on coastal floodplains	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Sydney Freshwater Wetlands in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known
Themeda australis	*Themeda* Grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner	Community > Threatened Ecological Communities	Endangered Ecological Community	Known

	bioregions			
Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion	Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion	Community > Threatened Ecological Communities	Endangered Ecological Community	Known

Last updated: 01/09/2005

NSW National Parks & Wildlife Service
atlas of nsw wildlife

Species known as per map records.

Search Results

Your selection: Fauna, threatened species, LGA - LAKE MACQUARIE returned a total of 1937 records of 73 species.

Report generated on 27/05/2010 - 08:42 (Data valid to 25/04/2010)

Choose up to 3 species to map.

** Exotic (non-native) species*

Amphibia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Hylidae						
	☐	Litoria aurea	Green and Golden Bell Frog	E1	1	
	☐	Litoria brevipalmata	Green-thighed Frog	V	3	
	☐	Litoria littlejohni	Littlejohn's Tree Frog	V	14	
Myobatrachidae						
	☐	Crinia tinnula	Wallum Froglet	V	28	
	☐	Mixophyes balbus	Stuttering Frog	E1	72	
	☐	Mixophyes iteratus	Giant Barred Frog	E1	23	
	☐	Pseudophryne australis	Red-crowned Toadlet	V	23	

Aves	Map	Scientific Name	Common Name	Legal Status	Count	Info
Acanthizidae						
	☐	Pyrrholaemus saggitatus	Speckled Warbler	V	2	
Accipitridae						
	☐	Circus assimilis	Spotted Harrier	V	1	
	☐	Hieraaetus morphnoides	Little Eagle	V	3	
	☐	Lophoictinia isura	Square-tailed Kite	V	2	
	☐	Pandion haliaetus	Osprey	V	23	
Anatidae						
	☐	Oxyura australis	Blue-billed Duck	V	1	
Ardeidae						
	☐	Ixobrychus flavicollis	Black Bittern	V	10	
Burhinidae						
	☐	Burhinus grallarius	Bush Stone-curlew	E1	1	
Cacatuidae						
	☐	Callocephalon fimbriatum	Gang-gang Cockatoo	V	30	
	☐	Calyptorhynchus lathami	Glossy Black-Cockatoo	V	100	
Charadriidae						
	☐	Charadrius leschenaultii	Greater Sand-plover	V	2	
	☐	Charadrius mongolus	Lesser Sand-plover	V	8	
Ciconiidae						
	☐	Ephippiorhynchus asiaticus	Black-necked Stork	E1	20	
Climacteridae						
	☐	Climacteris picumnus	Brown Treecreeper	V	7	
Columbidae						
	☐	Ptilinopus regina	Rose-crowned Fruit-Dove	V	3	

	Ptilinopus superbus	Superb Fruit-Dove	V	2
Diomedeidae				
	Diomedea exulans	Wandering Albatross	E1	2
	Thalassarche cauta	Shy Albatross	V	1
	Thalassarche melanophris	Black-browed Albatross	V	1
Estrildidae				
	Stagonopleura guttata	Diamond Firetail	V	1
Haematopodidae				
	Haematopus fuliginosus	Sooty Oystercatcher	V	3
	Haematopus longirostris	Pied Oystercatcher	E1	15
Jacanidae				
	Irediparra gallinacea	Comb-crested Jacana	V	3
Laridae				
	Sterna albifrons	Little Tern	E1	8
	Sterna fuscata	Sooty Tern	V	1
Meliphagidae				
	Epthianura albifrons	White-fronted Chat	V	12
	Xanthomyza phrygia	Regent Honeyeater	E1	33
Neosittidae				
	Daphoenositta chrysoptera	Varied Sittella	V	32
Petroicidae				
	Melanodryas cucullata	Hooded Robin	V	1
	Petroica boodang	Scarlet Robin	V	8
Pomatostomidae				
	Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	1
Procellariidae				
	Puffinus carneipes	Flesh-footed Shearwater	V	2
Psittacidae				
	Glossopsitta pusilla	Little Lorikeet	V	61
	Lathamus discolor	Swift Parrot	E1	44
	Neophema pulchella	Turquoise Parrot	V	6
Rostratulidae				
	Rostratula benghalensis australis	Painted Snipe (Australian subspecies)	E1	2
Scolopacidae				
	Calidris tenuirostris	Great Knot	V	3
	Xenus cinereus	Terek Sandpiper	V	1
Strigidae				
	Ninox connivens	Barking Owl	V	5
	Ninox strenua	Powerful Owl	V	102
Tytonidae				
	Tyto novaehollandiae	Masked Owl	V	56
	Tyto tenebricosa	Sooty Owl	V	21

Mammalia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Balaenidae						
		Eubalaena australis	Southern Right Whale	V	1	
Dasyuridae						
		Dasyurus maculatus	Spotted-tailed Quoll	V	15	
		Phascogale tapoatafa	Brush-tailed Phascogale	V	2	
Dugongidae						

clear map
search again
clear selection

	Dugong dugon	Dugong	E1	3
Emballonuridae				
	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	4
Macropodidae				
	Macropus parma	Parma Wallaby	V	2
	Petrogale penicillata	Brush-tailed Rock-wallaby	E1	5
Molossidae				
	Mormopterus norfolkensis	Eastern Freetail-bat	V	59
Petauridae				
	Petaurus australis	Yellow-bellied Glider	V	230
	Petaurus norfolcensis	Squirrel Glider	V	201
Phascolarctidae				
	Phascolarctos cinereus	Koala	V	33
Potoroidae				
	Potorous tridactylus	Long-nosed Potoroo	V	2
Pteropodidae				
	Pteropus poliocephalus	Grey-headed Flying-fox	V	141
Vespertilionidae				
	Chalinolobus dwyeri	Large-eared Pied Bat	V	12
	Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	8
	Kerivoula papuensis	Golden-tipped Bat	V	10
	Miniopterus australis	Little Bentwing-bat	V	118
	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	106
	Myotis macropus	Southern Myotis	V	30
	Scoteanax rueppellii	Greater Broad-nosed Bat	V	46
	Vespadelus troughtoni	Eastern Cave Bat	V	9

Reptilia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Cheloniidae						
		Caretta caretta	Loggerhead Turtle	E1	2	
		Chelonia mydas	Green Turtle	V	89	
Elapidae						
		Hoplocephalus stephensii	Stephens' Banded Snake	V	5	

** Exotic (non-native) species*

Choose up to 3 species to map.

study area = Lake Mac estuary.

Australian Government
Department of the Environment, Water, Heritage and the Arts

Environmental Reporting Tool

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21 May 2010 18:06

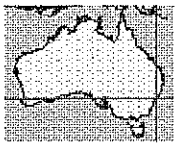
Database Report

This report includes places of national environmental significance that are registered in the Department of the Environment and Water Resources' databases, for the selected area. The information presented here has been provided by a range of groups across Australia, and the accuracy and resolution varies.

Search Type: Area

Buffer: 10 km

Coordinates: -32.9572,151.4657, -33.1856,151.4657, -33.1856,151.6711, -32.9572,151.6711



Report Contents: Summary >> Details >> Caveat >> Acknowledgment

Biodiversity

Threatened Species:	58
Migratory Species:	70
Listed Marine Species:	95
Invasive Species:	17
Whales and Other Cetaceans:	13
Threatened Ecological Communities:	

Heritage

World Heritage Properties:	None
Australian Heritage Sites:	21

Wetlands

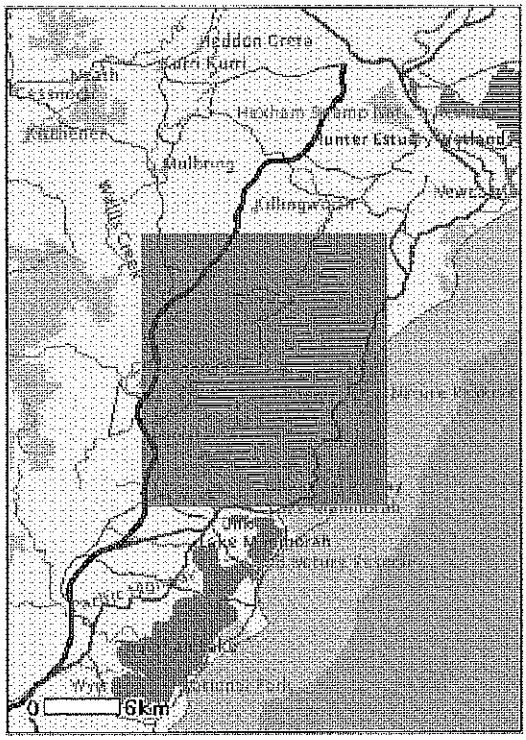
Ramsar sites: **(Internationally important)**	1
Nationally Important Wetlands:	7

National Pollutant Inventory

Reporting Facilities:	45
Airsheds:	1
Catchments:	1

Protected Areas

Reserves and Conservation Areas:	7
Regional Forest Agreements:	1



Biodiversity

Threatened Species [Dataset Information]	Status	Comments
Birds		
Anthochaera phrygia Regent Honeyeater	Endangered	Species or species habitat likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross	Vulnerable	Species or species habitat may occur within area
Diomedea exulans amsterdamensis Amsterdam Albatross	Endangered	Species or species habitat may occur within area
Diomedea exulans antipodensis	Vulnerable	Species or species habitat may occur

Antipodean Albatross		within area
Diomedea exulans exulans Tristan Albatross	Endangered	Foraging, feeding or related behaviour may occur within area
Diomedea exulans gibsoni Gibson's Albatross	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot	Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel	Vulnerable	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel	Endangered	Species or species habitat may occur within area
Pterodroma neglecta neglecta Kermadec Petrel (western)	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe	Vulnerable	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta salvini Salvin's Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross	Vulnerable	Species or species habitat may occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog	Vulnerable	Species or species habitat likely to occur within area
Litoria aurea Green and Golden Bell Frog	Vulnerable	Species or species habitat likely to occur within area
Litoria littlejohni Littlejohn's Tree Frog, Heath Frog	Vulnerable	Species or species habitat may occur within area
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria)	Vulnerable	Species or species habitat likely to occur within area
Mixophyes iteratus Southern Barred Frog, Giant Barred Frog	Endangered	Species or species habitat likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale	Endangered	Species or species habitat may occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	Endangered	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby	Vulnerable	Species or species habitat may occur within area
Potorous tridactylus tridactylus	Vulnerable	Species or species habitat may occur

Long-nosed Potoroo (SE mainland)		within area
Pteropus poliocephalus Grey-headed Flying-fox	Vulnerable	Roosting known to occur within area
Ray-finned fishes		
Prototroctes maraena Australian Grayling	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth	Endangered	Species or species habitat may occur within area
Hoplocephalus bungaroides Broad-headed Snake	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle	Vulnerable	Species or species habitat known to occur within area
Sharks		
Carcharias taurus (east coast population) Grey Nurse Shark (east coast population)	Critically Endangered	Species or species habitat may occur within area
Carcharodon carcharias Great White Shark	Vulnerable	Species or species habitat may occur within area
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark	Conservation Dependent	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish	Vulnerable	Species or species habitat may occur within area
Rhincodon typus Whale Shark	Vulnerable	Species or species habitat may occur within area
Plants		
Acacia bynoeana Bynoe's Wattle, Tiny Wattle	Vulnerable	Species or species habitat likely to occur within area
Angophora inopina	Vulnerable	Species or species habitat likely to occur within area
Apatophyllum constablei	Endangered	Species or species habitat may occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs	Vulnerable	Species or species habitat likely to occur within area
Cryptostylis hunteriana Leafless Tongue-orchid	Vulnerable	Species or species habitat may occur within area
Diuris bracteata	Extinct	Species or species habitat may occur within area
Diuris praecox Newcastle Doubletail	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus camfieldii Camfield's Stringybark	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus parramattensis subsp. *decadens* Earp's Gum, Earp's Dirty Gum	Vulnerable	Species or species habitat likely to occur within area
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea	Vulnerable	Species or species habitat likely to occur within area
Melaleuca biconvexa Biconvex Paperbark	Vulnerable	Species or species habitat known to occur within area
Microtis angusii	Endangered	Species or species habitat likely to occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269)	Critically	Species or species habitat may occur

a leek-orchid	Endangered	within area
Rhizanthella slateri Eastern Underground Orchid	Endangered	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry	Vulnerable	Species or species habitat likely to occur within area
Tetratheca juncea Black-eyed Susan	Vulnerable	Species or species habitat likely to occur within area
Migratory Species [Dataset Information]	Status	Comments
Migratory Terrestrial Species		
Birds		
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Migratory	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Migratory	Breeding may occur within area
Myiagra cyanoleuca Satin Flycatcher	Migratory	Breeding likely to occur within area
Rhipidura rufifrons Rufous Fantail	Migratory	Breeding may occur within area
Xanthomyza phrygia Regent Honeyeater	Migratory	Species or species habitat likely to occur within area
Migratory Wetland Species		
Birds		
Actitis hypoleucos Common Sandpiper	Migratory	Roosting known to occur within area
Ardea alba Great Egret, White Egret	Migratory	Breeding likely to occur within area
Ardea ibis Cattle Egret	Migratory	Breeding likely to occur within area
Arenaria interpres Ruddy Turnstone	Migratory	Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper	Migratory	Roosting known to occur within area
Calidris alba Sanderling	Migratory	Roosting known to occur within area
Calidris canutus Red Knot, Knot	Migratory	Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper	Migratory	Roosting known to occur within area
Calidris ruficollis Red-necked Stint	Migratory	Roosting known to occur within area
Calidris tenuirostris Great Knot	Migratory	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover	Migratory	Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover	Migratory	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover	Migratory	Roosting known to occur within area
Gallinago hardwickii	Migratory	Roosting known to occur within area

Latham's Snipe, Japanese Snipe		
Heteroscelus brevipes Grey-tailed Tattler	Migratory	Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper	Migratory	Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit	Migratory	Roosting known to occur within area
Limosa limosa Black-tailed Godwit	Migratory	Roosting known to occur within area
Numenius madagascariensis Eastern Curlew	Migratory	Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel	Migratory	Roosting likely to occur within area
Numenius phaeopus Whimbrel	Migratory	Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover	Migratory	Roosting known to occur within area
Pluvialis squatarola Grey Plover	Migratory	Roosting known to occur within area
Rostratula benghalensis s. lat. Painted Snipe	Migratory	Species or species habitat may occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank	Migratory	Roosting known to occur within area
Xenus cinereus Terek Sandpiper	Migratory	Roosting known to occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Breeding likely to occur within area
Ardea ibis Cattle Egret	Migratory	Breeding likely to occur within area
Calonectris leucomelas Streaked Shearwater	Migratory	Species or species habitat may occur within area
Diomedea amsterdamensis Amsterdam Albatross	Migratory	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross	Migratory	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross	Migratory	Foraging, feeding or related behaviour may occur within area
Diomedea exulans (sensu lato) Wandering Albatross	Migratory	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross	Migratory	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel	Migratory	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel	Migratory	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel	Migratory	Species or species habitat may occur within area
Puffinus griseus Sooty Shearwater	Migratory	Breeding known to occur within area
Puffinus leucomelas Streaked Shearwater	Migratory	Species or species habitat may occur within area
Puffinus pacificus Wedge-tailed Shearwater	Migratory	Breeding known to occur within area

Puffinus tenuirostris Short-tailed Shearwater	Migratory	Breeding known to occur within area
Sterna albifrons Little Tern	Migratory	Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross	Migratory	Species or species habitat may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross	Migratory	Species or species habitat may occur within area
Thalassarche chlororhynchos Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross, Indian Yellow-nosed Albatross	Migratory	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross	Migratory	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross	Migratory	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross	Migratory	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross	Migratory	Species or species habitat may occur within area
Migratory Marine Species		
Mammals		
Balaenoptera edeni Bryde's Whale	Migratory	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale	Migratory	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale	Migratory	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale	Migratory	Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin	Migratory	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale	Migratory	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca	Migratory	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle	Migratory	Species or species habitat known to occur within area
Chelonia mydas Green Turtle	Migratory	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth	Migratory	Species or species habitat may occur within area
Natator depressus Flatback Turtle	Migratory	Species or species habitat known to occur within area
Sharks		
Carcharodon carcharias Great White Shark	Migratory	Species or species habitat may occur within area
Rhincodon typus Whale Shark	Migratory	Species or species habitat may occur within area
Listed Marine Species [Dataset Information]	Status	Comments
Birds		
Actitis hypoleucos Common Sandpiper	Listed	Roosting known to occur within area
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area

Ardea alba Great Egret, White Egret	Listed - overfly marine area	Breeding likely to occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Breeding likely to occur within area
Arenaria interpres Ruddy Turnstone	Listed	Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper	Listed	Roosting known to occur within area
Calidris alba Sanderling	Listed	Roosting known to occur within area
Calidris canutus Red Knot, Knot	Listed - overfly marine area	Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper	Listed - overfly marine area	Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper	Listed - overfly marine area	Roosting known to occur within area
Calidris ruficollis Red-necked Stint	Listed - overfly marine area	Roosting known to occur within area
Calidris tenuirostris Great Knot	Listed - overfly marine area	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater	Listed	Species or species habitat may occur within area
Catharacta skua Great Skua	Listed	Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover	Listed - overfly marine area	Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover	Listed	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover	Listed	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover	Listed - overfly marine area	Roosting known to occur within area
Diomedea amsterdamensis Amsterdam Albatross	Listed	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross	Listed	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross	Listed	Foraging, feeding or related behaviour may occur within area
Diomedea exulans (sensu lato) Wandering Albatross	Listed	Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross	Listed	Species or species habitat may occur within area
Eudyptula minor Little Penguin	Listed	Breeding known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Roosting known to occur within area
Gallinago megala Swinhoe's Snipe	Listed - overfly marine area	Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe	Listed - overfly marine area	Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Heteroscelus brevipes Grey-tailed Tattler	Listed	Roosting known to occur within area
Himantopus himantopus Black-winged Stilt	Listed - overfly marine area	Roosting known to occur within area

Hirundapus caudacutus White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
Larus dominicanus Kelp Gull	Listed	Breeding known to occur within area
Larus novaehollandiae Silver Gull	Listed	Breeding known to occur within area
Lathamus discolor Swift Parrot	Listed - overfly marine area	Species or species habitat likely to occur within area
Limicola falcinellus Broad-billed Sandpiper	Listed - overfly marine area	Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit	Listed	Roosting known to occur within area
Limosa limosa Black-tailed Godwit	Listed - overfly marine area	Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel	Listed	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel	Listed	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
Myiagra cyanoleuca Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
Numenius madagascariensis Eastern Curlew	Listed	Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel	Listed - overfly marine area	Roosting likely to occur within area
Numenius phaeopus Whimbrel	Listed	Roosting known to occur within area
Pelagodroma marina White-faced Storm-Petrel	Listed	Breeding known to occur within area
Philomachus pugnax Ruff (Reeve)	Listed - overfly marine area	Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover	Listed	Roosting known to occur within area
Pluvialis squatarola Grey Plover	Listed - overfly marine area	Roosting known to occur within area
Puffinus griseus Sooty Shearwater	Listed	Breeding known to occur within area
Puffinus pacificus Wedge-tailed Shearwater	Listed	Breeding known to occur within area
Puffinus tenuirostris Short-tailed Shearwater	Listed	Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet	Listed - overfly marine area	Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail	Listed - overfly marine area	Breeding may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Sterna albifrons Little Tern	Listed	Species or species habitat may occur within area
Sterna bergii Crested Tern	Listed	Breeding known to occur within area
Thalassarche bulleri Buller's Albatross	Listed	Species or species habitat may occur within area

Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross	Listed	Species or species habitat may occur within area
Thalassarche chlororhynchos Yellow-nosed Albatross, Atlantic Yellow-nosed Albatross, Indian Yellow-nosed Albatross	Listed	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross	Listed	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross	Listed	Species or species habitat may occur within area
Thalassarche salvini Salvin's Albatross	Listed	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross	Listed	Species or species habitat may occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank	Listed - overfly marine area	Roosting known to occur within area
Xenus cinereus Terek Sandpiper	Listed - overfly marine area	Roosting known to occur within area
Mammals		
Arctocephalus forsteri New Zealand Fur-seal	Listed	Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal	Listed	Species or species habitat may occur within area
Ray-finned fishes		
Acentronura tentaculata Shortpouch Pygmy Pipehorse	Listed	Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish	Listed	Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish	Listed	Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish	Listed	Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish	Listed	Species or species habitat may occur within area
Hippocampus abdominalis Eastern Potbelly Seahorse, New Zealand Potbelly, Seahorse, Bigbelly Seahorse	Listed	Species or species habitat may occur within area
Hippocampus whitei White's Seahorse, Crowned Seahorse, Sydney Seahorse	Listed	Species or species habitat may occur within area
Histiogamphelus briggsii Briggs' Crested Pipefish, Briggs' Pipefish	Listed	Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish	Listed	Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish	Listed	Species or species habitat may occur within area
Notiocampus ruber Red Pipefish	Listed	Species or species habitat may occur within area
Phyllopteryx taeniolatus Weedy Seadragon, Common Seadragon	Listed	Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse	Listed	Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish,	Listed	Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish	Listed	Species or species habitat may occur within area

Solenostomus paradoxus Harlequin Ghost Pipefish, Ornate Ghost Pipefish	Listed	Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish	Listed	Species or species habitat may occur within area
Stigmatopora nigra Wide-bodied Pipefish, Black Pipefish	Listed	Species or species habitat may occur within area
Syngnathoides biaculeatus Double-ended Pipehorse, Alligator Pipefish	Listed	Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bend Stick Pipefish, Short-tailed Pipefish	Listed	Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish	Listed	Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish	Listed	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle	Listed	Species or species habitat known to occur within area
Chelonia mydas Green Turtle	Listed	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth	Listed	Species or species habitat may occur within area
Natator depressus Flatback Turtle	Listed	Species or species habitat known to occur within area
Pelamis platurus Yellow-bellied Seasnake	Listed	Species or species habitat may occur within area
Invasive Species [Dataset Information]	Status	Comments
Selected Invasive Species: Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.		
Mammals		
Capra hircus Goat	Feral	Species or species habitat may occur within area
Felis catus Cat, House Cat, Domestic Cat	Feral	Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit	Feral	Species or species habitat likely to occur within area
Sus scrofa Pig	Feral	Species or species habitat may occur within area
Vulpes vulpes Red Fox, Fox	Feral	Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed	WoNS	Species or species habitat may occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus	WoNS	Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed	WoNS	Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom	Invasive	Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana,	WoNS	Species or species habitat likely to occur within area

Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage		
Lycium ferocissimum African Boxthorn, Boxthorn	Invasive	Species or species habitat may occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ)	WoNS	Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine	Invasive	Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry	WoNS	Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow	WoNS	Species or species habitat may occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed	WoNS	Species or species habitat may occur within area
Ulex europaeus Gorse, Furze	WoNS	Species or species habitat may occur within area
Whales and Other Cetaceans [Dataset Information]	Status	Comments
Balaenoptera acutorostrata Minke Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale	Cetacean	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale	Cetacean	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale	Cetacean	Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin	Cetacean	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale	Cetacean	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus	Cetacean	Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin	Cetacean	Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale	Cetacean	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca	Cetacean	Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin	Cetacean	Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	Cetacean	Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin	Cetacean	Species or species habitat may occur within area
Threatened Ecological Communities [Dataset Information]	Status	Comments
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Heritage

Australian Heritage Sites [Dataset Information]
Note that not all Indigenous sites may be listed.

Historic

Cooranbong Post Office (former) NSW

Dobell House NSW

Lambton Colliery Structures and Buildings NSW

Noraville NSW

Park NSW

Police Offices Including Stables NSW

Police Station and Watchhouse NSW

Public School NSW

Toronto Hotel NSW

Wallsend Civic Precinct NSW

Wallsend Courthouse NSW

Wallsend Post Office Including Original Stables NSW

Natural

Awabakal Nature Reserve NSW

Bird Island Nature Reserve NSW

Bow Wow Creek Gorge NSW

Fennell Bay Reserve (Public Reserve R 38237) NSW

Hunter Estuary Wetlands NSW

Moon Island Nature Reserve NSW

Mulbring Road-Fill Quarry NSW

Pulbah Island Nature Reserve NSW

Reserve R 81914 Tingira Heights Fossil Insect Beds NSW

Wetlands

Wetlands of International Importance (Ramsar sites) [Dataset Information]

HUNTER ESTUARY WETLANDS

Nationally Important Wetland Sites [Dataset Information]

Budgewoi Lake Sand Mass, NSW

Colongra Swamp, NSW

Hexham Swamp, NSW

Jewells Wetland, NSW

Lake Macquarie, NSW

Shortland Wetlands Centre, NSW

Tuggerah Lake, NSW

National Pollutant Inventory

NPI Location Report

Reporting Facility [Dataset Information]	Top Substance	Source
Substance emissions are ranked on a scale of 1-100: 1=lowest; 100=highest. Rankings are shown as: ◔=0-25; ◑=26-50; ◕=51-75; ●=76-100.		
	Particulate Matter 10.0 um ◔ [Low]	Steel processing/ fabrication. The Rod and Bar Mills hot form structural sections of rod and bar from billet feed stock.
Australian Co-Operative Foods Limited (Dairy Farmers Wetherill Park, Wetherill Park NSW)	Particulate Matter 2.5 um	Milk processing

	[Low]	
Bayer CropScience Pty Limited (Bayer Agricultural Operations Centre, Wyong NSW)	Total Volatile Organic Compounds [Low]	Formulation and packing of agricultural and animal health products.
Boral Montoro Pty Ltd (Boral Roofing Wyee, Bushells Ridge NSW)	Fluoride compounds [Low]	Manufacture of terracotta roof tiles on the site. This includes quarrying, crushing clay, extrusion and pressing, drying and firing the product.
Centennial Coal Pty Ltd (Mannering Colliery, Wyee NSW)	Boron & compounds [Low]	Underground coal mining and coal handling (no washing).
Centennial Mandalong Pty Ltd (Mandalong Colliery, Mandalong NSW)	Particulate Matter 10.0 um [Low]	Underground coal mining and coal handling
Centennial Munmorah Pty Limited (Munmorah Colliery, Doyalson NSW)	Fluoride compounds [High]	Decommissioned Underground coal mining and coal handling.
Centennial Myuna Pty Ltd (Myuna Colliery, Wangi Wangi NSW)	Manganese & compounds [Low]	Underground coal mining and coal handling. Limited preparation/stockpiling and no washing of coal
Centennial Newstan Pty Ltd (Awaba Colliery, Awaba NSW)	Manganese & compounds [Low]	Underground coal mining
Centennial Newstan Pty Ltd (Newstan Colliery, Fassifern NSW)	Particulate Matter 10.0 um [Low]	Underground coal mining and coal handling (stockpiling coal washing and reject emplacement).
Commonwealth Steel Company Ltd (Onesteel Waratah, Waratah NSW)	Mercury & compounds [Low]	Secondary steel manufacture
Delta Electricity (Munmorah Power Station, Doyalson NSW)	Oxides of Nitrogen [Low]	Electricity generator
Delta Electricity (Vales Point Power Station, Mannering Park NSW)	Selenium & compounds [Medium]	Electricity generator
Electric Lamp Manufacturers (Australia) Pty Ltd (Hamilton NSW)	Oxides of Nitrogen [Low]	Manufacture of incandescent and fluorescent lamps and glass
Eraring Energy (Eraring Power Station, Eraring NSW)	Fluoride compounds [High]	Coal fired electricity generation
George Weston Foods Limited (Tip Top Bakeries Newcastle, Gateshead NSW)	Ethanol [Low]	Bread and bread roll baking and packaging
Hunter Water Corporation (Belmont Wastewater Treatment Works, Belmont NSW)	Hydrogen sulfide [Low]	Wastewater treatment by conventional activated sludge
Hunter Water Corporation (Burwood Beach Wastewater Treatment Works, Merewether NSW)	Hydrogen sulfide [Low]	Conventional activated sludge sewage treatment
Hunter Water Corporation (Edgeworth Wastewater Treatment Works, Edgeworth NSW)	Hydrogen sulfide [Low]	Continuous extended aeration sewage treatment
Hunter Water Corporation (Shortland Wastewater Treatment Works, Shortland NSW)	Total Phosphorus [Low]	Intermittent decanted extended aeration sewage treatment
Hunter Water Corporation (Toronto Wastewater Treatment Works, Toronto NSW)	Ammonia (total) [Low]	Intermittent decant extended aeration sewage treatment
Hunter Water Corporation (Windale Wastewater Treatment Works, Windale NSW)	Total Nitrogen [Low]	Biological trickling filter
Hunter Water Limited (Dora Creek Wastewater Treatment Works, Dora Creek NSW)	Ammonia (total) [Low]	Wastewater treatment through intermittent decant extended aeration
Incitec Pivot Ltd (Incitec Pivot Cockle Creek Works, Boolaroo NSW)	Fluoride compounds [Low]	Manufacture and distribution of superphosphate

Inghams Enterprises Pty Ltd (Inghams Cardiff Feedmill, Cardiff NSW)	Particulate Matter 10.0 um [Low]	Animal feed manufacture
Metromix Pty Limited (Teralba Quarry, Teralba NSW)	Chromium (III) compounds [Low]	Drill and blast, extraction, crushing and processing, sale and transport of concrete aggregates and road construction materials.
Newcastle Coal Pty Ltd (Tasman Underground Mine, Seahampton NSW)	Particulate Matter 10.0 um [Low]	Tasman Underground mining
Oceanic Coal Australia Limited (Macquarie Coal Preparation Plant, Teralba NSW)	Particulate Matter 10.0 um [Low]	Coal washery facility with tailings and coarse reject emplacement regions.
Oceanic Coal Australia Limited (Teralba Colliery, Teralba NSW)	Chromium (III) compounds [Low]	Underground Coal Mining - coal was delivered underground directly to Macquarie Coal Preparation Plant. Minimal surface facilities. Operations ceased on 28 May, 2001. Site now undergoing care and maintenance activities.
Oceanic Coal Australia Limited (West Wallsend Colliery, Killingworth NSW)	Total Volatile Organic Compounds [Low]	Underground coal mining using longwall methods and continuous mining (only in development units). Coal is directly transported via a private haul road directly to Macquarie Coal Preparation Plant by haul trucks.
Oceanic Coal Australia Limited (Westside Mine, Wakefield NSW)	Particulate Matter 10.0 um [Low]	Open cut coal mine with crushing plant.
One Steel (One Steel - Market Mill (Rod Mill), Mayfield East NSW)	Particulate Matter 10.0 um [Low]	Steel Processing/Fabrication
OneSteel Australian Tube Mills (OneSteel Newcastle Tube Mill, Mayfield NSW)	Xylenes (individual or mixed isomers) [Low]	Forming pipe and tube from steel coil with some galvanizing. Fabricated metal product manufacturing.
OneSteel Manufacturing Pty Ltd (Newcastle Bar Mill, Mayfield West NSW)	Particulate Matter 10.0 um [Low]	Steel processing/ fabrication. The Rod and Bar Mills hot form structural sections of rod and bar from billet feed stock.
OneSteel Trading Pty Ltd (OneSteel Metaland Wallsend, Mayfield NSW)	Manganese & compounds [Low]	Distributes a wide range of metal products for building/construction/trades customers. Minimal processing with some cutting of product to customer requirements.
OneSteel Wire Pty Ltd (OneSteel Newcastle Wire Mill, Mayfield NSW)	Hydrochloric acid [Low]	Steel processing/ fabrication and galvanizing. Wire is drawn from rod. Some is cleaned and coated. Some is galvanised and some is fabricated into barbed wire and fencing wire.
Pasminco Cockle Creek Smelter Pty Limited (Pasminco Cockle Creek Smelter, Boolaroo NSW)	Sulfuric acid [Low]	Lead smelting from concentrates; zinc smelting from concentrate, sulphuric acid production. Smelting operations ceased 12 September 2003. Major activities since have been associated with waste treatment and demolition of site buildings.
Quality Bakers Australia Limited (Quality Bakers Australia Broadmeadow Plant, Broadmeadow NSW)	Oxides of Nitrogen [Low]	Bakeries - bread and bread rolls
Rail Corporation NSW (Railcorp) (Railcorp Endeavour Service Centre, Broadmeadow NSW)	Cumene (1-methylethylbenzene)	Train maintenance and fuelling facility. Cleaning, service and maintenance of

	[Low]	Xplorer and Endeavour trains.
Sanitarium Health Food Company (Sanitarium Health Food Company Cooranbong, Cooranbong NSW)	Particulate Matter 2.5 um [Low]	Snack and health foods processing, manufacturing and packaging products.
The Newcastle Wallsend Coal Company Pty Ltd (New Wallsend No.2 Colliery, Wallsend NSW)	Chromium (III) compounds [Low]	Underground coal mining, mine decommissioning activities and rehabilitation activities
The Shell Company of Australia Limited (Shell Newcastle Petroleum Terminal, Hamilton NSW)	n-Hexane [Low]	Petroleum storage and distribution.
Works Infrastructure Pty Ltd (Works Infrastructure Teralba, Teralba NSW)	Particulate Matter 10.0 um [Low]	Production of hot-mix asphalt
Wyong Shire Council (Norah Head Outfall - Toukley Sewage Treatment Plant, Noraville NSW)	Total Phosphorus [Low]	Sewage treatment processes: preliminary, primary, secondary sludge digestion and sludge dewatering. Portion of effluent is tertiary treated.
Yates Australia Pty Ltd (a Division of Orica) (Yates Australia Wyee, Wyee NSW)	Ammonia (total) [Low]	Manufacture of manure and mineral blend fertilisers and potting mix.
Airshed [Dataset Information]	Substances	Sources
Greater Sydney Newcastle & Wollongong Regions (GMR), NSW	73	23
Catchment [Dataset Information]	Substances	Sources
Hunter River, NSW	2	32

Other

Reserves and Conservation Areas [Dataset Information]

Awabakal Nature Reserve, NSW

Bird Island Nature Reserve, NSW

Hexham Swamp Nature Reserve, NSW

Moon Island Nature Reserve, NSW

Pulbah Island Nature Reserve, NSW

Tingira Heights Nature Reserve, NSW

Watagans National Park, NSW

Regional Forest Agreements [Dataset Information]
Note that all RFA areas including those still under consideration have been included.

Lower North East NSW RFA, New South Wales

Caveat

The information presented here has been drawn from a range of sources, compiled for a variety of purposes. Details of the coverage of each dataset are included in the metadata [Dataset Information] links above.

Acknowledgment

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia

- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Appendix J

Review of Social Impacts (AECOM Australia Pty Ltd, 2010a)

Review of Social Impacts

Review of Social Impacts

Review of Social Impacts

Review of Social Impacts

Prepared for

Centennial Myuna Pty Ltd

Prepared by

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Distribution

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Revision History

Revision	**Revision Date**	**Details**	**Authorised**	
			Name/Position	**Signature**
1	25/10/10	Final	Catherine Brady Technical Peer Reviewer	

Contents

List of Tables

List of Figures

Executive Summary

AECOM has been commissioned by Centennial Myuna Pty Ltd (CMPL) to undertake a review of social impacts as part of the Environmental Assessment (EA) for the Myuna Colliery Extension Project. This Review of Social Impacts will form an appendix to the Environmental Assessment (EA) being prepared to support an application for Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This review of social impacts has drawn on information from the Lake Macquarie and Wyong Shire Local Government Areas (LGAs)**.**

A series of impacts are considered in this report, including those relevant to the current operations, which will provide a benchmark for any future impacts, as well as potential impacts of the proposed extension of mining at Myuna Colliery.

Background

The proposed Project will extend mining and coal handling at Myuna Colliery within the Project Application Area and proposes to:

- mine using bord and pillar methods in the Wallarah, Great Northern and Fassifern seams in CCL762 and ML1370, for a further 21 years;
- produce, handle and distribute to Eraring Power Station, up to 2 Mtpa using existing infrastructure;
- continue the use of ancillary infrastructure and services for a further 21 years;
- upgrade the water management system; and
- rehabilitate the surface facilities within 5 years of completion of mining.

All existing infrastructure within the Surface Facilities Area of Myuna Colliery, located in Wangi Wangi on the western side of Lake Macquarie, 25 kilometres south-west of Newcastle, will be utilised to service the proposed Project. Myuna Colliery will continue to use the Eraring Energy owned Enclosed Overland Conveyor to transport coal to Eraring Power Station.

CMPL undertakes underground mining at Myuna Colliery:

- Within the Development Consent Mining Area; and
- Within Consolidated Coal Lease (CCL) 762 and Mining Lease (ML) 1370 but external to the Development Consent Mining Area, pursuant to the combined operation of Section 74(1) of the Mining Act 1992 (Mining Act) and clause 8K of the Environmental Planning and Assessment Regulation 2000.

The Project Application Area encompasses ML 1370, a portion of CCL 762 and the Surface Facilities Area. The Project Application Area comprises an area within the boundaries of CCL 762 and ML 1370, but external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area).

Methodology

The objective of this review of social impacts is to assess the potential social impacts the proposed Project may have on the surrounding areas.

The methodology utilised for this review focused on a desktop assessment of secondary data, i.e. data collected by someone other than the user, including:

- CMPL information;
- Australian Bureau of Statistics (ABS) Census data;
- Media review; and
- Literature review.

Stakeholder and community consultation has been undertaken by the Myuna Colliery as part of the EA process and as such is not included in this report.

Social Profile

A social profile was undertaken as part of this review in order to outline the existing social characteristics of the Lake Macquarie and Wyong LGAs, therefore providing a benchmark against which potential impacts could be assessed.

The social profile has focused on the Lake Macquarie and Wyong LGAs, which are the two LGAs within which the proposed Project sits and from where the majority of Myuna Colliery employees reside. As a result of this, the social profile has focused predominantly on discussing the broader socio-economic trends for these two LGAs, in comparison to NSW. The subjects examined as part of this social profile include:

- Geographical Location and Governance, including:
  - Wyong and Lake Macquarie LGAs; and
  - State Governance and Federal Governance of these LGAs.
- Industry, including:
  - The industries surrounding the Project Application Area and other major projects relevant to the Project Application Area.
- Socio-economic characteristics, including:
  - Population demographics, including age structure, and family structure; and
  - Education and levels of educational qualification.
- Local economy, including:
  - Economic growth industries, particularly mining and tourism;
  - Industry and employment characteristics; and
  - Household incomes.
- Housing, including:
  - Temporary accommodation; and
  - Housing, the cost of living and income.
- Community services and Infrastructure, including:
  - Health services, local emergency services (police, fire brigade, rural fire service and state emergency service);
  - Aged care facilities;
  - Educational facilities (primary, secondary and tertiary);
  - Childcare;
  - Public Transport;
  - Leisure and recreational facilities;
  - Community facilities; and
  - Service infrastructure (sewer, water and waste).
- Community Issues
- Community needs and social values, including:
  - Sustainability and council policies.

Impact Assessment

The potential social impacts of the proposed Project were assessed on a broad, LGA-based scale and also within the primary and secondary areas of influence. Potential impact areas that were addressed include:

- Environmental impacts (including effects of subsidence and ongoing operations at the Surface Facilities Area);
- Economic impacts (including wages, State economic stimulus, and cessation of mining);
- Social impacts (including CMPL's ongoing investment in community projects);
- Financial impacts (due to increased concern with reduced property prices);
- Cumulative impacts (with existing development and proposed projects in the local area); and
- Impact significance, including:
    - People's way of life;
    - Culture;
    - Community;
    - Political system;
    - Environment;
    - Health and wellbeing;
    - Person and property rights; and
    - Fears and aspirations.

This review of social impacts determined that as Myuna Colliery is an existing land use and operation, the social impacts will either remain generally as per the existing operation or will be improved by the proposed Project. The proposed Project would therefore result in minimal negative social impact, and instead the proposed Project would provide ongoing employment opportunities for 210 individuals and economic stimulus to the local, regional and State economies.

Conclusion

While the potential social impacts are identified as part of this review, it should be highlighted social impacts are both positive and negative in nature. There is the potential for some minor negative impacts however these will be managed under Myuna Colliery's existing Environmental Management System and the measures outlined in the EA Statement of Commitments.

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned by Centennial Myuna Pty Ltd (CMPL) to prepare an Environmental Assessment (EA) for the Myuna Colliery Extension of Mining (proposed Project), located 25 kilometres south-west of Newcastle (refer to **Figure 1**). This study was undertaken as part of the EA to support an application for Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979*.

AECOM has been commissioned by CMPL to undertake a review of social impacts, as part of the EA process, for the proposed Project. This review of social impacts has drawn on information from the Lake Macquarie and Wyong Shire Local Government Areas (LGAs)

A series of impacts are considered in this report, including those relevant to the current operations as well as potential impacts of the proposed extension of mining at Myuna Colliery.

1.1 Purpose of this Report

The purpose of this report was to review the potential social impacts, both positive and negative in nature, associated with the proposed Project. A series of impacts are considered in this report, including the impacts of the current operation as well as potential impacts of the proposed Project.

1.2 Structure of this Report

This review of social impacts is structured as follows:

- **Chapter 1** provides an introduction on the purpose of the report;
- **Chapter 2** provides an overview of the background to the project and the surrounding land uses;
- **Chapter 3** provides an outline of the social impact review methodology;
- **Chapter 4** outlines the social profile of the Wyong and Lake Macquarie LGAs;
- **Chapter 5** discusses the potential social impacts of the project and their significance; and
- **Chapter 6** provides a conclusion to the report.

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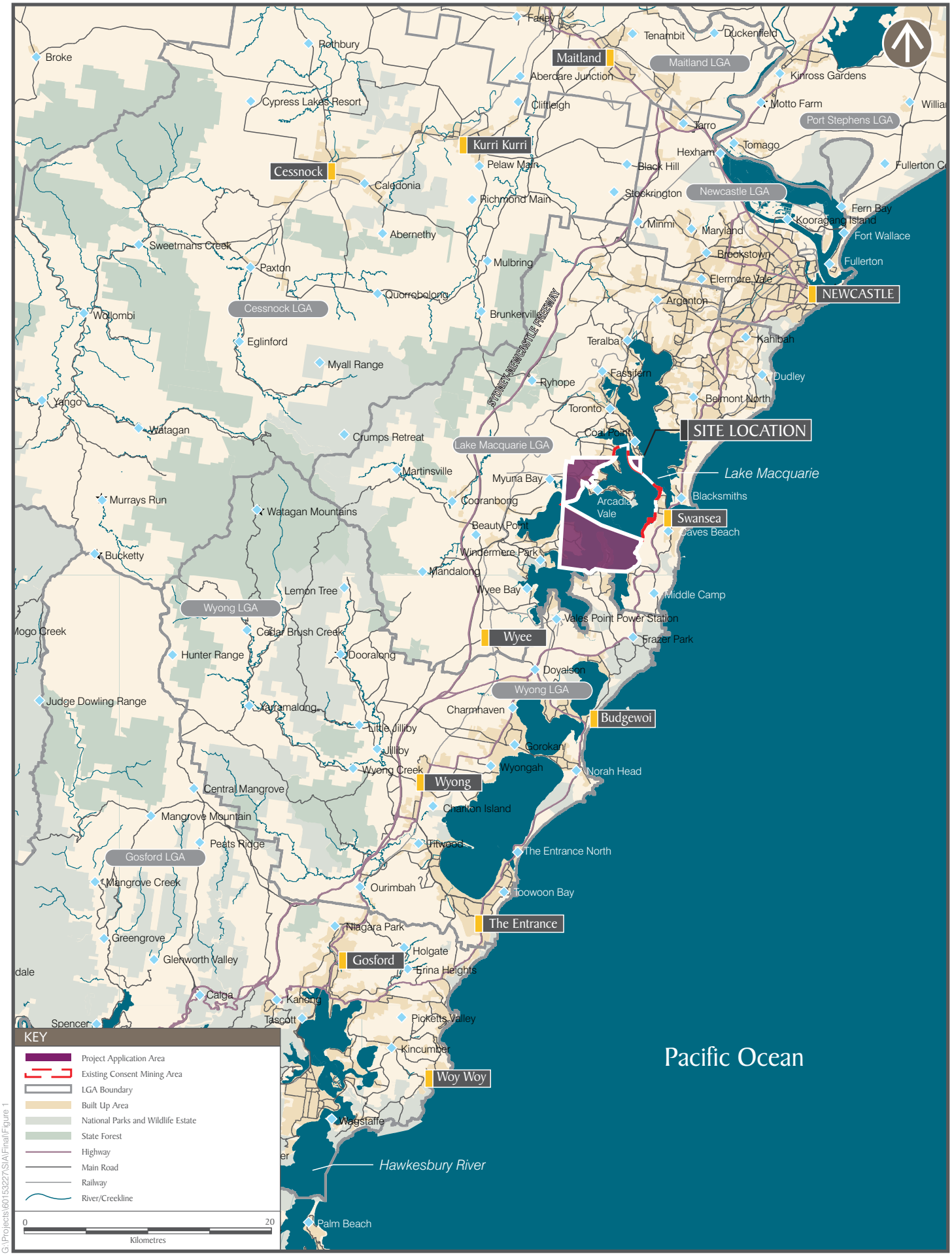

G:\Projects\60153227\SIA\Final\Figure 1

AECOM

SITE LOCATION

Centennial Myuna Pty Ltd

Review of Social Impacts

Figure 1

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2.0 Background

2.1 Overview

The proposed Project will extend mining and coal handling at Myuna Colliery within the Project Application Area and proposes to:

- mine using bord and pillar methods in the Wallarah, Great Northern and Fassifern seams in CCL762 and ML1370, for a further 21 years;
- produce, handle and distribute to Eraring Power Station, up to 2 Mtpa using existing infrastructure;
- continue the use of ancillary infrastructure and services for a further 21 years;
- upgrade the water management system; and
- rehabilitate the surface facilities within 5 years of completion of mining.

All existing infrastructure within the Surface Facilities Area of Myuna Colliery, located in Wangi Wangi on the western side of Lake Macquarie, 25 kilometres south-west of Newcastle, will be utilised to service the proposed Project. Myuna Colliery will continue to use the Eraring Energy owned Enclosed Overland Conveyor to transport coal to Eraring Power Station.

CMPL undertakes underground mining at Myuna Colliery:

- Within the Development Consent Mining Area; and
- Within Consolidated Coal Lease (CCL) 762 and Mining Lease (ML) 1370 but external to the Development Consent Mining Area, pursuant to the combined operation of Section 74(1) of the Mining Act 1992 (Mining Act) and clause 8K of the Environmental Planning and Assessment Regulation 2000.

The Project Application Area is shown on **Figure 2** and encompasses ML 1370, a portion of CCL 762 and the Surface Facilities Area. The Project Application Area comprises an area within the boundaries of CCL 762 and ML 1370, but external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area).

2.2 Project Description

The Project will extend mining at Myuna Colliery within the Project Application Area, comprising an area external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area) but within the boundaries of CCL 762 and ML 1370.

The Project's mining operations will continue to be carried out using bord and pillar methods in the Wallarah, Great Northern and Fassifern coal seams, generally consistent with the manner in which CMPL undertakes current mining operations at Myuna Colliery.

Further, all existing infrastructure at the Surface Facilities Area will be utilised to service the Project, with some minor modification.

2.2.1 Mining Area

The Project Application Area encompasses the coal measures and three seams previously mined at Myuna Colliery and as such includes some existing workings and areas requiring new workings to be developed. Access to new areas will be from the existing workings.

2.2.2 Mining Methods

The Project's mining operations will continue to be carried out using bord and pillar methods in the Wallarah, Great Northern and Fassifern coal seams, generally consistent with the manner in which CMPL undertakes current mining operations at Myuna Colliery. The mining layout to be implemented within the three seams in any given area of the Project Application Area will be determined during detailed mine planning and development of a geotechnically engineered mine design. The mine design will address the various mine constraints, including (at least) the High Water Level Subsidence Control Zone; the 40 metres of solid rock head and the coal pillar factor of safety. For any areas where secondary extraction is proposed to be undertaken, CMPL will seek approval from the Department of Industry and Investment.

2.2.3 Surface Subsidence

Mining within the Project Application Area will be designed to remain below two levels of subsidence. The two zones include:

Zone A – Long term stable mining systems generating less than 20 millimetres of surface subsidence (i.e. no noticeable surface impact); and

Zone B – Mining systems generating a maximum of 650 millimetres of surface subsidence.

Zone A level of negligible subsidence is proposed under sensitive areas such as residential areas, State Conservation Areas, foreshore areas and seagrass beds. Zone B level of subsidence is proposed under the less sensitive areas of Lake Macquarie.

2.3 Surrounding Land Use

Underground coal mining has already been carried out in the Project Application Area and surrounds. The Project Application Area is predominately positioned beneath Lake Macquarie which is NSW Government Crown land and used primarily for recreational purposes. Other land ownership includes Crown and freehold land.

Myuna Colliery's Surface Facilities Area is located on land owned by Centennial Fassifern Pty Ltd, is surrounded by vegetated ridgelines and constructed adjacent to the now disused Wangi Power Station. The Enclosed Overland Conveyor located to the north-west of the surface facilities is owned by Eraring Energy and situated on land owned by Eraring Energy, the State of NSW and Centennial Fassifern Pty Ltd.

Myuna Colliery's Surface Facilities Area is located west of the residential area of Arcadia Vale and northwest of Wangi Wangi, with surface infrastructure located approximately 0.5 kilometres from the nearest receiver.

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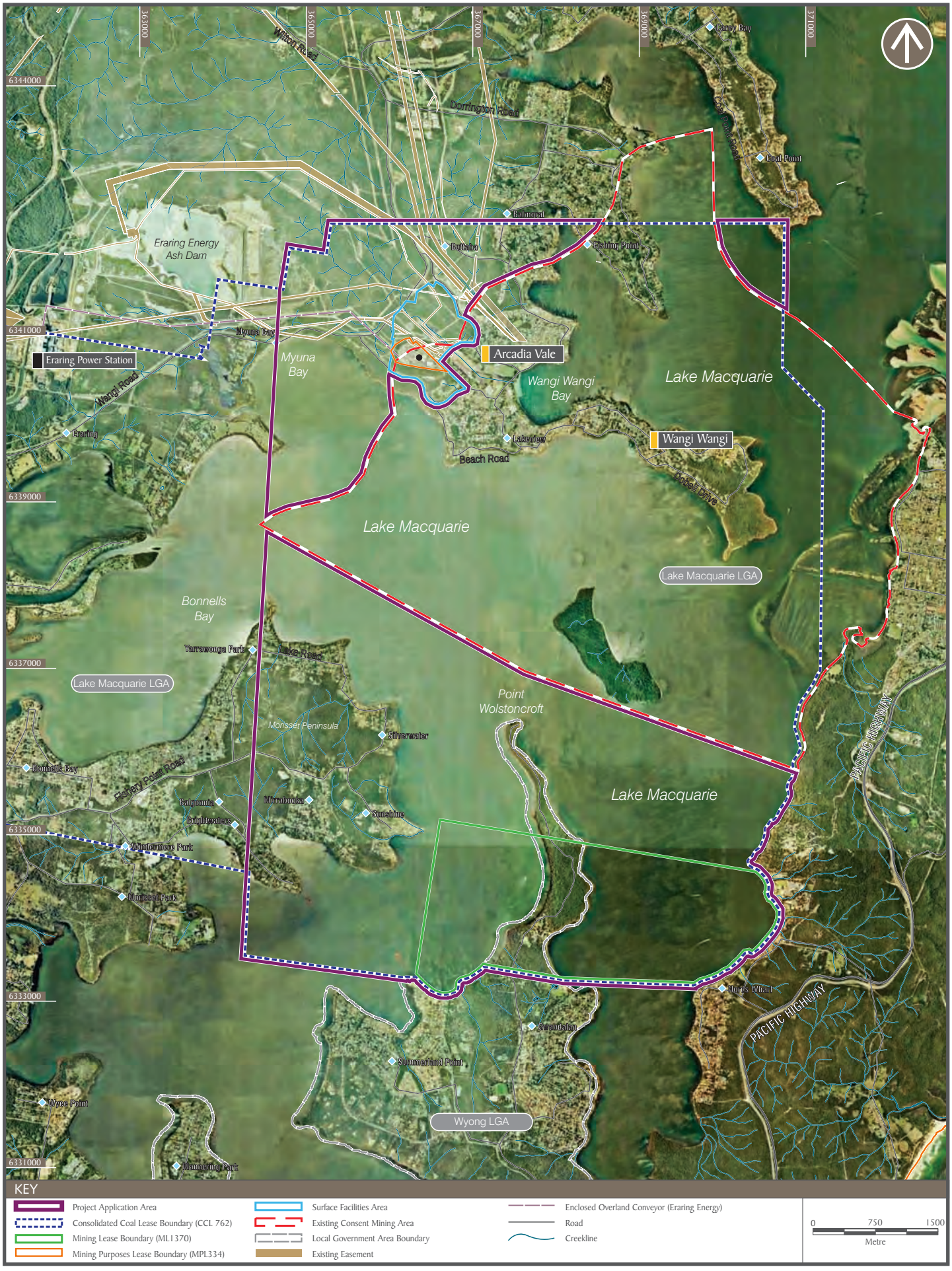

AECOM

PROJECT APPLICATION AREA

Centennial Myuna Pty Ltd

Review of Social Impacts

Figure 2

3.0 Review of Social Impacts Methodology

The objective of this review of social impacts is to assess the potential social impacts the proposed Project may have on the surrounding areas. This review has focused on the Lake Macquarie and Wyong Shire LGAs, with particular emphasis on the primary and secondary areas of influence (refer to **Section 5.1).**

The methodology utilised for this review focused on a desktop assessment of secondary data, i.e. data collected by someone other than the user, including:

- CMPL data;
- Australian Bureau of Statistics (ABS) Census data;
- Media review; and
- Literature review.

Stakeholder and community consultation has been undertaken by CMPL as part of the EA process and as such is not included in this report.

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4.0 Social Profile

A social profile was undertaken as part of this review in order to outline the existing social characteristics of the Lake Macquarie and Wyong LGAs, therefore providing a benchmark against which potential impacts could be assessed.

The social profile has focused on the Lake Macquarie and Wyong LGAs, which are those within which the Project Application Area sits and where the majority of Myuna Colliery employees reside. 54% of employees reside in the Lake Macquarie local Government area (LGA), 29% reside in West Newcastle and Hunter LGAs and 17% reside on the Central Coast.

4.1 Geographical Location and Governance

4.1.1 Lake Macquarie LGA

The Lake Macquarie LGA is located 150 kilometres north of Sydney on the east coast of NSW, directly north of the Wyong LGA.

The region covers an area of 754 square kilometres comprising a landscape of mountains, beaches and coastal plains encircling Lake Macquarie, coastal saltwater lagoon. Lake Macquarie is on the southern border of the coastal Hunter region and the city of Lake Macquarie is the fastest growing region in the Hunter. The Lake Macquarie LGA is the fourth most populous in NSW. The larger urban centres in the region are Toronto, Belmont, Morisset, Swansea/Caves Beach and Charlestown. Covering 110 square kilometres with 174 kilometres of shoreline, Lake Macquarie is the dominant landscape feature of the region, accounting for 14.5% of the LGA's area.

The majority of land in the Lake Macquarie LGA is zoned for residential purposes. Industry takes up the next largest portion of land, followed by intensive agriculture and rural land. A large portion of land in the LGA is part of the Watagans National Park. Open space accounts for over 2,000ha of the Lake Macquarie LGA, which is used primarily for the many recreational activities for which the area is famous (SoER, 2009).

4.1.2 Wyong LGA

The Wyong LGA is located approximately 100 kilometres north of Sydney on the east coast of NSW, bordered by Lake Macquarie LGA to the north, Gosford LGA to the south and Cessnock LGA to the north-west.

The area covers 820 square kilometres and is home to approximately 149,000 people. Approximately 110ha of the Wyong LGA at Point Wolstoncroft, falls within the Project Application Area. The landscape of the Wyong LGA encompasses coastal shoreline and beaches in the east, Mangrove Mountain Plateau and Ourimbah and Wyong state forests to the west and three lakes – Lake Tuggerah, Lake Budgewoi and Lake Munmorah. The LGA has several urban centres including Wyong, The Entrance, Toukley and Budgewoi.

Forestry encompasses the largest land use of the LGA at 37%, followed by bushland and extensive agriculture making up 29% and 15% respectively. Residential land zoning covers 8% of the Wyong Shire, with other land uses including intensive agriculture, wetlands, industry/commerce, rural residential and disturbed lands all at less than 1% of total land area each. Mining and ash dams also make up less than 1% of land each (SoER, 2009).

4.1.3 State Governance

The Lake Macquarie LGA is in the State electoral district of Lake Macquarie, which includes parts of Lake Macquarie and Wyong and has an electoral voter population of 48,202. In the 2007 State election, the seat in the Legislative Assembly was won by Greg Piper, an Independent member. The region had previously been dominated by a Labor seat, with the four elected politicians since 1950 members of the ALP. Approximately 50% of the total votes in the 2007 election were preferenced to the Independent candidate.

The remaining part of the Wyong LGA which is not included in the Lake Macquarie state electoral region is part of the Wyong district. The total voting population stands at 50,287. The current elected State representative is David Harris of the ALP. Also a strong Labor seat, all elected politicians since 1961 have been ALP members.

4.1.4 Federal Governance

West Lake Macquarie lies within the federal government electorate of Charlton, which is in 688 square kilometres area and has been represented by Greg Combet since 2007, member of the ALP.

The Wyong Shire LGA is encompassed by the federal government electorates of Dobell and Shortland. In the 2007 federal election, the Dobell seat (covering an area of 886 square kilometres), was won by Craig Thomson of the ALP, though has previously been held by the Liberal Party from 2001-2007.

Point Wolstoncroft is within the federal electorate of Shortland, represented since 1998 by Jill Hall, member of the ALP. The electorate covers only 182 square kilometres and is bordered by Charlton to the west.

4.2 Industry

4.2.1 Surrounding Industry

The Myuna Colliery is an existing land use within the Lake Macquarie and Wyong Shire LGAs. A band of suburbs from Tuggerah in the south to Maitland in the north, including the Project Application Area, fall under existing Coal Titles, while nearby Mineral titles exist at Awaba, and a Petroleum Title covers the entire region. Eraring Energy Power Station is situated west of Myuna Colliery's Surface Facilities Area.

4.2.2 Other Proposed Development

As at 25 May 2010, the proposed Project is one of 26 Major Projects for the Lake Macquarie LGA and 18 Major Projects for the Wyong LGA listed on the NSW Department of Planning website (DoP Register of Major Projects, 2010).

Table 1 provides details of the Major Projects and other development relevant to Lake Macquarie, within 10 kilometres of the Project Application Area.

Table 1: Projects proposed within the Lake Macquarie and Wyong LGAs

Project	Description	Status	Geographical Location
07_0138 Marmong Point Marina Expansion: Marina Expansion	Upgrade and expansion of Marmong Point Marina, comprising: - demolition of eastern marina arm; - new floating marina arm consisting of four arms for 155 wet berths extending east from existing marina structure; - provision of parking for 30 cars; - relocate affected recreational swing moorings; - relinquish affected commercial swing moorings; - sewer pump-out; and - replace emergency spill shed.	Approved - 18/02/2010	Lake Macquarie - Marmong Point (approximately 10kilometres NNE of Myuna Surface Facilities Area)
06_0309 Trinity Point Drive: Mixed use marina/tourist/residential (Concept Plan)	Marina comprising 308 wet berths and associated marina club and tourism facilities, boat repair and maintenance facilities, chandlery and helipad, kayak launch facility, restaurant and cafe, function rooms, conference and business centre, gymnasium, shops, 150 apartments (75 residential and 75 tourist accommodation), boardwalk and associated parking.	Approved - 05/09/2009	Morisset Park (approximately 7.2kilometres SW of Myuna Surface Facilities Area)

Project	Description	Status	Geographical Location
Awaba Coal Project	The Awaba Coal Project, including: - extending the life of the Awaba Colliery until 2015; - extracting coal from existing approved mining areas, extending the Stage 3 mining area and developing the East B mining area to produce a total of 880,000 tonnes of run-of-mine coal per annum; - expanding the mine's existing pollution control dam; - continued coal delivery to the Eraring Power Station and Newstan Colliery; - continued use of the mine's surface infrastructure, including processing and transport systems; and - rehabilitating the site.	DGR's Issued: 22/04/2010	Wilton Road, Awaba (approximately 5 kilometres NW of Myuna Surface Facilities Area)
Wangi Power Station Rezoning	Lake Macquarie Local Environmental Plan 2004 (draft amendment No 33) rezones land at the Wangi Power Station from Zone 10 Investigation to Zone B4 Mixed Use Zone, and 2(2) Residential (Urban Living) Zone. This will allow a mix of uses and the future development and conservation of the Wangi Power Station Building and its surrounds. The following matters, must be adopted by the Council before consent is granted for any development: "f) measures to reduce any potential conflicts with adjoining land uses, including Myuna colliery,"	Approved	Adjacent to the Myuna Colliery Surface Facilities Area on Wangi Road, Wangi Wangi
Chain Valley Colliery	Chain Valley Colliery - Continuation of Mining Operations	DGR's Issued: 12/08/2009	Vales Point (approximately 11 kilometres south of Myuna Surface Facilities Area)

4.3 Socio-Economic Characteristics

The profile presented below is based on Australian Bureau of Statistics (ABS) census data from 2001 and 2006 (www.abs.gov.au).

4.3.1 Population Numbers

The Lake Macquarie LGA had a population of 180,126 (48.9% were males and 51.1% were females) and the Wyong LGA had a population of 139,801 (48.3% were males and 51.7% were females) at the time of census (ABS, 2006).

Lake Macquarie is the fourth most populous of 152 LGAs in New South Wales (NSW) behind Blacktown, Sutherland Shire and Wollongong (SoER, 2009). Wyong LGA is the 16th most populous LGA (SOSR, 2009).

The population of the Lake Macquarie LGA increased in the 1990s, from 162,097 in 1991 to 177,000 in 2001. The population continued to increase from 2001, although at a slower rate, rising to 180,126 in 2006, an increase of 11.1%, representing an average annual growth rate of 0.74% (SoER, 2009). The population of Lake Macquarie

LGA is expected to grow by 60,000-70,000 residents over the next 25 years (Lake Macquarie Community profile, 2009).

Over the past 25 years Wyong LGA has changed from a holiday and retirement area to an urban fringe area of Sydney. While Wyong LGA is still growing, the rate of growth has slowed since 1986. The average annual growth rate from 1997 to 2001 was 2.44%, which slowed to 1.0% from 2002 to 2006 (SOSR, 2009).

4.3.2 Age Structure

The majority of persons in the Lake Macquarie and Wyong LGAs are of working age, with the number of children being similar to the State average while the number of older people is higher (refer **Figure 1**). All three populations, Lake Macquarie LGA, Wyong LGA and NSW, have an ageing population, as shown in **Figure 1**.

Figure 1: Percentage of age ranges in 2006 for Lake Macquarie and Wyong LGAs, compared to NSW (ABS, 2006)

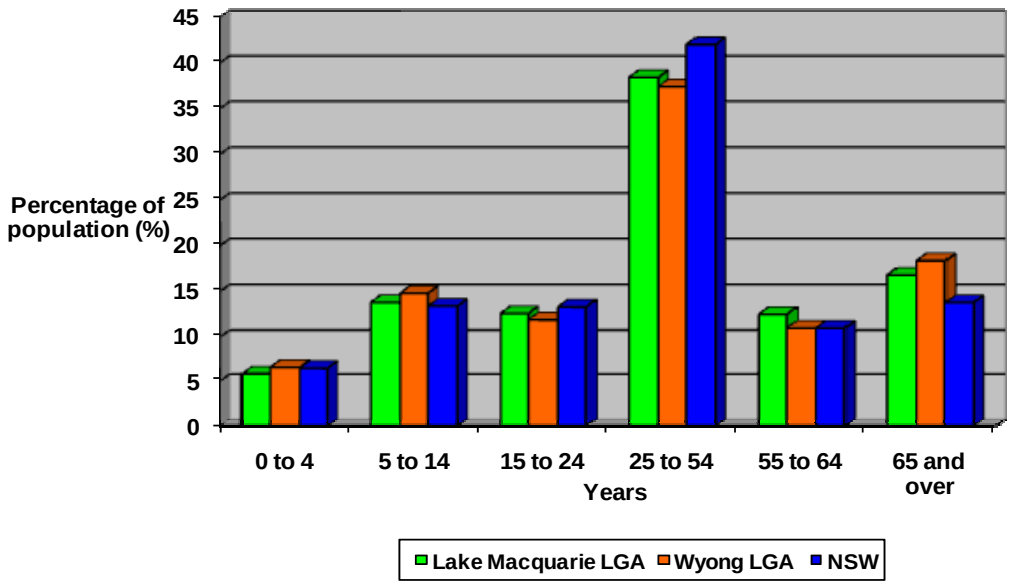
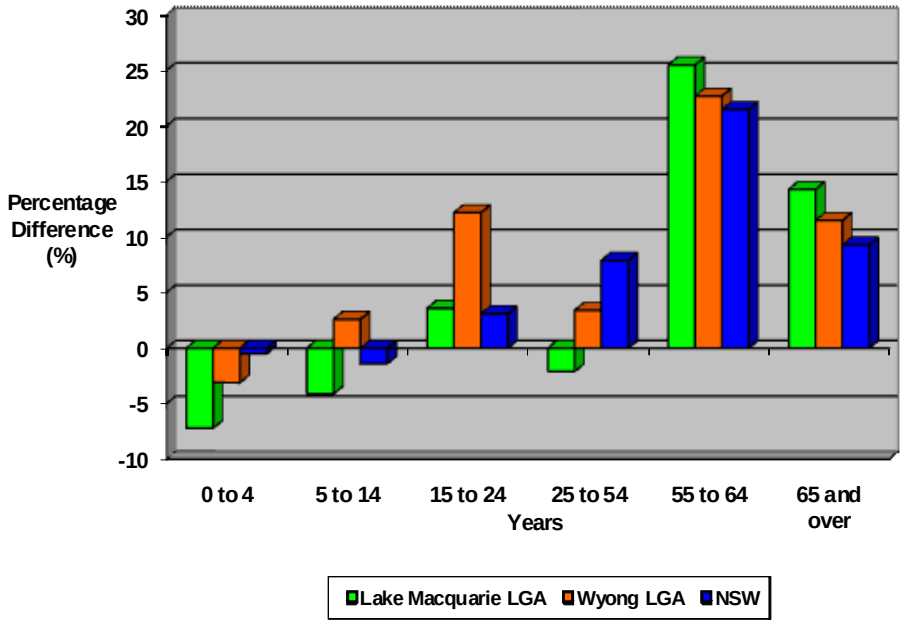


Figure 2: Percentage Difference in Age Structure 2001-2006 (ABS, 2006).



4.3.3 Family Structure

The family structures of the Lake Macquarie and Wyong LGAs compared to NSW are shown in **Table 2** below.

Table 2: Family Structure in Lake Macquarie and Wyong LGAs compared to NSW (ABS, 2006).

	Lake Macquarie LGA	Wyong LGA	NSW
Total Families	51,327	38,035	1,716,220
Couple families with children	22,394 (43.6%)	15,653 (41.2%)	792,685 (46.2%)
Couple families without children	19,717 (38.4%)	14,507 (38.1%)	618,583 (36.0%)
One Parent families	8,634 (16.8%)	7,467 (19.6%)	275,799 (16.1%)
Other families	582 (1.1%)	408 (1.1%)	29,153 (1.7%)

As shown in **Table 2**, almost half of the Lake Macquarie and Wyong LGAs comprise couple families with children, which is slightly less than the NSW average. The proportion of couple families without children in Lake Macquarie and Wyong LGAs is slightly higher than in NSW, as is the proportion of one parent families.

4.3.4 Educational Qualifications

The majority of residents in the Lake Macquarie LGA have attained Certificate III and IV at TAFE. The majority of those with this qualification are male - an approximate 21,000 of the total 27,000 who have attained these Certificates specifically. A large number of residents (approximately 14,000) have attained tertiary qualifications,

which correlates with the majority of the workforce in the area employed in the professional field. Approximately 11,000 people did not state their educational qualification.

The majority of the qualified workforce in the Wyong LGA also possesses TAFE qualifications. Wyong has many male residents (approximately 15,000) who possess Certificate III and IV accreditation. Approximately 13,500 people in the area have attained qualifications at university. Approximately 5,000 people did not state their level of education.

4.3.5 Local Economy

Overview

The original inhabitants of the Lake Macquarie and Wyong LGAs were the Awabakal Aboriginal people and the Guringai and Darkinjung Aboriginal people respectively. European settlement in the area is dated from when the first land grants were made, from 1826 in Lake Macquarie LGA and from 1825 in Wyong LGA.

Timber-getting and farming formed the main economic drivers for both Lake Macquarie and Wyong LGAs around the time of their foundation. The discovery of coal and the development of the railway to Sydney has encouraged the growth of these areas and contributed to their evolution from quiet rural areas to vibrant, residential, commercial and industrial areas with strong tourism industries (Community profile, 2009 and 2008).

The economic strength of the LGAs is built upon their diverse landscapes and natural resource bases, with key industries developing out of timber, agriculture, water, minerals and tourism. With a diverse industry base, Lake Macquarie and Wyong LGAs are not reliant on particular industries.

Economic Growth

Economic growth in the Lake Macquarie and Wyong LGAs has traditionally been fuelled by coal mining and was enhanced by the construction of the railway line. Growth in these areas continues to be improved by upgrades and expansions of the Sydney-Newcastle Freeway. Economic growth within these LGAs now centres on the tourism and aged care industries. The increasing number of aged care facilities being developed is a response to the ageing population of these LGAs, discussed further in **Chapter 4.4.3** of this report.

The service industry is the largest sector in the regional economy, followed by manufacturing, building, mining and primary industries (Gillespie Economics, 2010). The Wyong and Lake Macquarie LGAs attract many tourists due to their abundance of lakes, beaches and national parks therefore establishing tourism as a source of economic growth in these areas. Whilst mining itself is not a growth area within these LGAs, the economic benefits of this industry to the area are significant.

Mining

Whilst mining only accounts for 2% of employment in Lake Macquarie relative to other industries, mining and mining-related businesses are still intrinsic to the region's economic strength, with Centennial Coal being one of the largest underground coal suppliers in NSW (DoP, 2008).

Although, mining could not be classified as a growth industry within the Lake Macquarie and Wyong LGAs, it provides significant economic benefits, most notably the provision of high income employment.

Coal has been mined under the northern coastal sections of Wyong LGA since the 1960s and within the Lake Macquarie LGA for the last 100 years. There are four underground coal mines currently operating partly or wholly within Wyong LGA (Chain Valley Colliery, Mandalong Colliery, Mannering Colliery and Myuna Colliery). In 2005-6, these mines provided direct employment for around 565 people (DoP, 2008).

Average mining industry incomes are substantially higher than other sectors. The average weekly income for an underground coal miner in NSW in 2005-06 was approximately $2,000, significantly higher than the median weekly income of $770 in 2006 for households in Wyong LGA, $922 for households in Lake Macquarie LGA and $1036 for the state average (DoP, 2008).

The mining industry in Lake Macquarie and Wyong LGAs support Munmorah, Vales Point and Eraring power stations. Approximately 40% of the state's installed coal-fired electricity generating capacity is located within these LGAs. The continued operation of these power stations with low-input costs, as would be the case through the proposed Project, is of significant benefit to NSW (DoP, 2008).

Whilst the economic growth of Lake Macquarie and Wyong LGAs has diversified and now includes service and manufacturing industries, the traditional sector of mining still has an important role, particularly with regard to the value of production and exports from the region and its role as an economic support to the local area (DoP, 2008).

Tourism

The Lake Macquarie LGA attracts around 900,000 visitors per year, a third of which stay in one of over 100 accommodation options available including lakeside resorts, motels, bed and breakfasts and self-contained cottages (SoER, 2009). Wyong LGA also attracts many tourists each year as the Central Coast is one of the nation's leading tourist areas with pristine beaches and outstanding surfing conditions (Wyong Council website).

The National Parks and Lake Macquarie are the key attractions in this area. The main focus for tourism in these LGAs relate to the provision of accommodation and recreational experiences on and around Lake Macquarie.

Examples of the tourism operators and activities in the area include:

- Lake Macquarie water based activities:
  - Cruises;
  - Kayak and boat hire;
  - Catamaran and yacht charters;
  - Jet boat rides;
  - Fishing charters; and
  - Bike hires.
- Scenic Walks, surrounding Lake Macquarie and within various park areas;
- **Beaches and pools, including;**
  - Blacksmiths Beach;
  - Lake Macquarie City Council Pools; and
  - Valentine Hydrotherapy Pool.

The tourism industry within these two LGAs provides economic growth, support and employment within these areas. The tourism industry also provides a service for the local community.

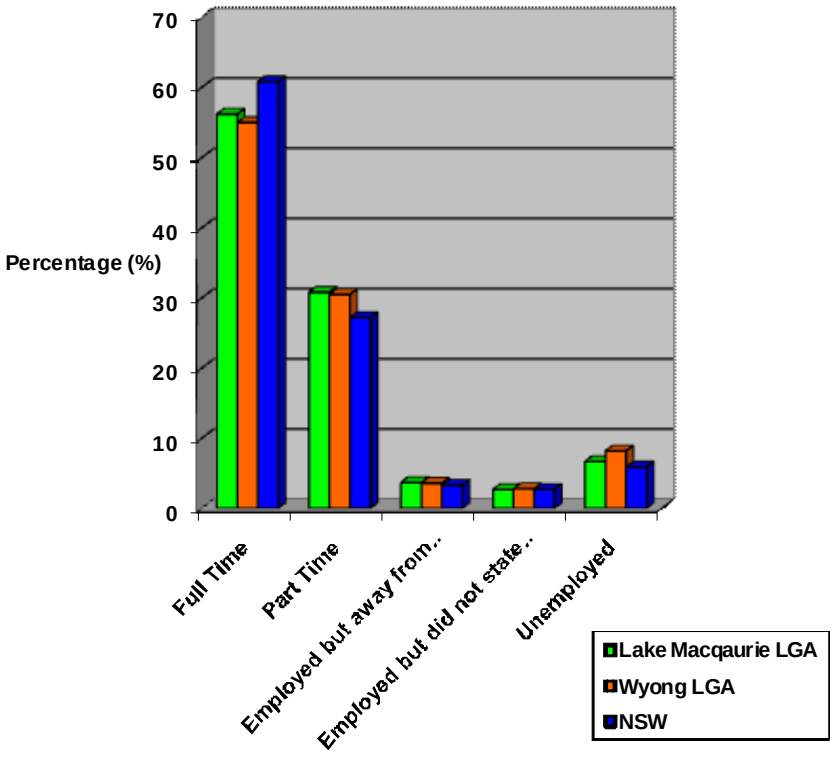
4.3.6 Industry and Employment Characteristics

Based on the 2006 census data, the number of people aged between 15 and 65 in the labour force was 82,226 (45.6% of the total population) from the Lake Macquarie LGA and 58,666 (41.9% of the total population) from the Wyong LGA. In both the Lake Macquarie and Wyong LGAs, the number of persons employed far outweighs the number of persons not in the labour force for those aged between 15 and 65. Their level of employment is shown in **Table 3** and **Figure 3.**

Table 3: Level of employment within NSW, and the Lake Macquarie and Wyong Shire LGAs in 2006 (ABS, 2006).

LGA	Employed Full-time	Employed Part-time	Employed but away from work	Employed but did not state hours	Unemployed (% and number)
Lake Macquarie	56.2%	30.8%	3.7%	2.7%	6.7% (7,806)
Wyong	55.0%	30.5%	3.6%	2.8%	8.2% (6,919)
NSW	60.8%	27.2%	3.3%	2.7%	5.9% (256,324)

Figure 3: Employment Levels in Lake Macquarie and Wyong LGAs, compared to NSW (2006) (ABS, 2006)



Analysis of the employment status of the population in Lake Macquarie and Wyong LGAs in 2006 compared to NSW shows that there was a smaller proportion in employment and a slightly higher proportion of unemployed. This unemployment level in the Lake Macquarie and Wyong LGAs represents 14,725 individuals.

The labour forces in these LGAs continue to grow, with a 4.3% growth from 2001 to 2006 in Lake Macquarie LGA and an 11.8% growth from 2001 to 2006 in Wyong LGA, this indicates that although the labour force is growing the levels of available employment are not keeping pace.

An analysis of the jobs held by the resident population in Lake Macquarie and Wyong LGAs in 2006 shows the three most popular industry sectors were health care and social assistance, retail trade and manufacturing, as shown in **Table 4**. All three of these industry sectors were more popular in the Wyong and Lake Macquarie LGAs than the NSW average. Whilst the mining industry in Lake Macquarie LGA provides employment for a higher percentage than the State average, the Wyong LGA provides slightly less.

Table 4: Number and Percentage of Labour Force Employed in the most Popular Industry Sectors, compared to the Mining Industry (ABS, 2006).

Industry	Lake Macquarie LGA	Wyong LGA	NSW
Health Care and Social Assistance	10,045 8.6%	6,322 7.5%	304,335 7.0%
Retail Trade	9,812 8.4%	7,830 9.3%	323,929 7.5%
Manufacturing	8,511 7.3%	6,077 7.2%	277,986 6.4%
Mining	1,465 1.3%	244 0.3%	20,318 0.5%

Both the Lake Macquarie and Wyong LGAs have a high ratio of part time to full time employment which can disguise significant levels of underemployment. The 2007 Quality of Life Survey undertaken for the Wyong LGA found that 32.5% of the region's residents working part time would like to work more hours (SOSR, 2009).

The growth in local employment opportunities in these LGAs has not kept pace with the increasing population resulting in many residents commuting beyond the Lake Macquarie and Central Coast areas for employment. The State Government has recognised this and, as detailed in the Central Coast Regional Strategy (2008), its objective is to increase the region's employment supply by increasing the capacity for new jobs (SOSR, 2009).

4.3.7 Household Incomes

Most households in the Lake Macquarie LGA earn between $500-$649 per week, with a large proportion of households earning between $350 and $499 per week. The second largest majority of households in the LGA earn between $1,000 and $1,199 per week. Over 16,500 households in the area have a weekly income over $1499. At the other end of the scale, approximately 1,300 households earn less than $350 per week, of which approximately 230 are nil income households.

Similarly in the Wyong LGA the majority of households earn between $500 and $649 per week. The next largest income groups are the $1,000-$1,199 and $350-$499 categories, demonstrating a similar profile to the Lake Macquarie LGA. In contrast to the Lake Macquarie LGA, the number of households living on incomes of $350 or less per week total approximately 10,000. Analysing these statistics in comparison to the high rent in the area, can explain the apparent housing crisis in the area in which a large number of households are spending more than a third of their income on rent.

4.3.8 Housing

Temporary Accommodation

As a popular tourist destination, the Lake Macquarie region receives over 900,000 visitors annually, most of whom stay in temporary accommodation. The area has over 100 choices of temporary accommodation, with occupancy rates cited at 75 per cent during peak periods (SoER, 2009).

Wyong and its surrounds also has a broad array of temporary accommodation choices including caravan parks, motels, bed and breakfasts, apartments and short-stay houses. However, Wyong has the second-largest number of residents living permanently in caravan parks in NSW, meaning that some temporary accommodation in the region may not actually be available to incoming visitors/residents.

Housing, Cost of Living and Income

The Central Coast housing market is characterised by high growth and high need for affordable housing. Wyong has high levels of home ownership and low levels of renting, and the percentage of public housing in the area (3.1%) is below the average for the Sydney Greater Metropolitan Region (ABS, 2006). Yet in the low, very low and median income groups of the Wyong Shire, housing stress is being experienced.

Housing stress is defined as when a household or individual spends more than 30% of their income on housing, and is particularly applicable to renters, rather than purchasers in the Wyong region. Between 2001 and 2006, the median house price in the area increased by 69%, with only 20% of residents able to afford this increase. Whilst there are extensive greenfield developments in the Shire, the cost of this type of housing does not correlate with the demographics of the people currently and potentially in need of housing in this region. ABS data shows that the private rental market is not satisfying the demands of the lower income private renters in the area, particularly smaller and single-person households. Recent trends show mortgage stress in middle-income earners, with flow on effects on the local economy and community. The 2006 Census data showed that the median weekly income for the area was $381 but median weekly rent was $200 and median weekly mortgage repayments were $1,462 (ABS, 2006).

The Lake Macquarie LGA has undergone a similar housing crisis. In 2009, local media reported that NSW Department of Housing statistics showed that 46% of low-moderate income households in the LGA were under housing stress due to inflated property prices and rising rents. Median house prices between 2003 and 2009 increased by 96%, along with median rental prices increasing by 45% during the same period. Similar to the housing situation in the Wyong LGA, the private rental market was not accommodating lower income, single-person and elderly households. In recognition of the level of housing stress in the area, Wyong Shire Council announced in November 2009 its plans to build a three-story block of high density apartments intended for public housing, to commence construction by December 2010.

The comparison between median weekly income, rent and mortgage repayments in the Wyong and Lake Macquarie LGAs and the national averages are show below in **Table 5** highlighting the apparent housing crisis in the area.

Table 5: Comparisons of income, rent and mortgage repayments between LGAs and Australian averages (ABS, 2006).

Median Statistics	Wyong LGA	Lake Macquarie LGA	Australian Average
Weekly Individual Income	$381	$394	$466
Weekly Rent	$200	$185	$190
Weekly Mortgage Repayments	$1,462	$1,300	$1,300

4.4 Community Services and Infrastructure

A key social indicator in a community is the number and availability of community services and service infrastructure. These include health services, local emergency services (police, fire and State Emergency Services (SES)), educational facilities, childcare, public transport, leisure and recreation facilities, community service facilities and general service infrastructure such as water, sewerage and waste services.

4.4.1 Health Services

Lake Macquarie LGA falls under the Hunter and New England Area Health Service with only one public hospital - Belmont Hospital – in the region. There are three private hospitals in the LGA and two community health centres located at Toronto and Windale. The area is also serviced by the John Hunter hospital in the Newcastle LGA.

Wyong LGA is included in the Northern Sydney and Central Coast Area Health Service. Wyong Hospital at Lake Haven is the only State funded public hospital; however there is also a private hospital at Berkeley Vale. There are three community health centres in the LGA at Kanwal, Wyong and Lake Haven.

4.4.2 Local Emergency Services

Police

The Local Area Command (LAC) for the Wyong LGA is the Tuggerah Lakes LAC which includes police stations located at The Entrance, Wyong and Toukley, all of which operate 24 hours. The Lake Macquarie LAC has seven stations at Belmont (24 hours), Boolaroo, Cardiff, Charlestown (24 hours), Morisset, Swansea and Toronto (24 hours).

Fire Brigade and Rural Fire Service

There are six fire stations each in the Wyong and Lake Macquarie LGAs. Both regions are also serviced by regional Rural Fire Service volunteer brigades.

State Emergency Service

SES volunteers have a presence in both Wyong and Lake Macquarie City Council areas, responding to storm damage, flood management and road crash rescue in their regions.

4.4.3 Aged Care Facilities

The Lake Macquarie and Wyong LGAs both have ageing populations and as a result the demand for aged care facilities is increasing. Lake Macquarie City Council has developed an Ageing Population Plan (2008/2017) in order to address this and both LGAs are supporting the development of the local retirement and aged care industries to meet his demand.

Residential aged care facilities within the Lake Macquarie and Wyong LGAs provide both high (nursing home) and low (hostel) care. These facilities are primarily operated by non-profit organisations with private organisations starting to provide self-care facilities within this area. Most of these facilities are constructed under the *State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004* (SEPP 2004). The Department of Housing also provides housing designed to meet SEPP2004 requirements. Mobile home villages have also become an affordable housing option for much of this older population (Ageing Population Plan, 2008).

4.4.4 Education

Primary and Secondary Schools

There are 38 primary schools in the Wyong area and 76 in Lake Macquarie LGA. High schools are also well catered in the areas with 12 and 22 schools in the Wyong and Lake Macquarie districts respectively

Tertiary Education

There are two tertiary education facilities in the Wyong LGA at the University of Newcastle campus at Ourimbah and the TAFE NSW Wyong campus. There is a TAFE NSW campus located in Belmont in the Lake Macquarie LGA. There is no university within either of the Lake Macquarie or Wyong LGAs.

4.4.5 Childcare

Lake Macquarie LGA has approximately 64 child care centres, some of which are operated by Council. There are over 60 child care facilities, pre-schools or kindergartens in the Wyong LGA.

4.4.6 Transport

Public transport options in the Lake Macquarie LGA include Newcastle Bus and Ferry Services which service the lake's east side, rail and private bus companies which service the lake's west and north-west side. Furthermore, taxis service the entire region. Inter-city bus coaches depart from the major centres on the lake's east side.

The Wyong LGA is serviced by public and private bus companies and rail. Investment for cycle paths and other public transport infrastructure is growing as part of the Central Coast Transport Action Plan.

4.4.7 Leisure and Recreation

The Lake Macquarie LGA supports over 100 sport complexes including the Hunter Sports Centre, one of the largest centres in the Hunter region. The area also has six swimming centres and four major patrolled beaches. Lake Macquarie has an extensive off-road network of tracks for walking, jogging and cycling. Eight skate parks in the region particularly attract youth.

Wyong LGA has 31 sporting facilities and four pools including one ocean pool at The Entrance. There are six patrolled beaches in the area, extensive parks and playgrounds, fourteen skate parks and one extreme sports centre at San Remo.

4.4.8 Community Facilities

The Lake Macquarie City Council provides approximately 2,280 hectares of community land including:

- 230 hectares of sportsgrounds;
- 270 hectares of parks;
- 1,700 hectares of natural areas (bushland, wetland, foreshores, escarpments, watercourses etc.); and
- 80 hectares of general community use areas (leased areas, public halls, child care centre, senior citizen centres etc.)

This equates to approximately 120 square metres per resident of council-owned community land, not including Crown land (SoER, 2009).

Parks and Reserves in the Lake Macquarie LGA include Watagan National Park, Munmorah State Conservation Area, Lake Macquarie State Conservation Area, Awabakal Nature Reserve, Blacksmiths Nature Reserve, and Green Point Foreshore Reserve (Community Profile, 2009).

Wyong Shire Council currently provides for public use:

- 156 parks;
- 409 parks and reserves;
- Approximately 107 kilometres of shared pathways;
- 70 kilometres of foreshore reserves;
- 32 public ovals and sporting grounds;
- Three swimming enclosures on the lakes at Lake Munmorah, Gwandalan and Mannering Park;
- One “ocean baths” pool at the Entrance;
- One outdoor Olympic pool at Wyong;
- Aquatic Centres at Toukley and Mingara Sport and Recreation Club;
- Three hydrotherapy pools at Wyong and Berkeley Vale; and
- Heated learn to swim pools at 7 locations from Berkeley Vale to Gwandalan (SOSR, 2009).

4.4.9 Service Infrastructure

Sewer

Some areas of the Lake Macquarie LGA experience sewer surcharges, during which overflows of wastewater from sewerage systems occurs. Council has received complaints regarding the presence of effluent in Lake Macquarie, creeks, drains or the beach. To combat this, Council has implemented effluent and biosolid recycling, which has reduced the volume of wastewater requiring treatment in sewage plants and the consequent ocean outfall (SoER, 2009).

Approximately 147,000 residents receive sewerage service from Wyong Council through its six sewerage treatment plants and 149 pumping stations. These facilities process approximately 12,000 ML of wastewater annually, before discharging the treated water into the Pacific Ocean via two outlets. The area is considered to be well serviced with regard to sewage, as no backlog for provisions in urban areas currently exist, and most facilities are relatively new and have required low levels of refurbishment in the past (SoSR, 2009).

Water

Water services in Lake Macquarie LGA are provided by Hunter Water. The water comes from surface water at Chichester and Grahamstown dams and ground water at Tomago sand beds, followed by treatment at water filtration plants, and is considered to be a very pristine water supply (SoER, 2009).

Wyong Shire’s water supply is sourced from Hunter Water’s Central Coast source. The main sourcing reservoirs are Wyong River, Ourimbah Creek, Mooney Mooney Creek and Mangrove Creek, with three storage dams at Mangrove Creek Dam, Mooney Dam and Mardi Dam. Wyong LGA has one of the lowest water usage rates per household in NSW, provisioned by the use of rainwater tanks, recycled effluent reuse, stormwater harvesting and demand monitoring programs (SoSR, 2009).

Waste

The Lake Macquarie region is serviced by the Awaba Waste Management Facility (AWMF). At current rates of waste, the expected lifetime of the AWMF is around 5 years. Considering this, future waste management options are currently being assessed, as well as efforts to redirect waste from the AWMF through activities such as increased recycling (including construction and public place recycling), operations at the Teralba Worm Farm and environmental education programs.

All waste in the Wyong region is disposed of at the Buttonderry Waste Management Facility at Jilliby. The expected lifetime of the landfill is approximately 50 years, as only 25 of the 120 hectares approved for landfill use are currently occupied by waste. The volume of waste produced by Wyong Shire in 2008-2009 increased by 4 per cent compared to the long term average (excluding unscheduled clean-up activities at closed landfill sites).

4.5 Community Issues

A review of local, State and National media sources was undertaken to provide an overview of public opinion within the community and to identify salient community issues within the Project Application Area. This information is presented below utilising themes that have emerged from the analysis.

4.5.1 Lake Macquarie LGA

All 2010 editions of the newspaper *The Post*, were reviewed to identify community issues in the area. The most apparent issue in the area was that of waste management. Several articles outlined a potential crisis in the area regarding this issue. A survey of the LGA identified 47 illegal dumping grounds for waste, as well as the fact that the area is in need of a waste management review.

Drug and alcohol abuse has been identified as another issue in the region, as funding was granted to Lake Macquarie Centrelink for the training of new community engagement officers. The region is also in need of support for the parents of intellectually and physically disabled youth, who currently require round the clock child care. *The Post* reported that facilities were required and would be provided in the next year.

4.5.2 Wyong LGA

The Wyong based paper, *The Central Coast Express,* was reviewed in a similar fashion. Community issues relate to water resources in the area and as a result $2 million has recently been provided, through the Central Coast Water Savings Fund, to be spent on water saving facilities estimated to save 164 million tons of water per year. Additionally, a Water Smart Australia program is assisting the installation of a $120 million Mardi Dam to Wyong River link for the supply of water in the area. This will have the benefit of boosting dam storage levels providing a faster drought recovery period and the protection against future extended periods of lower than average rainfall.

The Central Coast Advocate and the Newcastle Herald were also reviewed for specific community issues relating to the mining industry. Issues relating to water quality, subsidence, air quality and noise impacts from the proposed mines within the Wyong LGA were raised. Of particular concern were areas where underground mining was proposed underneath residential areas, particularly within the Chain Valley Bay, Summerland Point and Gwandalan areas, as subsidence in these locations would be detrimental to the local residents.

The above issues identified within the two LGAs through the media review are not likely to be exacerbated by the proposed Project.

4.6 Community Needs and Social Values

4.6.1 Sustainability/Council Policy

The concept of sustainability is central to the Strategic Plans for the Lake Macquarie and Wyong LGAs. These plans are used to assist council and the community to plan for the future and realise their vision.

Lake Macquarie LGA

Lower Hunter Regional Strategy 2006-31

The Regional Strategy is the primary planning document for the Lower Hunter Region and applies to the five LGAs of Newcastle, Lake Macquarie, Cessnock, Maitland and Port Stephens.

The primary purpose of the Regional Strategy is to plan for the provision of sufficient new urban and employment lands to meet expected strong demands for growth. The Strategy plans to do this by ensuring that adequate land is available and appropriately located to sustainably accommodate the projected housing and employment needs of the Region's population over the next 25 years.

In particular, the Strategy aims to:

- Ensure that sufficient employment lands are available to cater for 66,000 new jobs;
- Plan for an additional 160,000 residents and 115,000 new dwellings;
- Establish important green corridors, to protect and even enhance the Region's strong environmental and biodiversity assets; and
- Reinforce the role of the Newcastle City Centre as the Regional City.

The proposed Project is consistent with this Strategy as it will provide additional employment opportunities within the local area without hindering the availability of land for other future employment and housing needs.

Wyong LGA

Shaping the Central Coast Action Plan

The Central Coast comprises the two LGAs of Gosford City and Wyong Shire, which combined cover an area of 1,854 square kilometres. The Action Plan was been prepared as a joint State and Local Government project to address the region's existing issues and manage the impacts of future growth on the Central Coast. The Action Plan identifies the key issues confronting the region and highlights the relationship between the desired outcomes and the supporting actions necessary to achieve these. The desired outcomes and supporting actions set out in the Action Plan seek to ensure that future growth will promote:

- Diversity of employment and business opportunities;
- Educated community and skilled workforce;
- Access and efficient transport systems;
- Protection of the region's natural environment;
- Appropriate infrastructure and the sustainable use of resources;
- Connected, safe and valued communities;
- Healthy communities;
- Regional identity and a diversity of recreational and cultural opportunities;
- Smart growth settlement patterns and housing choice; and
- Integrated regional governance.

The proposed Project is consistent with the objectives of this Action Plan as it creates employment opportunities for a skilled workforce whilst not negatively impacting on settlement growth patterns and transportation systems.

Residential Development Strategy 2002

The *Residential Development Strategy* was prepared by Wyong Shire Council to meet metropolitan planning objectives by implementing good planning principles and to show evidence of a number of positive changes including building a broader range of housing addressing the correlation between changing demographics and economic profiles for Wyong and the greater Central Coast. The aims of the Strategy are to:

- Provide a comprehensive strategy to guide residential development which will increase the quality and diversity of development in Wyong Shire;
- Plan for residential development which is environmentally, economically and socially sustainable (ESD) in both a local and regional context;
- Provide a local approach which justifies exemption from *SEPP 53 - Metropolitan Residential Development*;
- Identify amendments to the *Wyong Local Environmental Plan 1991* which seek to satisfy residential development objectives of the Greater Metropolitan Region, while retaining local sustainability; and
- Identify short and medium term actions which Council can facilitate to realise metropolitan planning objectives for residential development, while maintaining local sustainability.

The proposed Project is consistent with this Strategy as it is unlikely to impact on any future residential development due to the Surface Facilities Area of the Myuna Colliery remaining largely consistent with existing. The proposed Project also takes into account the principles of Ecologically Sustainable Development (ESD) (refer to the EA).

4.6.2 Summary of Community Needs

The social profile conducted as part of this review has determined the community needs of the Lake Macquarie and Wyong LGAs to include:

- Increased employment opportunities;
- Increased availability of land for housing; and
- Improved waste management facilities.
- The proposed Project will provide employment opportunities for around 35 members of the local community, thereby addressing one of the community needs of these two LGAs. In addition, the Project Application Area will not impact on the availability of land for housing or employment opportunities, or on potential waste management facilities.

5.0 Impact Assessment

This section outlines the potential issues and impacts identified as a result of the social profile conducted.

5.1 Area of Influence

While Section 4 assesses a broader, LGA based scale, the secondary and primary areas of influence have been determined to identify the areas that are particularly sensitive to potential social impacts from the proposed Project.

5.1.1 Primary Area of Influence

The primary area of influence of the proposed Project comprises the physical footprint of the Project Application Area, including Lake Macquarie, and the suburbs immediately surrounding the Surface Facilities Area. There are residents, service providers and facilities in the Project Application Area, within the suburbs of Arcadia Vale, Wangi and Myuna Bay, the Morisset Peninsula, Point Wolstoncroft, and to a lesser extent, under the suburbs of Coal Point, Fishing Point and Rathmines.

CMPL currently contributes to the local community through the form of sponsorships and donations including initiatives at:

- Wangi Amateur Sailing Club;
- Arcadia Vale Public School;
- Wangi Peter Pan Kindergarten;
- Lake Macquarie Combined Fishing Club;
- Wangi Netball Club;
- Rathmines Public School;
- Powerhouse Christian Church;
- Wangi Lawn Bowling Club;
- Wangi Lions Club;
- Wangi Men's shed; and
- West Lake Soccer Club.

5.1.2 Secondary Area of Influence

The secondary area of influence has considered where the existing 175 Myuna Colliery employees reside, which include areas of the Central Coast (30 employees), Lake Macquarie (95 employees) and West Newcastle / Lower Hunter Valley (50 employees) as shown in **Table 6**.

CMPL currently aims to maximise local employment and provide training by:

- Advertising employment, apprenticeships and traineeships in the local media; and
- Providing a link to the above opportunities on Centennial Coal's website.

Table 6: Employee locations

Area	Post code	Suburbs	Number of Employees
Central Coast	2262	Blue Haven, Budgewoi, Buff Point, Doyalson, Halekulani and San Remo.	30
	2263	Charmhaven, Gorokan, Lake Haven, Norah Head, Noraville, Toukley and Bonnells Bay.	
	2264	Brightwaters, Dora Creek, Eraring, Mandalong, Mirrabooka, Morisset, Silverwater, Sunshine and Yarrawonga Park.	
	2265	Cooranbong and Martinsville.	
	2267	Wangi Wangi.	
Lake Macquarie	2280	Belmont, Croudace Bay, Floraville, Jewells, Marks Point and Valentine.	95
	2281	Blacksmiths, Cams Wharf, Catherine Hill Bay, Caves Beach, Middle Camp, Nords Wharf and Swansea.	
	2282	Eleebana, Lakelands and Warners Bay.	
	2283	Arcadia Vale, Awaba, Balmoral, Blackalls Park, Bolton Point, Buttaba, Carey Bay, Coal Point, Fassifern, Fennell Bay, Fishing Point, Kilaben Bay, Rathmines and Toronto.	
	2289	Adamstown, Adamstown Heights, Garden Suburb, Highfields, Kotara and Kotara Fair.	
	2284	Argenton, Boolaroo, Booragul, Marmong Point, Speers Point, Teralba and Woodrising.	
	2290	Bennetts Green, Charlestown, Dudley, Gateshead, Hillsborough, Kahibah, Mount Hutton, Redhead, Tingira Heights and Whitebrisge.	
	2291	Merewether, Merewether Heights and The Junction.	
	2300	Bar Beach, Cooks Hill, Newcastle, Newcastle East and The Hill.	
West Newcastle/ Lower Hunter Valley	2285	Cardiff, Edgeworth and Glendale.	50
	2286	Holmesville and West Wallsend.	
	2287	Birmingham Gardens, Elermore Vale, Fletcher, Maryland, Minmi, Rankin Park, Summer Hill, Wallsend, and Wallsend South.	
	2320	Bolwarra, Farley, Hillsborough, Largs, Lorn, Maitland, Maitland North, Pokolbin, Rothbury, Rutherford and Telarah.	

Area	Post code	Suburbs	Number of Employees
	2322	Beresfield, Black Hill, Hexham, Lenaghan, Tarro, Thornton, Tomago and Woodberry.	
	2323	Ashtonfield, Brunkerville, East Maitland, Freemans Waterhole, Greenhills, Metford, Metford DC, Mount Vincent, Mulbring and Tenambit.	
	2324	Balickera, Brandy Hill, Bundabah, Carrington, Cells River, Eagleton, East Seaham, Heatherbrae, Karuah, Limeburners Creek, Millers Forest, Motto Farm, Nelsons Plains, North Arm Cove, Osterley, Pindimar, Raymond Terrace, Raymond Terrace East, Seaham, Swan Bay, Tahlee, Tea Gardens, Twelve Mile Creek and Wallaroo.	
	2326	Abermain, Bishops Bridge, Loxford and Weston.	
	2327	Kurri Kurri, Pelaw Main and Stanford Merthyr.	
	2335	Belford, Branxton, Dalwood, Elderslie, North Rothbury, and Stanhope.	
	2444	Blackmans Point, Flynns Beach, Port Macquarie and Port Macquarie BC.	

5.2 Potential Social Impacts

Social impacts can be either positive or negative in nature. Based on the social profile and the review of secondary data sources, the potential environmental, economic, social, financial and cumulative impacts on the local community resulting from the proposed Project are discussed as follows.

5.2.1 Environmental Impacts

Activities identified as part of the proposed Project with the potential to cause land-based environmental impacts to the surrounding community include:

- Land subsidence within Zone A of the Project Application Area as a result of underground mining;
- Ongoing operation of the Colliery and its Surface Facilities Area, including production levels up to 2 Mtpa ROM coal, with potential impacts associated with noise, dust, and greenhouse gas (GHG); and
- Marginally increased daily traffic movements to and from the Surface Facilities Area associated with an increase in employees above current levels.

Land Subsidence

Underground coal mining has previously been extensively carried out by Myuna Colliery across the existing Development Consent Mining Area and within the current Project Application Area. Potential subsidence induced impacts as a result of underground mining for the proposed Project relate to land use, ecology, heritage and water.

The Project Application Area lies within the West Lake and Swansea North Entrance Mine Subsidence Districts for which CMPL pays levies under the *Mine Subsidence Compensation Act 1961*. This act requires that an approval is given by the Mine Subsidence Board for the alteration or erection of buildings or structures, or the subdivision of land, within a proclaimed Mine Subsidence District. The Mine Subsidence Board sets subdivision, building, and construction guidelines, which are designed to ensure that residences and other structures will tolerate the expected levels of subsidence in an area. Construction guidelines vary from area to area depending on the coal mining activity and the expected amount of subsidence.

The proposed Project would restrict subsidence of land areas within these Subsidence Districts to less than 20 millimetres, and as such potential negative impacts on surface improvements (buildings, infrastructure, roads etc) would be minimal.

Extension of Operations

Myuna Colliery is a long standing existing operation and the proposed Project would see the continuation of this operation. No complaints have been received from the community regarding the existing operations (CMPL, AEMR 2009).

The proposed Project would extend operation of the mine and Surface Facilities Area by 21 years, and ROM coal production up to 2 Mtpa. This production rate is within the operational capacities of the existing approved CHP at the Surface Facilities Area, while the total daily production would not exceed the current production capacities of up to 6,000 tonnes per day.

Potential impacts on the local community resulting from the extended operation of the mine and Surface Facilities Area, including an increase in the production rate of ROM coal, relate to air and noise emissions, greenhouse gas production, and water quality. Assessment of the impacts of these issues on the local area has been undertaken for the EA (AECOM, 2010), and concluded that:

- Continued operations at Myuna Colliery are not expected to generate significant impacts to air quality as has been demonstrated by the existing operations. The continued operations of the Colliery are not expected to adversely impact the existing cumulative ambient air quality of the local area or surrounding region.
- Operational noise levels at the Surface Facilities Area are predicted to meet the Project-specific noise criteria at all modelled residential receivers under calm and prevailing weather conditions with a number of recommended noise mitigation and management strategies in place.

- Direct and indirect GHG emissions relating to the proposed extension of mining operations at Myuna Colliery have been calculated to increase GHG emissions by approximately 38% over existing site emissions.
- The proposed Project would result in minimal impacts to alluvial aquifers, existing alluvial groundwater users and GDEs, and therefore significant impacts to the groundwater environment are not expected. Provided identified water management measures are implemented, the proposed Project is also not expected to result in a significant impact to surface water.

Myuna Colliery operates under an existing Environmental Management System that would be implemented and updated for the proposed Project. The proposed Project also incorporates several measures that would improve efficiencies of water management at the Surface Facilities Area, which would result in positive environmental outcomes.

Given the existing environment, history of operations, low number of complaints registered from the community over the life of the mine, and the proposed mitigation measures, the proposed Project is not expected to result in significant environmental impacts on the local community.

Traffic Movements

The proposed Project would employ in the order of 210 personnel per day, which represents an increase of 35 employees above current levels, and would give rise to an additional 70 movements on the traffic network per day. This increase is considered minimal and unlikely to compromise the function of the surrounding network (AECOM, 2010).

The intersections of Summerhill Drive / Wangi Point Road and Donnelly Road / Wangi Road all have sufficient sight distances for vehicles accessing and egressing the Surface Facilities Area. The additional 70 vehicle movements generated by the Project at these intersections is considered to be negligible, and employees would achieve safe through-movement when accessing and exiting the Surface Facilities Area (AECOM, 2010).

5.2.2 Economic Impacts

As detailed in the Economic Assessment undertaken for the proposed Project (Gillespie Economics, 2010), Myuna Colliery currently provides significant benefit to the local community from the direct injection of wages into the local economy as more than half of all employees come from within the Lake Macquarie and Central Coast area. As the proposed Project would result in the additional employment of 35 individuals, the social impacts within the secondary area of influence are likely to be positive yet limited in nature.

Myuna Colliery and the proposed Project provide a source of economic growth for the area through both direct employment and through the mining industry being a major economic support for the region. Into the future, the proposed Project would continue to benefit the local area and provide benefits to the overall State economy through royalties payable to State and Federal governments. The proposed Project would contribute approximately $222M into the State economy through additional wages, royalties and business turnover on an annual basis, while flow-on spending as a result of the proposed Project is likely to economically benefit a number of different sectors of the regional economy (Gillespie Economics, 2010).

Consequently, mine closure in 2031 would negatively impact the local community due to the removal of the economic stimulus provided by the proposed Project. These economic impacts are discussed further in the Economic Assessment Report (Gillespie Economics, 2010).

5.2.3 Social Impacts

Centennial has made recent and ongoing investments in several community projects of benefit to the local area, and which will continue throughout the proposed Project. As previously outlined, these projects have included sponsorship of initiatives at Arcadia Vale Public School, Wangi Peter Pan Kindergarten, Wangi Amateur Sailing Club Australia Day Sailing Regatta, Lake Macquarie Combined Fishing Club, Wangi Netball Club, Rathmines Public School fundraiser, Powerhouse Christian Church for the Carols in Dobell Park, Wangi Lawn Bowling Club repair and maintenance, Wangi Lions Club fundraisers and the Wangi Beautification Project, Wangi Dobell Festival of Arts and Crafts and the Wangi Men's shed.

5.2.4 Financial Impacts

Although mining for the existing operation and the proposed Project would be undertaken within known Mine Subsidence Districts, undermining of existing residential areas of the Project Application Area is likely to give rise

to give rise to a level of concern within the community, relating to reduced property prices within the residential areas of the Project Application Area.

The proposed Project would extend mining within the Project Application Area for a further 21 years, and could extend beneath portions of the residential suburbs of Arcadia Vale, Wangi and Myuna Bay, the Morisset Peninsula, Point Wolstoncroft, and to a lesser extent, under the suburbs of Coal Point, Fishing Point and Rathmines.

As coal resources within the Project Application Area are not anticipated to be exhausted until 2031, and as mining could continue under existing mining leases but not for the repeal of section 74(1) of the Mining Act, there would currently be no potential to relax or remove current constraints on new developments within these Districts.

As the proposed Project would limit land surface subsidence to less than 20 millimetres within Mining Zone A, which encompasses all the residential areas listed above, the proposed Project is unlikely to have a negative impact on property prices.

5.2.5 Cumulative Impacts

The projects outlined in **Table 1** relate to marina expansions on Lake Macquarie, the continuation of existing coal mining projects at Awaba and Chain Valley Bay, and the rezoning of the adjacent Wangi Power Station on Wangi Road. Potential cumulative impacts of the proposed Project with these proposed projects and other existing developments and operations in the area would relate to air, noise, water, traffic, GHG, and land use.

The cumulative impacts of the proposed Project on these issues have been considered in the EA (AECOM, 2010), the assessments of which took into account other existing and recent developments and operations. Based on the results of these assessments, cumulative impacts of the proposed Project would be minor.

In addition, rezoning of the Wangi Power Station requires any future development on the former power station site to have regard to and mitigate potential impacts from Myuna Colliery (Lake Macquarie Local Environmental Plan 2004 Draft Amendment Number 33).

The potential impacts of the proposed Project on the LGAs of Lake Macquarie and Wyong are summarised in **Table 7**.

Potential positive and negative impacts have been classified based on the following considerations:

Severity of Impacts

Low: localised implications; imperceptible or short term cumulative impacts.

Moderate: regional implications; modest or medium term cumulative impacts.

High: inter-regional implications: serious or long term cumulative impacts.

Likelihood of Effects

Unlikely: minor environmental change; offsets readily available.

Likely: moderate adverse environmental change; offsets available.

Definite: important adverse environmental change, offsets not readily available.

Severity of Impacts	Likelihood of Effects		
	3 Unlikely	2 Likely	1 Probable
1 Low	4 (Moderate)	3 (Low)	2 (Low)
2 Moderate	5 (High)	4 (Moderate)	3 (Low)
3 High	6 (High)	5 (High)	4 (Moderate)

Table 7: Summary of Potential Social Impacts

Aspect	Potential Impact	Type and level of Impact	Likelihood of Impact
Land Subsidence	Potential subsidence induced impacts as a result of underground mining for the proposed Project relate to land use, ecology, heritage and water. The Project Application Area is within a Mine Subsidence District for which CMPL pays levies under the Mine Subsidence Compensation Act. The proposed Project will restrict subsidence of land areas within these Subsidence Districts to less than 20 millimetres, and as such potential negative impacts on surface improvements (buildings, infrastructure, roads etc) will be minimal.	Negative Low	Unlikely
Extension of Operations	Potential impacts on the local community relate to air and noise emissions, GHG production, traffic and water quality. Given the existing environment, history of operations, negligible potential traffic, noise, air and water impacts related to the proposed Project, and mitigation measures proposed for GHG emissions, the proposed Project is not expected to result in significant environmental impacts on the local community.	Negative Low	Unlikely
Community Projects	Centennial has made recent and ongoing investments in several community projects of benefit to the local area, and which will continue throughout the proposed Project.	Positive Low	Likely
Local Economy	Socio-economic benefits associated with the proposed Project include wage distribution within the community, and royalties payable to State and Federal governments, which will positively impact the community by providing a source of economic growth for the area and will continue for a further 21 years should the Project proceed (refer to Gillespie Economics, 2010).	Positive Moderate	Probable
Employment	The proposed Project will result in the generation of employment for an additional 35 employees. The population demographics of the Lake Macquarie and Wyong LGAs indicate an increase in the younger working age group and a high level of unemployment. The 35 jobs created by the proposed Project could positively impact the area by providing employment opportunities for members of these communities.	Positive Low	Likely
Mine Closure	Mine closure in 2031 will negatively impact the local community due to the removal of the economic stimulus provided by the proposed Project and the loss of 210 jobs following the cessation of mining.	Negative Moderate	Probable
Financial Impacts	Undermining of existing residential areas of the Project Application Area is likely to give rise to a level of concern within the community, relating to reduced property prices within the residential areas. As the proposed Project will limit land surface subsidence to less than 20 millimetres within Mining Zone A, the proposed Project is unlikely to have a negative impact on property prices.	Negative Low	Unlikely

Cumulative Impact with Other Existing and Proposed Developments	Potential cumulative impacts of the proposed Project with existing developments and proposed projects in the area will relate to air, noise, water, traffic, GHG, and land use. Based on cumulative assessments undertaken for the EA, cumulative impacts of the proposed Project will be minor. Further, redevelopment of the site of the former Wangi Power Station is to have regard to and mitigate against any potential impacts from the Colliery.	Negative Low	Unlikely

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6.0 Conclusion and Mitigation Strategies

6.1 Summary

Myuna Colliery is a long standing existing operation and the proposed Project will see the continuation of this operation. Few complaints have been registered from the community over the life of the Colliery and no complaints regarding the existing operations were received during 2009 (CMPL AEMR, 2009). It is considered that potential negative impacts on the surrounding environment are unlikely as only minor alterations of existing surface infrastructure are proposed. Subsidence impacts will be managed to specified levels with negligible land surface subsidence.

Myuna Colliery currently provides significant benefit to the local community from the direct injection of wages into the local economy as more than half of all employees come from within the Lake Macquarie and Central Coast area. Into the future, the proposed Project will continue to benefit the local area and provide benefits to the overall State economy through royalties payable to State and Federal governments.

Potential impacts to the local area and broader region have been assessed and discussed throughout the EA, including air quality and GHG emissions, noise and traffic. Each of these assessments includes a discussion of the mitigation and management measures to be implemented to ensure potential impacts are avoided or managed to appropriate levels.

6.2 Strategy Areas

The potential social impacts identified as part of this review, are both negative and positive in nature. Myuna Colliery will continue to operate as a good neighbour in the community and utilise existing strategies and programs implemented in the local area.

CMPL currently contributes to the local community through various sponsorships and donations, including initiatives at a number of local schools, sporting clubs, community initiatives, and cultural associations. Future reviews will develop a list of priority areas for investment which is integrated with Myuna Colliery's current Risk Assessment process to ensure that the areas are still relevant and meet community need.

A key mechanism to ensure that potential community impacts are managed and measured effectively is via a well structured community engagement program. Myuna Colliery has an existing well-structured community engagement program in the form of a Stakeholder Engagement Plan that will continue to be utilised for the proposed Project. This Stakeholder Engagement Plan is regularly reviewed to ensure that the information and mechanisms for providing that information to key community and government stakeholders are appropriate.

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Appendix K

Traffic Impact Assessment (AECOM Australia Pty Ltd, 2010b)

Centennial Myuna Pty Ltd

25 October 2010

Myuna Colliery Extension of Mining

Traffic Impact Assessment

Myuna Colliery Extension of Mining

Traffic Impact Assessment

Prepared for

Centennial Myuna Pty Ltd

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Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
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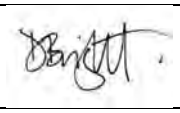
B	29 June 2010	Final Draft Report	Dan Bright Associate Director	Original Signed
1	29 July 2010	Final Report	Dan Bright Associate Director	Original Signed
2	25-Oct-2010	Final Report	Dan Bright Associate Director	

Table of Contents

1.0 Introduction

1.1 Overview

Myuna Colliery is a small underground coal mine owned and operated by Centennial Myuna Pty Limited (CMPL), a wholly owned subsidiary of Centennial Coal Company Limited (Centennial). Myuna Colliery's Surface Facilities Area is located in Wangi Wangi on the western side of Lake Macquarie, 25 kilometres south-west of Newcastle.

The original proponent of Myuna Colliery was Newcom Colliery Pty Ltd. The potential environmental impacts associated with Myuna Colliery were assessed in the Environmental Impact Statement for Myuna and Cooranbong Collieries (Newcom Colliery Pty Ltd, 1977) (the EIS). Lake Macquarie Municipal Council resolved at its meeting of 15 December 1977 to consent to the development of the Myuna and Cooranbong Collieries, as described in the EIS and subject to certain conditions (the Development Consent). The Development Consent was granted pursuant to the provisions of the now repealed *Local Government Act 1919*, and is deemed to be a development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) by virtue of the operation of clause 7 in Schedule 3 of the *Miscellaneous Acts (Planning) Repeal and Amendment Act 1979*.

The Development Consent remains in force and authorises the extraction of coal within an area designated in the EIS as the "Myuna Colliery proposed working area" (the Development Consent Mining Area). Development of Myuna Colliery commenced in 1979. Extraction of coal and associated mining activities at Myuna Colliery has occurred in three coal seams (Wallarah, Great Northern and Fassifern) using continuous miner methods. The Development Consent Mining Area is indicated in **Figure 1.1**.

CMPL undertakes underground mining at Myuna Colliery:

- Within the Development Consent Mining Area; and
- Within Consolidated Coal Lease (CCL) 762 and Mining Lease (ML) 1370 but external to the Development Consent Mining Area, pursuant to the combined operation of Section 74(1) of the *Mining Act 1992* (Mining Act) and clause 8K of the *Environmental Planning and Assessment Regulation 2000*.

The Project Application Area is shown on **Figure 1.1** and encompasses ML 1370, a portion of CCL 762 and the Surface Facilities Area. The Project Application Area comprises an area within the boundaries of CCL 762 and ML 1370, but external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area).

The Project will extend mining and coal handling at Myuna Colliery within the Project Application Area and proposes to:

- Mine using bord and pillar methods in the Wallarah, Great Northern and Fassifern seams in CCL762 and ML1370, for a further 21 years;
- Produce, handle and distribute to Eraring Power Station, up to 2 million tonnes per annum (Mtpa) using existing infrastructure;
- Continue the use of ancillary infrastructure for a further 21 years;
- Upgrade the water management system; and
- Rehabilitate the surface facilities within 5 years of completion of mining.

All existing infrastructure located at the Myuna Colliery Surface Facilities Area will be utilised to service the Project, including the use of the Eraring Energy owned Enclosed Overland Conveyor to transport coal to the Eraring Power Station. No coal is transported by the local road network. Therefore, this report focuses on the impact of employee vehicles associated with Myuna Colliery and the Project.

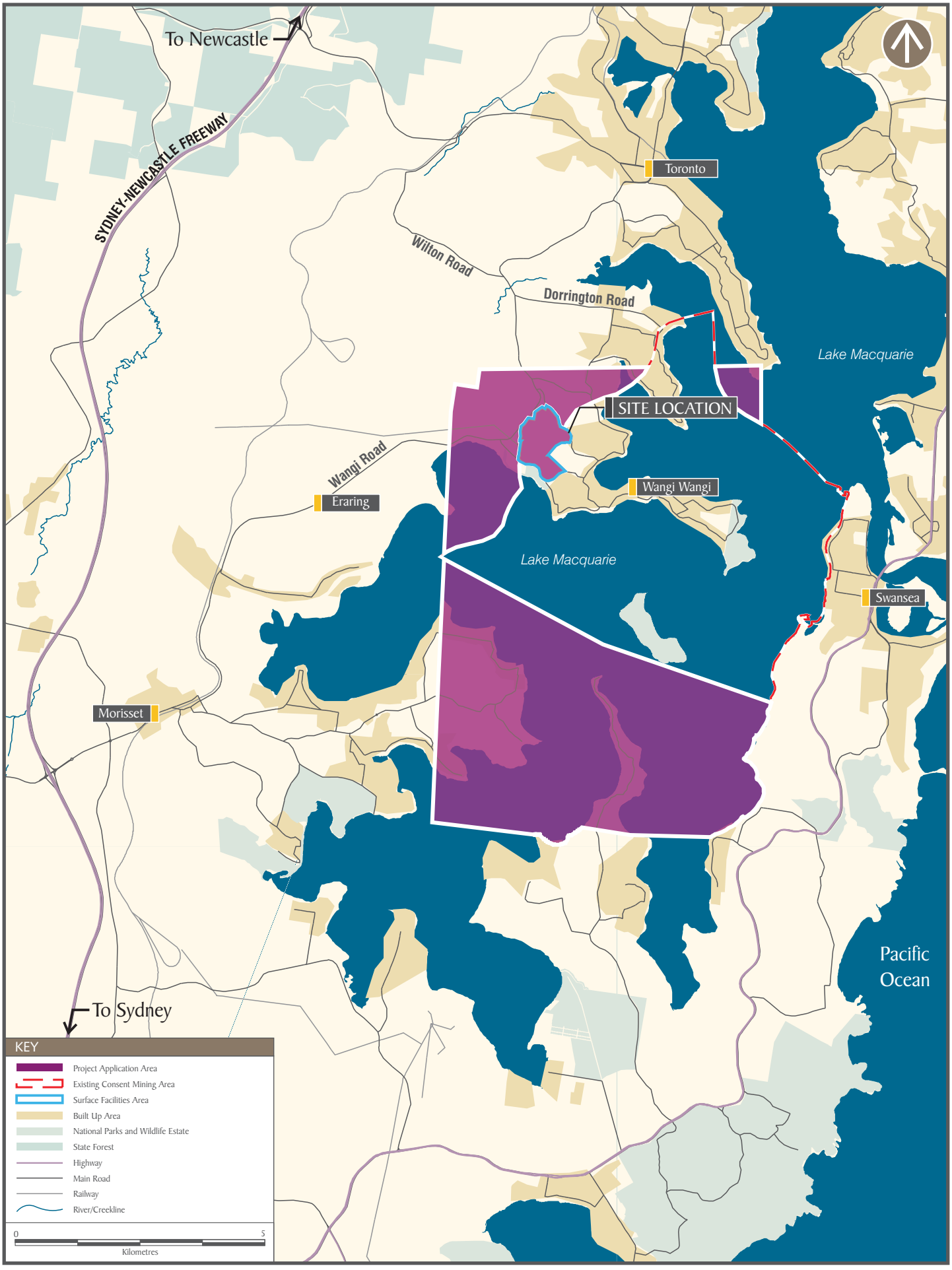
In accordance with the 1977 Development Consent, Myuna Colliery has approval to operate with up to 350 personnel at the Colliery. At present, however, there are currently 175 personnel employed at Myuna Colliery. As such, this assessment has focussed on the impact between existing and proposed operations, although it is noted that Myuna Colliery currently has approval to operate with a greater number of personnel than are currently employed.

This Traffic Impact Assessment consists of:

- A review of the existing traffic conditions;
- An assessment of likely changes in traffic as a result of the proposed Project;
- An evaluation of any potential impact on the road network as a result of the propsoed Project; and
- A discussion around any mitigation measures that may be necessary.

1.2 Site Location

Myuna Colliery's Surface Facilities Area is located in Wangi Wangi on the western side of Lake Macquarie, 25 kilometres south-west of Newcastle. Myuna Colliery in its regional context is shown in **Figure 1.1**.



AECOM

REGIONAL CONTEXT OF PROPOSED PROJECT

Centennial Myuna Pty Ltd

Environmental Assessment

Figure 1.1

2.0 Existing Conditions

2.1 Road Network

Myuna Colliery is bounded by Wangi Road, Summerhill Drive and Donnelly Road. Myuna Colliery is accessed via a private road (Wangi Point Road) which intersects with Summerhill Drive. Summerhill Drive connects to Donnelly Road (via The Promenade) and Wangi Road to the north west of proposed Project as shown in **Figure 2.2**.

2.1.1 Wangi Point Road

Wangi Point Road is a private access road that leads to the Myuna Colliery (**Figure 2.1**). It is a divided, sealed road with one lane in each direction and a posted speed limit of 20km/hr at the mine entrance. Wangi Point Road traverses the site and intersects with Wangi Road; however, it is closed at the Wangi Road intersection.

Figure 2.1 Wangi Point Road Intersection with Summerhill Drive (facing west towards Wangi Point Road)

Source: AECOM, 2010

AECOM

LOCATION OF MYUNA COLLIERY SURFACE FACILITIES AREA AND SURROUNDING LOCAL ROAD NETWORK

Centennial Myuna Pty Ltd

Environmental Assessment

Figure 2.2

2.1.2 Summerhill Drive

Summerhill Drive is a sealed road that connects Wangi Point Road with Wangi Road to the northwest because Wangi Point Road is closed at the Wangi Road intersection. It intersects with the access road via a priority controlled T intersection (an at-grade, three-way intersection, which allows one direction of traffic on the main road to travel straight through without stopping) and with Wangi Road via a seagull intersection (an at-grade 'give way' intersection). It is a divided road consisting of one lane in each direction and has a speed limit of 80km/hr between Wangi Road and Boorabea Road, where after it reduces to 50km/hr (**Figure 2.3**). It is a Lake Macquarie City Council (LMCC) owned and operated road, and is one of the main roads to Myuna Colliery to/from the south.

Figure 2.3: Summerhill Drive

Source: AECOM, 2010

2.1.3 Donnelly Road

Donnelly Road provides an alternate route for vehicles travelling to/from the north. It connects with Wangi Road via a seagull intersection (see **Figure 2.4**) and is a sealed road consisting of one lane in each direction. Donnelly Road has a speed limit of 70km/hr and is a LMCC owned and operated road.

Figure 2.4: Donnelly Road Intersection with Wangi Road

Source: AECOM, 2010

In 2009, the intersection of Donnelly Road and Wangi Road was upgraded as part of the Federal Accident Black Spot Program. Upgrades to the intersection included a median on Wangi Road and a left slip lane from Wangi Road to Donnelly Road.[1]

[1] Information provided by the RTA, 10 June, 2010

2.1.4 Wangi Road

Wangi Road connects the townships of Dora Creek to the southwest and Toronto to the northeast. It is a sealed, divided road consisting of one lane in each direction for the majority of its length. To the northeast of Summerhill Drive, the northbound and southbound lanes of Wangi Road alternate between one and two lanes in each direction. Wangi Road has a speed limit of 90km/hr and is a NSW Roads and Traffic Authority (RTA) controlled road (**Figure 2.5**).

Figure 2.5: Wangi Road

Source: AECOM, 2010

2.2 Proposed Road Upgrades

Lake Macquarie City Council advised AECOM via email on 1 June 2010 that there are no planned road upgrades (except routine maintenance) for the roads in the vicinity of proposed Project.

2.3 Traffic Volumes

2.3.1 Daily Traffic Counts

Traffic data has been obtained from the Council to determine the mid-block traffic flows in the surrounding area. **Table 2.1** shows Average Annual Daily Traffic (AADT) volumes from October 2005 at various points along the roads in the vicinity of proposed Project provided by the Council. The locations of where traffic volumes were monitored are shown in **Figure 2.6**.

Table 2.1: Historical traffic volumes

Count Station	Road	Location	AADT (2005)
1	Donnelly Road	Between Alexander Parade and Arcadia Street	3,167
2	Donnelly Road	Between Arcadia Street and House no 95	3,276
3	Donnelly Road	Between House no 95 and Wangi Road	3,410
4	Summerhill Drive	Between Wangi Road and Boundary Road	2,123
5	Summerhill Drive	Between Boundary Road and Dobell Drive	1,708

Source:Lake Macquarie City Council, 2005

The nearest RTA permanent count station in the vicinity of proposed Project is located on Wangi Road at Wangi Creek Bridge. **Table 2.2** and **Figure 2.6** show historical AADT at this station and the associated historical growth rate.

Table 2.2: Historical traffic volumes and growth

Road	Location	AADT				
		1995	1998	2001	2004	% annual growth
Wangi Road	Wangi Creek Bridge	7,211	7,531	8,514	8,728	2.1%

Source: RTA, 2004

Based on the data above, the average annual growth rate in the area between 1995 and 2004 was 2.1%.

Using the growth rate identified in **Table 2.2,** existing (2010) and future (2031) AADT data has been calculated at each count location and is shown in **Table 2.3**. 2031 has been chosen as this is the life span of Myuna Colliery for which approval is being sought. The traffic volumes for 2010 and 2031 are considered to be a conservative scenario as the growth rate applied (to the local roads in the vicinity of the site as well as Wangi Road) has been derived from counts on Wangi Road which connects townships, as opposed to local roads within townships.

Table 2.3: Existing and future traffic volumes

Count Station	Road	Location	AADT		
			2005	2010	2031
1	Donnelly Road	Between Alexander Parade and Arcadia Street	3,167	3,521	5,498
2	Donnelly Road	Between Arcadia Street and House no 95	3,276	3,643	5,687
3	Donnelly Road	Between House no 95 and Wangi Road	3,410	3,792	5,920
4	Summerhill Drive	Between Wangi Road and Boundary Road	2,123	2,361	3,685
5	Summerhill Drive	Between Boundary Road and Dobell Drive	1,708	1,899	2,965
RTA count station	Wangi Road	Wangi Creek Bridge	8,728 (2004)	9,913	15,476

Source: AECOM, RTA, LMCC, 2010

AECOM

2005 AADT DATA IN THE VICINITY OF PROPOSED PROJECT

Centennial Myuna Pty Ltd

Environmental Assessment

Figure 2.6

2.4 Existing Operations

Myuna Colliery produces coal that is conveyed from the underground workings to the Coal Handling Plant at the Myuna Colliery Surface Facilities Area, prior to being transported directly by the Eraring Energy owned Enclosed Overland Conveyor to Eraring Power Station. No coal is transported by truck via the road network.

In accordance with the 1977 Development Consent, Myuna Colliery has approval to operate with up to 350 personnel at the Colliery. At present, however, there are currently 175 personnel employed at Myuna Colliery. As such, this assessment has focussed on the impact between existing and proposed operations, although it is noted that Myuna Colliery currently has approval to operate with a greater number of personnel than are currently employed.

Employees operate between three 8-hour shifts over 24 hours. The shifts generally operate between the following hours:

- 6.30 am – 2.30 pm;
- 2.30 pm – 10.30 pm; and
- 10.30 pm – 6.30 am.

Table 2.4 indicates the employee numbers associated with each shift. As a worst case, it is assumed that each employee travels alone in one vehicle to Myuna Colliery (i.e. a vehicle occupancy of 1.0).

Table 2.4: Existing employee numbers per shift

Shift	Workforce	Office	Total	Shift proportion
Morning (06.30am – 14.30pm)	72	8	80	46%
Afternoon (14.30pm – 10.30pm)	52	0	52	30%
Night (10.30pm – 06.30am)	43	0	43	24%

Source: Centennial Coal, 2010

Employees access Myuna Colliery via Wangi Point Road and are able to park in the existing car park at the Surface Facilities Area which consists of approximately 200 spaces.

Employee postcode data, provided by CMPL, indicates that 54% of employees reside in the Lake Macquarie local Government area (LGA), 29% reside in West Newcastle and Hunter LGAs and 17% reside on the Central Coast. Further analysis of the geographic location of individual postcode areas and employee numbers within each postcode area indicates that 77% of employees come from areas to the north, 20% from areas to the south and west and 3% of employees from Wangi Wangi to the east of Myuna Colliery.

Table 2.5 shows the number of existing employees travelling from each direction along with their assignment to the road network based on their origin.

Table 2.5: Current employee trip distribution and assignment

Shift	South and West (Summerhill Drive)	North (Donnelly Road/ The Promenade)	East (Dobel Road)
Morning (06.30 am – 14.30 pm)	16	61	3
Afternoon (14.30 pm – 10.30 pm)	10	40	2
Night (10.30 pm – 06.30 am)	9	33	1
Total one-way trips	35	134	6
Total two-way trips (in and out)	70	268	12

The table indicates that the highest number of employee vehicles (61 vehicles) will access Myuna Colliery prior to the morning shift via Donnelly Road.

3.0 Proposed Project

The proposed Project will extend mining at Myuna Colliery for 21 years and will increase coal production to 2.0 Mtpa. Coal will continue to be transported by conveyor from underground to the Coal Handling Plant at the Myuna Colliery Surface Facilities Area. Product coal is then delivered by the Eraring Energy owned Enclosed Overland Conveyor to Eraring Power Station and will therefore have no impact on the local road network.

The number of employees required for the proposed Project is anticipated to be 210 per day (an increase of 35 employees). It is envisaged that 130 employees (62%) will work during the morning shift, 40 (19%) during the afternoon shift and 40 (19%) during the night shift[2]. **Table 3.1** shows the associated trip distribution and assignment of employees under the current and proposed Project, based on the location of existing employees.

Table 3.1: Employee trip distribution and assignment under the proposed Project

Shift	Current employee trip distribution			Proposed employee trip distribution		
	South and West (Summerhill Drive)	North (Donnelly Road)	East (local road)	South and West (Summerhill Drive)	North (Donnelly Road)	East (local road)
Morning (06.30am – 14.30pm)	16	61	3	25	100	5
Afternoon (14.30pm – 10.30pm)	10	40	2	8	31	1
Night (10.30pm – 06.30am)	9	33	1	8	31	1
Total one-way trips	35	134	6	41	162	7
Total two-way trips (in and out)	70	268	12	82	324	14

[2] Information provided by CMPL – 28/05/2010

4.0 Traffic Impact

4.1 Impact on Road Network

Relevant RTA guidelines, namely the RTA Guide to Traffic Generating Developments, were consulted in association with this assessment. Forecast employee numbers were supplied by CMPL and these have been used to predict trips generated.

The proposed Project will generate up to an additional 35 employees vehicles (an equivalent 70 employee vehicle movements) on the local road network per day. **Table 4.1** shows the additional two-way vehicle movements as a proportion of the existing and future AADT along the local roads in the vicinity of proposed Project.

Table 4.1: Additional employee vehicle movements as a proportion of existing and future AADT

Count Location	Road	Location	AADT 2010	% Existing traffic	AADT 2031	% Future traffic
1	Donnelly Road	Between Alexander Parade and Arcadia Street	3,521	1.5%	5,498	1.0%
2	Donnelly Road	Between Arcadia Street and House no 95	3,643	1.5%	5,687	0.9%
3	Donnelly Road	Between House no 95 and Wangi Road	3,792	1.4%	5,920	0.9%
4	Summerhill Drive	Between Wangi Road and Boundary Road	2,361	0.6%	3,685	0.4%
5	Summerhill Drive	Between Boundary Road and Dobell Drive	1,899	0.7%	2,965	0.5%

Source: AECOM, 2010

The additional vehicle movements from Myuna Colliery are shown to be less than 1.5% of the existing 2010 traffic on the local roads, which is considered to be negligible. This should be considered as the worst case scenario as the proportion of additional vehicle movements will be the highest against the existing 2010 traffic flows. In reality, the background traffic flows should increase over the 21 years of the production increase and therefore the additional employee vehicles will be less than 1% of traffic flows in 2031. This is again considered to be negligible and therefore Project generated traffic is predicted to have a negligible impact on the local road network in the vicinity of proposed Project in the future year of 2031.

At present, a worst case scenario of 132 two-way employee vehicles per hour use Wangi Point Road at the shift change over time of 2.30pm (52 employee vehicles arriving for the new shift and 80 vehicles leaving from the previous shift). This will increase to 170 two-way movements under the proposed Project. The RTA's Guide to Traffic Generating Developments indicates that a local street has a maximum peak hour environmental capacity of 300 vehicles per hour. The amount of traffic generated by the Project is well within the capacity of Wangi Point Road and will therefore have a negligible impact on the road.

4.2 Intersection Performance

The intersection geometries of Summerhill Drive / Wangi Point Road (**Figure 4.1** and **Figure 4.2**), and Donnelly Road / Wangi Road (**Figure 4.5** and **Figure 4.6**) all have sufficient sight distances for vehicles accessing and egressing. This therefore reduces potential impacts on safety at the intersections the additional Project generated vehicles might have.

The intersection of Summerhill Drive / Wangi Road (**Figure 4.3** and **Figure 4.4**) however is on the crest of a hill and so the sight distance to the north is less sufficient. As the amount of Project generated traffic is negligible, and this is an existing condition that will not be enhanced by the proposed Project, it is not considered to be a significant issue. Accident data supplied by the RTA for a period between 1 July 2004 and 30 June 2009 shows

that there have been only five crashes during this time period. Of the five crashes, three were non-injury crashes and two were injury crashes. There were no fatal crashes at this intersection during this time period.

Figure 4.1: Summerhill Drive / Access Road looking north

Source: AECOM, 2010

Figure 4.2: Summerhill Drive / Access Road looking south

Source: AECOM, 2010

Figure 4.3: Summerhill Drive / Wangi Road looking south

Source: AECOM, 2010

Figure 4.4; Summerhill Drive / Wangi Road looking north

Source: AECOM, 2010

Figure 4.5: Donnelly Road / Wangi Road looking south

Source: AECOM, 2010

Figure 4.6: Donnelly Road / Wangi Road looking north

Source: AECOM, 2010

5.0 Conclusion

CMPL proposes to extend mining within the Project Application Area for a further 21 years and produce, handle and distribute coal up to 2 Mtpa using existing infrastructure.

Myuna Colliery produces coal that is conveyed from the underground workings to the Coal Handling Plant at the Myuna Colliery Surface Facilities Area. Product coal is then transported directly by the Eraring Energy owned Enclosed Overland Conveyor to Eraring Power Station. No coal is transported by via the local road network. Therefore, this report focuses on the impact of employee vehicles associated with Myuna Colliery and the Project.

The proposed Project will result in up to an additional 35 employee vehicles (assuming 1.0 single vehicle occupancy rate) which equates to an additional 70 employee vehicle movements on the local road network per day. When compared to existing and future AADT along the roads in the vicinity of proposed Project, it is deemed to be a negligible increase as it is less than 1.5% and 1% of the existing and future AADT flow, respectively.

The sufficient visible sight distances at the intersections of Summerhill Drive / Myuna Colliery Access Road and Donnelly Road / Wangi Road will assist in reducing any safety impact proposed Project generated traffic has on the intersections.

Sight distance to the north at the intersection of Summerhill Drive / Wangi Road is reduced under the existing situation, due to the crest of the hill at this location. However as the amount of traffic generated by the Project is negligible, and this is an existing road condition that will not be enhanced by the proposed Project, it is not considered to be a significant issue.

Therefore it is considered that no significant impacts to the Wangi Point Road mine access or the surrounding road network are anticipated through the proposed Project.

Appendix L

Terrestrial Flora and Fauna Impact Assessment (RPS Australia East Pty Ltd, 2011a)

Terrestrial Flora and Fauna Impact Assessment

Myuna Colliery Extension of Mining

Prepared by:

RPS

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Report No: 103000
Version/Date: Final / February 2011

Prepared for:

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Document Status

Version	Purpose of Document	Orig	Review	Review Date	Format Review	Approval	Issue Date
Draft V1	Draft for Client Review	SC	TL	15-6-10	JH 8-6-10	T.Lambert	15-6-10
Draft V2	Draft for Client Review	SC	TL	24-6-10	SC 24-6-10	T.Lambert	24-6-10
Draft V3	Final Draft for Client Review	SC	TL	6-8-10		T.Lambert	6-8-10
Final	Final for Issue	SC	TL	21-10-10	JH 12-8-10	T.Lambert	21-10-10
Final	Revised Final for Issue	RS	TL	24-2-11		T.Lambert	24-2-11

Disclaimers

Executive Summary

AECOM Australia Pty Ltd (AECOM) was commissioned by Centennial Myuna Pty Ltd (CMPL) to prepare an Environmental Assessment (EA) for the Myuna Colliery Extension of Mining (proposed Project) located near Lake Macquarie, approximately 90 kilometres north east of Sydney. This study by RPS Australia East Pty Ltd (RPS) was undertaken as part of the EA to support an application for Project Approval under Part 3A of the *Environmental Planning & Assessment Act 1979* (*EP&A Act*).

The proposed Project involves the extension of existing underground coal mining operations under parts of Lake Macquarie and adjacent terrestrial areas. This report investigated the potential impact of the proposed mining operations on land areas within the proposed expanded mining area.

Negligible surface disturbance will occur as existing surface infrastructure will be utilised to service the proposed Project. Negligible surface impacts are expected to occur. Surface subsidence on all sensitive surface features will be limited to a maximum of 20 millimetres and no surface cracking is expected to occur. No water inflow from the surface into the workings is expected and therefore no changes to sub-surface hydrology are anticipated. Due to the lack of predicted surface impacts this report was limited to a relevant desktop assessment with field surveys considered unnecessary. The proposed Project includes a single small area of direct surface disturbance comprised of minor drainage works at the Myuna Colliery Surface Facilities Area. A field survey was undertaken for these proposed works.

The Project Application Area (PAA) to which the Application and this assessment applies is shown on **Figure 1-2**. While the PAA includes areas of Lake Macquarie, this RPS assessment is limited to terrestrial flora and fauna species. Aquatic species such as fish and turtles are assessed in the Aquatic Impact Assessment (Cardno Ecology Lab, 2010).

The desktop assessment identified 29 threatened flora species, one endangered flora population, 12 threatened ecological communities (TECs) and one preliminary flora determination listed on the *Threatened Species Conservation Act 1995 (TSC Act)* as possibly occurring within the Study Area (the Study Area comprises a 10 kilometre radius around the boundary of the PAA). Of the 29 threatened flora species, four have been recorded within the PAA, 21 are considered a moderate chance of occurring and four are considered a low chance of occurring within the PAA. The single endangered population is considered a moderate chance of occurring within the PAA. Three of the 12 TECs have been recorded within the PAA and eight could possibly occur, though have not been mapped as occurring. The single preliminary determination is considered a low chance of occurring within the PAA.

The desktop assessment also identified 81 threatened fauna species listed on the *TSC Act* as possibly occurring within the Study Area. Of the 81 threatened fauna species, 16 have been recorded within the PAA, 44 are considered a moderate chance of occurring and 21 are considered a low chance of occurring within the PAA.

No threatened species, endangered populations or TECs were identified during a survey of the proposed minor drainage works at the Surface Facilities Area.

Due to the expected negligible surface impacts the proposed Project is unlikely to significantly impact on any species, population or ecological community listed under the *TSC Act*, *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) or SEPP 44.

Contents

Figures

Tables

Plates

Appendices

1 Introduction

AECOM was commissioned by CMPL to prepare an EA for the Myuna Colliery Extension of Mining (the proposed Project) located near Lake Macquarie, approximately 90 kilometres north east of Sydney (**Figure 1-1**). This study by RPS was undertaken as part of the EA to support an application for Project Approval under Part 3A of the *EP&A Act*.

The Project will extend mining and coal handling at Myuna Colliery within the Project Application Area and proposes to:

- mine using bord and pillar methods in the Wallarah, Great Northern and Fassifern seams in CCL762 and ML1370, for a further 21 years;
- produce, handle and distribute to Eraring Power Station, up to 2 Mtpa using existing infrastructure;
- continue the use of ancillary infrastructure and services for a further 21 years;
- upgrade the water management system; and
- rehabilitate the surface facilities within 5 years of completion of mining.

CMPL undertakes underground mining at Myuna Colliery:

- Within the Development Consent Mining Area; and
- Within Consolidated Coal Lease (CCL) 762 and Mining Lease (ML) 1370 but external to the Development Consent Mining Area, pursuant to the combined operation of Section 74(1) of the *Mining Act 1992* (*Mining Act*) and clause 8K of the Environmental Planning and Assessment Regulation 2000.

The Project Application Area is shown on (**Figure 1-2**) and encompasses ML 1370, a portion of CCL 762 and the Surface Facilities Area. The Project Application Area comprises an area within the boundaries of CCL 762 and ML 1370, but external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area). **Figure 1-3** shows the proposed levels of maximum subsidence throughout the Project Application Area.

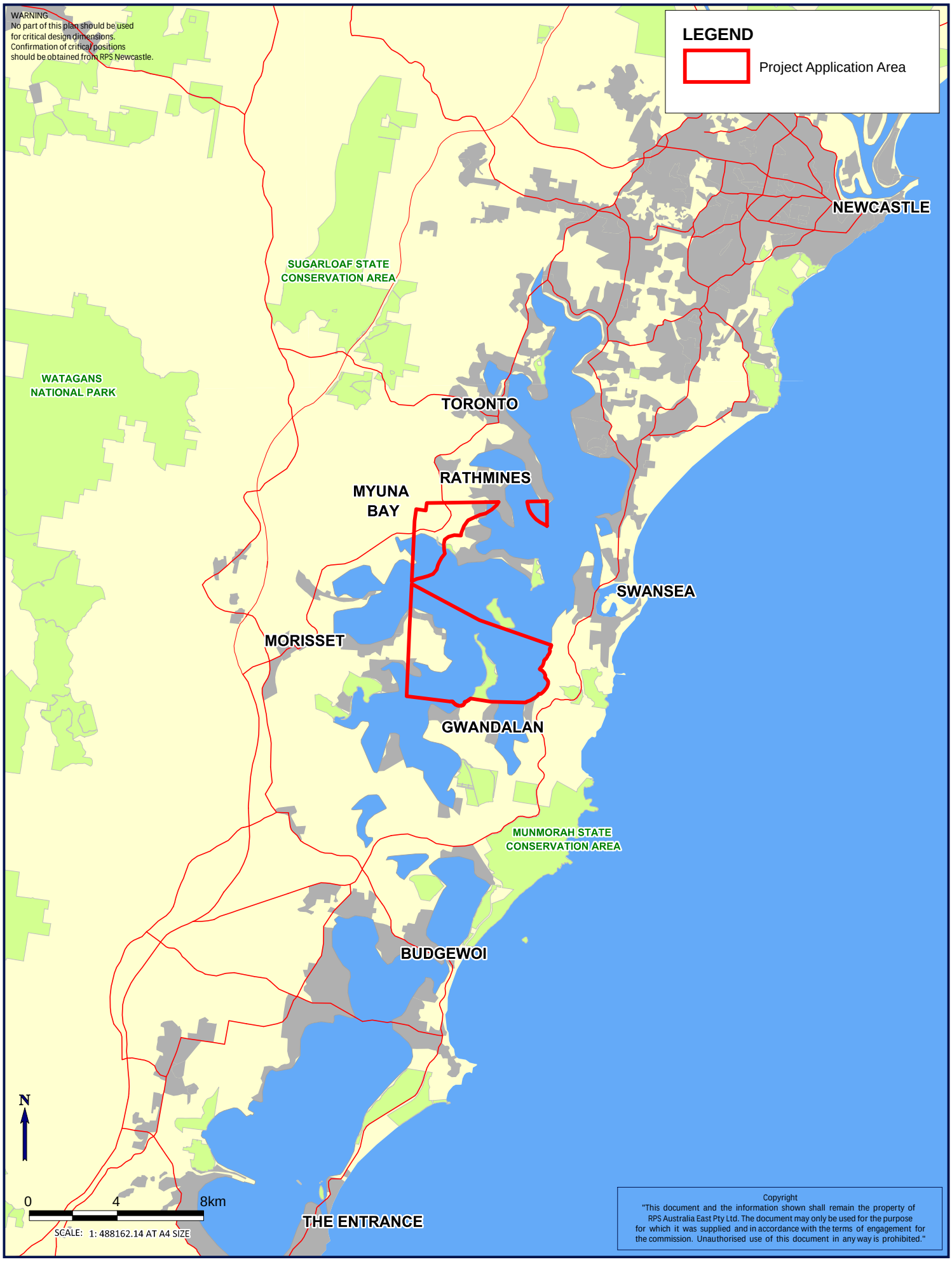
RPS has been commissioned by AECOM to undertake an assessment of impacts on terrestrial ecology from the proposed Project for inclusion in the EA.

1.1 Project Description

The Project will extend mining at Myuna Colliery within the Project Application Area, comprising an area external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area) but within the boundaries of CCL 762 and ML 1370.

The Project's mining operations will continue to be carried out using bord and pillar miner methods in the Wallarah, Great Northern and Fassifern coal seams, generally consistent with the manner in which CMPL undertakes current mining operations at Myuna Colliery. Further, all existing infrastructure at the Surface Facilities Area will be utilised to service the Project.

The proposed Project also includes a single small area of direct surface disturbance comprised of minor drainage works at the Surface Facilities Area.



TITLE: FIGURE 1-1 SITE LOCATION
LOCATION: MYUNA
DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 1/6/2010
PURPOSE: REPORT FIGURE
LAYOUT REF: J:\JOBS\Centennial\All Jobs\103000 Myuna\10- Drafting\Eco Workspaces
VERSION (PLAN BY): A-A4 (S.C / P.H)

CLIENT: CENTENNIAL COAL
JOB REF: PR 103000

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RPS

TITLE: FIGURE 1-2
PROJECT APPLICATION AREA

LOCATION: MYUNA

DATUM:
PROJECTION: NON-EARTH

DATE: 1/6/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: J:\JOBS\Centennial\All Jobs\103000 Myuna\10- Drafting\Eco Workspaces

VERSION (PLAN BY): A-A4 (S.C)

CLIENT: CENTENNIAL COAL
JOB REF: PR 103000

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RPS

TITLE: FIGURE 1-3
PROPOSED SUBSIDENCE ZONES

LOCATION: MYUNA

DATUM:
PROJECTION: NON-EARTH

DATE: 6/8/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: J:\JOBS\Centennial\All Jobs\103000 Myuna\10- Drafting\Eco Workspaces
VERSION (PLAN BY): A-A4 (S.C)

CLIENT: CENTENNIAL COAL
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RPS

1.2 Site Particulars

Locality – Myuna Colliery's Surface Facilities Area is located in Wangi Wangi on the western side of Lake Macquarie, 25 kilometres south-west of Newcastle. The underground workings comprise three coal seams at various depths and locations. The proposed underground workings generally extend under the southern portions of Lake Macquarie as far as Point Wolstoncroft to the south, Balcolyn in the south-west, the southern portions of Buttaba in the north-west and Fishing Point and Rathmines in the north-east. The majority of the underground workings are located under the lake water body. **Figure 1-1** shows the location of the proposed Project.

PAA -The Project Application Area (PAA) is shown in **Figure 1-2**. It encompasses ML 1370, a portion of CCL 762 and the Surface Facilities Area**.** It comprises an area external to the existing Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area). The PAA encompasses areas of lake and land totalling 3,142 hectares.

Local Government Area – The Wyong Local Government Area (LGA) encompasses Point Wolstoncroft, while the Lake Macquarie LGA encompasses the remainder of the PAA.

Study Area – The Study Area comprises a 10 kilometre radius around the boundary of the PAA.

Current Land Use – The majority of the PAA is located below the water body of southern Lake Macquarie. Other areas include areas of urban development, Open Space, infrastructure such as electricity water and sewage, crown lands and other areas of reserved bushland.

Topography – The PAA is located over large areas of the water body of southern Lake Macquarie. In addition, the site encompasses low rolling rises and crests of the peninsulas associated with the land and foreshores surrounding the lake. The land within the PAA ranges from 0 metres to 50 metres AHD. The land contains numerous first and second order perennial watercourses and is generally accessible by established roads and farm / fire / access trails.

Soils - Surface soils in the Wangi area are classified under the *Lake Macquarie to Gosford 1:100,000 Map Sheet* as part of the Awaba erosional landscapes. Soils in this area are typically shallow and gravelly, and are generally of moderate to low erodibility that vary in type from gravelly loam to well structured plastic clays.

1.3 Description of the Proposed Project

1.3.1 Mining Area

The Project Application Area encompasses the coal measures and three seams previously mined at Myuna Colliery and as such includes some existing workings and areas requiring new workings to be developed. Access to new areas will be from the existing workings.

1.3.2 Surface Subsidence

Mining within the Project Application Area will be designed to remain below two levels of subsidence (Seedsman Geotechnics, 2010). The two zones are shown on **Figure 1-2** and include:

- Zone A – Long term stable mining systems generating < 20 millimetres of surface subsidence (i.e. no noticeable surface impact); and
- Zone B – Mining systems generating a maximum of 650 millimetres of surface subsidence.

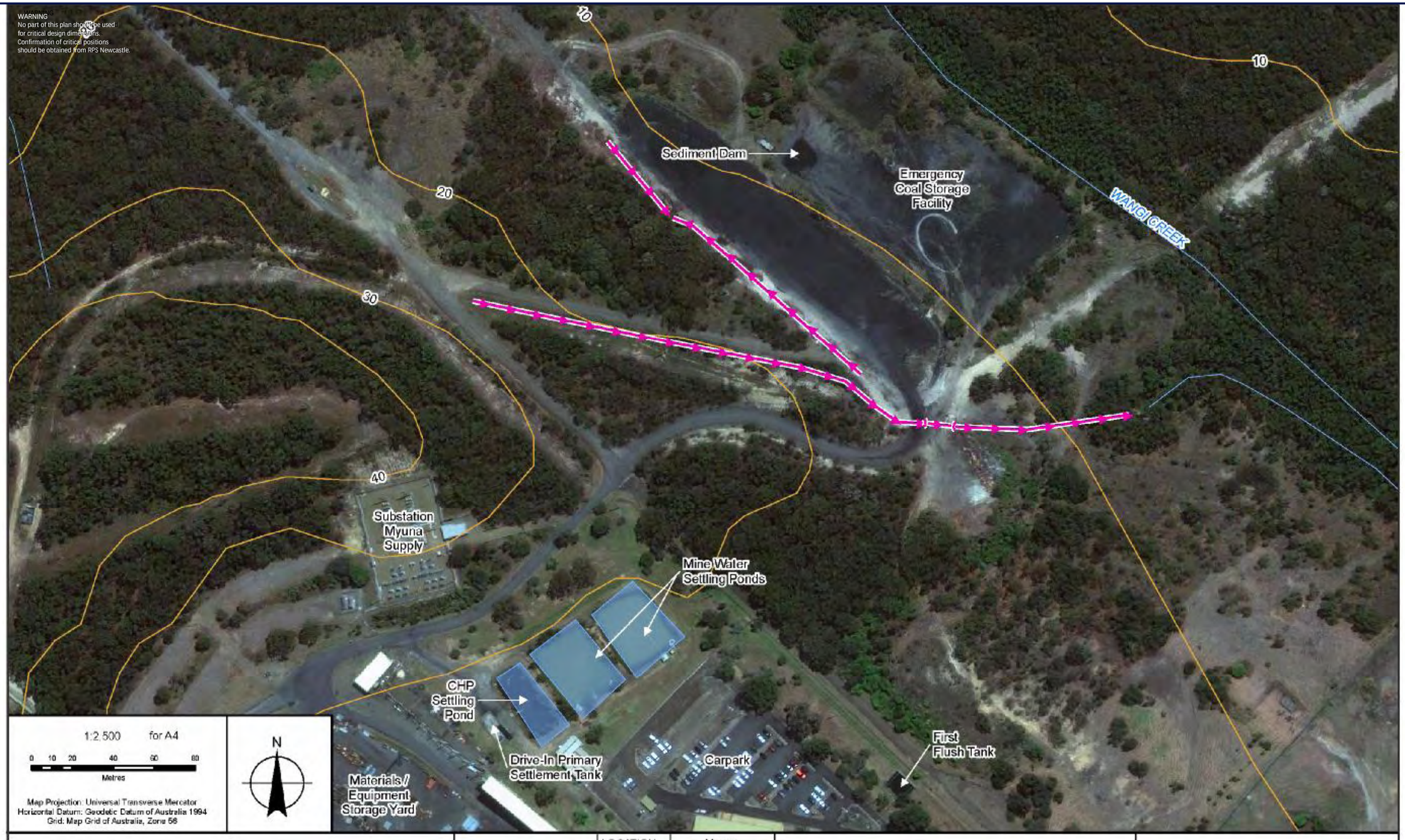
Zone A level of negligible subsidence is proposed under sensitive areas such as residential areas, State Conservation Areas, foreshore areas and sea grass beds. Zone B level of subsidence is proposed under areas of Lake Macquarie.

1.3.3 Mine Access and Surface Facilities

Existing mining areas (including existing underground workings for ventilation) will continue to be utilised for the proposed Project including (but not limited to) mine access, emergency management and underground services and infrastructure. As such, no changes are proposed to the current mine access, infrastructure or facilities.

Minor changes to surface water management at the Surface Facilities Area, involving the creation of clean water diversions at the temporary coal stockpile area, will be undertaken as part of the Project(refer to **Figures 1-3 & 1-4**).

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.



LEGEND

- Watercourse
- 10m Contours
- Proposed Clean Water Diversions

LOCATION	Myuna
SEAM	Great Northern, Fassifern & Wallarah Seam
DRAWN	F.M
CHECKED	
APPROVED	
SCALE	refer to scalebar

Myuna Colliery

Location of Proposed Works
Emergency Stockpile Dam

Centennial Myuna

DATE 07-06-2010

TITLE: FIGURE 1-4 EMERGENCY STOCKPILE DAM PROPOSED DRAINAGE WORKS

LOCATION: MYUNA

DATUM: DATUM
PROJECTION: NON-EARTH (FEET)

DATE: 24/6/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: J:\JOBS\Centennial\All Jobs\103000 Myuna\10- Drafting\Eco Workspaces
VERSION (PLAN BY): A-A3 (S.C)

CLIENT: CENTENNIAL COAL
JOB REF: PR 103000

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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RPS

GHD

LEGEND

- Watercourse
- 10m Contours
- Proposed Clean Water Diversions

LOCATION	Myuna
SEAM	Great Northern, Fassifern & Wallarah Seam
DRAWN	F.M
CHECKED	
APPROVED	
SCALE	refer to scalebar

Myuna Colliery

Location of Proposed Works
Coal Handling Plant Dam

Centennial Myuna

DATE 07-06-2010

TITLE: FIGURE 1-5 COAL HANDLING PLANT DAM PROPOSED DRAINAGE WORKS

LOCATION: MYUNA

DATUM: DATUM
PROJECTION: NON-EARTH (FEET)

DATE: 24/6/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: J:\JOBS\CENTENNIAL\ALL JOBS\103000 MYUNA\10- DRAFTING\ECO WORKSPACES
VERSION (PLAN BY): A-A3 (S.C)

CLIENT: CENTENNIAL COAL
JOB REF: PR 103000

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1.4 Scope of the Study

The scope of this flora and fauna impact assessment report was predominately composed of a desktop assessment of the following tasks:

- identify terrestrial plant and fauna species found within the PAA;
- identify and map existing vegetation communities within the PAA;
- assess the status of identified plant species, fauna species and vegetation communities under relevant legislation;
- assess the habitat potential for threatened species, populations, or ecological communities known from the Study Area;
- identify threatened flora and fauna, and potential for threatened flora and fauna that may occur within the PAA; and
- assess the potential of the proposed Project to have a significant impact on any threatened species, populations or ecological communities identified or as having potential habitat on the PAA;

The scope of this flora and fauna impact assessment report also included a field survey of the proposed minor water drainage works at the Surface Facilities Area.

The purpose of this report is to:

- ensure planning, management and development decisions are based on sound scientific information and advice by documenting the presence of any biodiversity components or potential significant impacts that may result from the proposed Project; and
- provide information to enable compliance with applicable assessment requirements contained within the *TSC Act*, *EP&A Act*, the *EPBC Act*, and any other relevant state, regional and local environmental legislation.

It is considered that a desktop assessment is adequate for the proposed Project due to continuation of existing mining that will require no additional surface facilities to be constructed (with only minor surface water management changes), no change in existing operations (apart from increased coal production), no clearing of native vegetation, and negligible (less than 20 millimetres) subsidence in terrestrial areas.

It should be noted that this report does not assess the impacts on aquatic ecosystems of Lake Macquarie itself, as potential impacts on the aquatic ecology of Lake Macquarie have been considered separately by Cardno Ecology Lab (2010).

2 Qualifications and Licensing

2.1 Qualifications

This report was written by Steven Cox B.App.Sc. (Hons.) and Toby Lambert B.Env.Sc. of RPS Australia East Pty Ltd. The academic qualifications and professional experience of RPS consultants involved with the preparation of this report are documented in **Appendix 3.**

2.2 Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2010);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2011);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2011).

2.3 Certification

As the principal author, I, Toby Lambert make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the Study Area; and
- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995, National Parks and Wildlife Act 1974* and the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

Toby Lambert
Senior Project Manager \ Senior Ecologist
RPS Australia East Pty Ltd
February 2011

3 Methodology

The Director-General's Requirements for the Project included a letter from DECCW for CMPL's information, which stated:

"DECCW is of the opinion that if the predicted subsidence levels can be shown not to adversely impact on terrestrial threatened species, populations, ecological communities and their habitat then no further assessment would be required."

Due to the predicted minimal level of subsidence (less than 20 millimetres) in land-based areas of the PAA negligible terrestrial ecology impacts are expected to occur. Additionally no surface cracking leading to inflows of water into the workings is expected to occur (Seedsman Geotechnics, 2010). As negligible surface impacts are expected to occur as a result of the proposed Project, and taking into consideration DECCW's letter, it was considered that a field survey of the entire PAA was not warranted. Numerous studies have been previously completed in the local area and these were considered to provide sufficient ecological information to determine if any significant impacts are likely to result from the proposed Project.

3.1 Field Survey

A field survey was however undertaken of the area of the proposed minor surface water diversion works at the temporary coal stockpile area on 19 June 2010 (see **Figure 1-3**). The field survey comprised a walk along the length of the four metre wide area of the proposed drainage works, during which the vegetation communities, a cumulative flora species list and key fauna habitats were recorded.

The minor surface water diversion works proposed at the Coal Handling Plant Dam (see **Figure 1-4**) are instead proposed in a mown lawn area of the Surface Facilities Area and as such were assessed via desktop assessment.

3.2 Consultation

In order to obtain the most comprehensive and up-to-date threatened species information for the PAA, consultation was undertaken with the Department of Environment, Climate Change and Water (DECCW) and Lake Macquarie City Council (LMCC). These departments which include the National Parks and Wildlife Service (NPWS) arm of DECCW, were contacted to obtain information relevant to the PAA.

3.3 Literature Review

A literature review was undertaken to identify potential threatened species, endangered populations and TECs that may occur within the PAA. The following information sources were reviewed:

- Review of fauna and flora records contained in the DECCW Atlas of NSW Wildlife (accessed May 2010) within a 10 kilometre radius of the PAA (Study Area);
- Department of the Environment, Water, Heritage and the Arts (DEWHA – now SEWPAC) *EPBC Act* Protected Matters Search (accessed May 2010) within the Study Area;
- DECCW Threatened Species, Populations and Ecological Communities website (http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/);
- A review of Geographic Information System (GIS) data including (but not limited to) aerial photography, topographic maps, State Environmental Planning Policy (SEPP) 14 Wetland Mapping, Soil Landscapes and Acid Sulphate Soil Potential;
- Flora and fauna reports and relevant management plans for Myuna Colliery;
- Plans of management for conservation areas within the Study Area;
- Lake Macquarie City Council reports;
- Regional vegetation mapping covering the Study Area;
- Flora and Fauna Impact assessments and Environmental Assessments for Eraring Power Station; and
- Collective knowledge gained from previous work in the local area.

Where relevant, assessment of threatened species listed on the *TSC Act* considered:

- Threatened Biodiversity Survey and Assessment: Guidelines for Activities and Developments (DEC 2004);
- Threatened Species Assessment Guidelines – The Assessment of Significance (DECC 2007); and
- Lake Macquarie *Tetratheca juncea* Management Plan.

A number of other guidelines and documents listed in the DECCW letter however were not relevant due to the desktop assessment nature of this assessment and the negligible land surface subsidence and surface and groundwater impacts.

4 Results

4.1 Literature Review

A review of the literature listed in **Section 3.3** identified the following threatened flora species (**Table 4-1**), threatened fauna species (**Table 4-2**), endangered populations (**Table 4-3**), TECs (**Table 4-4**) and ROTAP species (**Table 4-5**) as occurring or likely to occur within the Study Area.

Table 4-1: Relevant Threatened Flora Species Identified During a Review of Local Ecological Studies

Scientific Name	Common Name	*TSC Act*	*EPBC Act*	Notes and Source
Acacia bynoeana		E	V	Recorded in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5] Recorded in the Eraring area [6, 7, 8]
Angophora inopina		V	V	Recorded in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Recorded in the Lake Macquarie City Council Area[5]
Callistemon linearifolius		V		Recorded in the Lake Macquarie City Council Area[5] Recorded in the Eraring area[8]
Chamaesyce psammogeton	Coastal Spurge	E		Recorded in the Lake Macquarie City Council Area[5]
Cynanchum elegans	White Flowered Wax Plant	E	E	Recorded in the Lake Macquarie City Council Area[5]
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	Recorded in the Lake Macquarie City Council Area[5]
Dendrobium melaleucaphilum	Spider Orchid	E		Likely to occur in the Lake Macquarie City Council Area[5]
Diuris praecox	Newcastle Doubletail	V	V	Recorded in the Lake Macquarie City Council Area[5]
Eucalyptus camfieldii	Camfield's Stringybark	V	V	Recorded in the Lake Macquarie City Council Area[5]
Eucalyptus parramattensis subsp. Decadens	Earp's Gum	V	V	Recorded in the Lake Macquarie City Council Area[5]
Genoplesium baueri		V		Likely to occur in the Lake Macquarie City Council Area[5]
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	Recorded in the Lake Macquarie City Council Area[5]
Maundia triglochinoides		V		Likely to occur in the Lake Macquarie City Council Area[5]
Melaleuca biconvexa	Biconvex Paperbark	V	V	Recorded in the Lake Macquarie City Council Area[5]
Microtis angusii	Angus' Onion Orchid	E	E	Thought to occur in Lake Macquarie State Conservation Area[3] Likely to occur in the Lake Macquarie City Council Area[5]

Scientific Name	Common Name	TSC Act	EPBC Act	Notes and Source
Prostanthera densa	Villous Mintbush	V	V	Recorded in the Lake Macquarie City Council Area[5]
Pultenaea maritima	Coastal Headland Pea	V		Recorded in the Lake Macquarie City Council Area[5]
Rhizanthella slateri	Eastern Underground Orchid	V	E	Recorded in the Lake Macquarie City Council Area[5]
Rutidosis heterogama	Heath Wrinklewort	V	V	Recorded in the Lake Macquarie City Council Area[5]
Syzygium paniculatum	Magenta Lillypilly	V	V	Recorded in Lake Macquarie State Conservation Area[3] Likely to occur in the Lake Macquarie City Council Area[5] Recorded in the Lake Macquarie City Council Area[5]
Tetratheca glandulosa	Glandular Pink-bell	V	V	Likely to occur in the Lake Macquarie City Council Area[5]
Tetratheca juncea	Black-eyed Susan	V	V	Myuna Colliery Bushland Buffer [1] – recorded at four locations. Known to occur in compartments 5 and 6 of Myuna Colliery[2] Recorded in Lake Macquarie State Conservation Area[3]. May occur on Pulbah island[3]. Recorded along the north western portion of Myuna colliery lands (along Donnelly and Main roads)[4] Recorded in the Lake Macquarie City Council Area[5] Recorded in the Eraring area[6, 7, 8]
Thesium australe	Austral Toadflax		V	Likely to occur in the Lake Macquarie City Council Area[5]
Zannichellia palustris		E		Recorded in the Lake Macquarie City Council Area[5]

Sources:

1 - (SNK, 1999)
2 - (Centennial Myuna, 2008)
3 - (NPWS, 2005)
4- (HWR, 2001)
5 - (Lake Macquarie City Council, 2009)
6 – HLA (2007a)
7 – HLA (2007b)
8 – HLA (2006)
9 – HWR (2005)

Notes:

E = Endangered
V = Vulnerable

Table 4-2: Relevant Threatened Fauna Species Identified During a Review of Local Ecological Studies

Scientific Name	Common Name	TSC Act	EPBC Act	Notes and Source
		FROGS		
LItoria aurea	Green and Golden Bell Frog	E	V	Recorded in the Lake Macquarie City Council Area[5]
Mixophyes iteratus	Giant Barred Frog	E	E	Recorded in the Lake Macquarie City Council Area[5]
Mixophyes balbus	Stuttering Frog	E	V	Recorded in the Lake Macquarie City Council Area[5]
Heleioporus australiacus	Giant Burrowing Frog	V	V	Recorded in the Lake Macquarie City Council Area[5]
Pseudophryne australis	Red-crowned Toadlet	V		Recorded in the Lake Macquarie City Council Area[5]
Litoria brevipalmata	Green-thighed Frog	V		Recorded in the Lake Macquarie City Council Area[5]
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Recorded in the Lake Macquarie City Council Area[5]
Crinia tinnula	Wallum Froglet	V		Recorded in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
		REPTILES		
Hoplocephalus bitorquatus	Pale-headed Snake	V		Recorded in the Lake Macquarie City Council Area[5]
Hoplocephalus stephensii	Stephen's Banded Snake	V		Recorded in the Lake Macquarie City Council Area[5]
Varanus rosenbergi	Heath Monitor	V		Recorded in the Lake Macquarie City Council Area[5]
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Likely to occur in the Lake Macquarie City Council Area[5]
		BIRDS		
Stictonetta naevosa	Freckled Duck	V		Recorded in the Lake Macquarie City Council Area[5]
Ephippiorhynchus asiaticus	Black-necked Stork	E		Recorded in the Lake Macquarie City Council Area[5]
Burhinus magnirostris	Bush Stone Curlew	E		Likely to occur in the Lake Macquarie City Council Area[5]
Esacus neglectus	Beach Stone Curlew	CE		Likely to occur in the Lake Macquarie City Council Area[5]
Sterna albifrons	Little Tern	E		Recorded in the Lake Macquarie City Council Area[5]
Sterna fuscata	Sooty Tern	V		Recorded in the Lake Macquarie City Council Area[5]
Erythrotriorchis radiates	Red Goshawk	CE	V	Likely to occur in the Lake Macquarie City Council Area[5]
Haliaeetus leucogaster	White Breasted Sea Eagle		M	Nests at Awaba Bay, Wangi Point and Pulbah Island[3]
Lophoictinia isura	Square-tailed Kite	V		Recorded in the Lake Macquarie City Council Area[5]
Hieraaetus morphnoides	Little Eagle	V		Recorded in the Lake Macquarie City Council Area[5]
Circus assimilis	Spotted Harrier	V		Recorded in the Lake Macquarie City Council Area[5]

Scientific Name	Common Name	TSC Act	EPBC Act	Notes and Source
Pandion haliaetus	Osprey	V		Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Charadrius mongolus	Mongolian Plover	V		Recorded in the Lake Macquarie City Council Area[5]
Thinornis rubricollis	Hooded Plover	CE		Likely to occur in the Lake Macquarie City Council Area[5]
Rostratula benghalensis	Australian Painted Snipe	E	V, M	Recorded in the Lake Macquarie City Council Area[5]
Haematopus longirostris	Pied Oystercatcher	E		Recorded in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Haematopus fuliginosus	Sooty Oystercatcher	V		Recorded in the Lake Macquarie City Council Area[5]
Xenus cinereus	Terek Sand Piper	V	M	Recorded in the Lake Macquarie City Council Area[5]
Charadrius leschenaulti	Greater Sand Plover	V		Recorded in the Lake Macquarie City Council Area[5]
Calidris tenuirostris	Great Knot	V	M	Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Limosa limosa	Black-tailed Godwit	V		Recorded in the Lake Macquarie City Council Area[5]
Ixobrychus flavicollis	Black Bittern	V		Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Botaurus poiciloptilus	Australasian Bittern	V		Likely to occur in the Lake Macquarie City Council Area[5]
Irediparra gallinacea	Comb-crested Jacana	V		Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Calyptorhynchus lathami	Glossy Black-cockatoo	V		Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Callocephalon fimfriatum	Gang-gang Cockatoo	V		Recorded in the Lake Macquarie City Council Area[5]
Neophema pulchella	Turquoise Parrot	V		Recorded in the Lake Macquarie City Council Area[5]
Lathamus discolour	Swift Parrot	E	E	Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Glossopsitta pusilla	Little Lorikeet	V		Recorded in the Lake Macquarie City Council Area[5]
Tyto novaehollandiae	Masked Owl	V		Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]

Scientific Name	Common Name	TSC Act	EPBC Act	Notes and Source
Ninox connivens	Barking Owl	V		Unconfirmed record in the Lake Macquarie City Council Area[5]
Ninox strenua	Powerful Owl	V		Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Tyto tenebricosa	Sooty Owl	V		Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Ptilinopus magnificus	Wompoo Fruit Dove	V		Recorded in the Lake Macquarie City Council Area[5]
Ptilinopus regina	Rose-crowned Fruit Dove	V		Recorded in the Lake Macquarie City Council Area[5]
Ptilinopus superbus	Superb Fruit-Dove	V		Recorded in the Lake Macquarie City Council Area[5]
Climacteris picumnus victoriae	Brown Treecreeper	V		Recorded in the Lake Macquarie City Council Area[5]
Xanthomyza phrygia	Regent Honeyeater	E	E, M	Recorded in the Lake Macquarie City Council Area[5]
Melithreptus gularis gularis	Black-chinned Honeyeater	V		Likely to occur in the Lake Macquarie City Council Area[5] Recorded in the Wangi Wangi Area [9]
Melanodryas cucullata cucullata	Hooded Robin (south eastern subspecies)	V		Recorded in the Lake Macquarie City Council Area[5]
Petroica phoenicea	Flame Robin	V		Recorded in the Lake Macquarie City Council Area[5]
Pteroica boodang	Scarlet Robin	V		Recorded in the Lake Macquarie City Council Area[5]
Pyrrholaemus sagittata	Speckled Warbler	V		Likely to occur in the Lake Macquarie City Council Area[5]
Pomatostomus tempoalis temporalis	Grey-crowned Babbler (eastern subspecies)	V		Recorded in the Lake Macquarie City Council Area[5]
Stagonopleura guttata	Diamond Firetail	V		Likely to occur in the Lake Macquarie City Council Area[5]
Daphoenositta chrysoptera	Varied Sittella	V		Recorded in the Lake Macquarie City Council Area[5]
		MAMMALS		
Dasyurus viverrinus	Eastern Quoll	E		Likely to occur in the Lake Macquarie City Council Area[5]
Dasyurus maculates	Spotted-tailed Quoll	V	V	Recorded in the Lake Macquarie City Council Area[5]
Macropus parma	Parma Wallaby	V		Recorded in the Lake Macquarie City Council Area[5]
Petrogale penicillata	Brush-tailed Rock Wallaby	E	V	Recorded in the Lake Macquarie City Council Area[5]
Phascogale tapoatafa	Brush-tailed Phascogale	V		Likely to occur in the Lake Macquarie City Council Area[5]
Phascolarctos cinereus	Koala	V		Recorded adjacent to Myuna Colliery[2] Released on Pulbah Island – status unknown[3]. Known to occur in the Wangi Point SCA until the 1980s[3]. Recorded in the Lake Macquarie City Council Area[5]

Scientific Name	Common Name	TSC Act	EPBC Act	Notes and Source
Petaurus norfolcensis	Squirrel Glider	V		Recorded in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5] Recorded in the Eraring area[8] Recorded in the Wangi Wangi Area [9]
Petaurus australis	Yellow-bellied Glider	V		Recorded in the Lake Macquarie City Council Area[5]
Cercartetus nanus	Eastern Pygmy Possum	V		Recorded in the Lake Macquarie City Council Area[5]
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Recorded in the Lake Macquarie City Council Area[5] Recorded in the Eraring area[8,7] Recorded in the Wangi Wangi Area [9]
Saccolaimus flaviventris	Yellow-bellied Sheath Tailed Bat	V		Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Likely to occur in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5]
Miniopterus schreiberii oceanensis	Eastern Bentwing-bat	V		Recorded in Lake Macquarie State Conservation Area[3] Recorded in the Lake Macquarie City Council Area[5] Recorded in the Eraring area[8,7]
Myotis adversus	Large-footed Myotis	V		Recorded in the Lake Macquarie City Council Area[5]
Myotis macropus	Large-footed Mouse-eared Bat	V		Recorded in the Eraring area[8]
Miniopterus australis	Little Bent-wing Bat	V		Recorded in the Lake Macquarie City Council Area[5] Recorded in the Eraring area[8,7]
Kerivoula papuensis	Golden Tipped Bat	V		Recorded in the Lake Macquarie City Council Area[5]
Mormopterus norfolkensis	Eastern Freetail Bat	V		Recorded in the Lake Macquarie City Council Area[5] Recorded in the Eraring area[8,7]
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Recorded in the Lake Macquarie City Council Area[5]
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Recorded in the Lake Macquarie City Council Area[5]
Vespadelus troughtoni	Eastern Cave Bat	V		Recorded in the Lake Macquarie City Council Area[5]
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V		Recorded in the Lake Macquarie City Council Area[5]

Sources:

1 - (SNK, 1999)
2 - (Centennial Myuna, 2008)
3 - (NPWS, 2005)
4 - (HWR, 2001)
5 - (Lake Macquarie City Council, 2009)
6 – HLA (2007a)
7 – HLA (2007b)
8 – HLA (2006)
9 – HWR (2005)

Notes:

CE = Critically Endangered
E = Endangered
V = Vulnerable

Table 4-3: Endangered Populations Identified During a Review of Local Ecological Studies

Endangered Populations	TSC Act	EPBC Act	Notes and Source
Eucalyptus parramattensis subsp *parramattensis* in Wyong and Lake Macquarie Local Government Areas	E		Recorded in the Lake Macquarie City Council Area[1] Recorded in the Eraring area [7]

Sources:
1 - (Lake Macquarie City Council, 2009)
7 – HLA (2007b)

Notes:
CE = Critically Endangered
E = Endangered
V = Vulnerable

Table 4-4: TECs Identified During a Review of Local Ecological Studies

Ecological Communities	TSC Act	EPBC Act	Notes and Source
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E		Recorded in the Lake Macquarie City Council Area[5]
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bio-regions	E		Recorded in the Lake Macquarie City Council Area[5]
Hunter Lowland Redgum Forest	E		Recorded in the Lake Macquarie City Council Area[5]
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E		Recorded in the Lake Macquarie City Council Area[5]
Lower Hunter Spotted Gum Ironbark Forest	E		Recorded in the Lake Macquarie City Council Area[5]
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion	E		Recorded in the Lake Macquarie City Council Area[5]
River-flat Eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bio-regions	E		Recorded in the Lake Macquarie City Council Area[5]
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bio-regions	E		Recorded in the Lake Macquarie City Council Area[5]
Swamp Sclerophyll Forest on Coastal Floodplains	E		Recorded in the Lake Macquarie City Council Area[5] Recorded in the Wangi Wangi Area [9]
Sydney Freshwater Wetland	E		Recorded in the Lake Macquarie City Council Area[5]
Themeda Grassland on sea cliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E		Recorded in the Lake Macquarie City Council Area[5]
Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions	V		Recorded in the Lake Macquarie City Council Area[5]
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia		CE	Recorded in the Lake Macquarie City Council Area[5]

Sources:
1 - (SNK, 1999)
2 - (Centennial Myuna, 2008)
3 - (NPWS, 2005)
4- (HWR, 2001)
5 - (Lake Macquarie City Council, 2009)
9 – HWR (2005)

Notes:
CE = Critically Endangered
E = Endangered
V = Vulnerable

Table 4-5: ROTAP Species Identified During a Review of Local Ecological Studies

Scientific Name	Common Name	ROTAP Code	*TSC Act*	*EPBC Act*	Notes and Source
Callistemon shiressii	-	3RC			Known to occur in the Lake Macquarie City Council Area[1]
Eucalyptus fergusonii subsp. fergusonii	-	3KC			Known to occur in the Lake Macquarie City Council Area[1]
Gonocarpus salsoloides	-	3RCa			Known to occur in the Lake Macquarie City Council Area[1]
Macrozamia flexuosa	-	2K			Recorded in Lake Macquarie State Conservation Area[3]. May occur on Pulbah island[3].
Macrozamia pauli-guilielmi	Pineapple Zamia	2K	-	E	Known to occur in the Lake Macquarie City Council Area[1]
Melaleuca groveana	-	3RC	V	-	Associated with LHCCREMS Map Unit 48 - Coastal Clay Heath vegetation community[2]
Persicaria elatior	-	3V	V	V	Associated with LHCCREMS Map Unit 41 – Swamp Oak Sedge Forest vegetation community[2]
Typhonium elisoursum	-	3RC-	-	-	Known to occur in the Lake Macquarie City Council Area[1]

ROTAP Codes

Distribution Category
1 – Known by one collection only
2 – Geographic Range <100 kilometres
3 – Geographic Range >100 kilometres

Conservation Status
V – Vulnerable, at risk over longer period (20-50 yrs) through continued depletion.
R – Rare, no identifiable threat due to wide distribution, large population size or combination of both.
K – Poorly Known, no accurate information regarding population sizes within conservation areas.
C – Reserved, at least one population within a National Park or proclaimed conservation area

Size Class of Reserved Populations
a = >1000 plants known in conservation reserve
i = <1000 known in conservation reserve
- = reserved pop size not accurately known

Sources:
1 - (LMCC, 2009)
2 - (House, 2003)

Notes:
TSC Act and *EPBC Act* Codes
CE = Critically Endangered
E = Endangered
V = Vulnerable

4.1.1 Database Searches

Atlas of NSW Wildlife

A total of 24 flora species on the Atlas of NSW Wildlife database have been recorded within the Study Area (**Table 4-6, Figure 4-1**). Ten of the species are listed as Endangered and 14 as Vulnerable on the *TSC Act*.

Table 4-6: Flora Species Identified Within the Study Area by a Search of the NSW Atlas of Wildlife

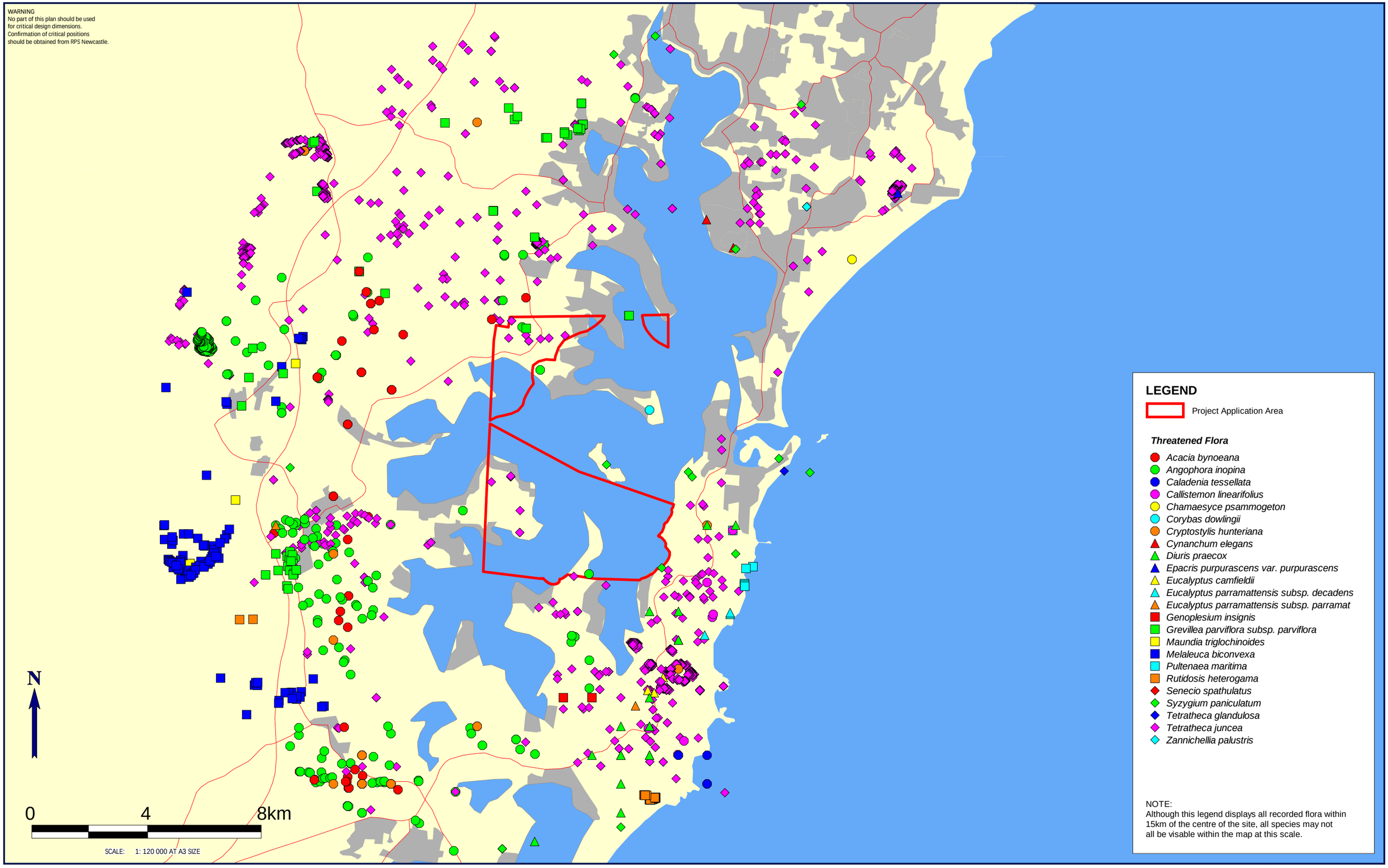
Scientific Name	Common Name	Status *TSC Act*	Status *EPBC Act*	First Date	Last Date	10km Radius	2.5km Radius
Acacia bynoeana	Bynoe's Wattle	E1	V	1899	2007	43	0
Angophora inopina	Charmhaven Apple	V	V	1995	2009	252	0
Caladenia tessellata	Thick Lip Spider Orchid	E1	V	1996	1998	4	0
Callistemon linearifolius	Netted Bottle Brush	V		1999	2008	7	0
Chamaesyce psammogeton	Sand Spurge	E1		1987	1987	1	0
Corybas dowlingii	Red Helmet Orchid	E1		2008	2008	1	0
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	1995	2008	26	0
Cynanchum elegans	White-flowered Wax Plant	E1		1995	2005	2	0
Diuris praecox	Newcastle Doubletail	V	V	1990	2008	19	0
Epacris purpurascens var. purpurascens		V		2006	2006	1	0
Eucalyptus camfieldii	Camfield's Stringybark	V	V	2003	2003	3	0
Eucalyptus parramattensis subsp. decadens		V	V	2007	2007	3	0
Eucalyptus parramattensis subsp. parramattensis		E2		2003	2007	2	0
Genoplesium insignis	Variable Midge Orchid	E1		1999	2000	2	0
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	1994	2008	63	0
Maundia triglochinoides		V		2009	2009	5	0
Melaleuca biconvexa	Biconvex Paperbark	V	V	2001	2009	96	0
Pultenaea maritima	Coast Headland Pea	V		2004	2005	6	0
Rutidosis heterogama	Heath Wrinklewort	V		2003	2008	119	0
Senecio spathulatus	Coast Groundsel	E1		1920	1920	2	0
Syzygium paniculatum	Magenta Lilly Pilly	E1	V	1990	2007	17	0
Tetratheca glandulosa	Black-eyed Susan	V		2003	2003	1	0
Tetratheca juncea	Black-eyed Susan	V	V	1770	2009	1380	0
Zannichellia palustris		E1		1990	1990	2	0

Status (*TSC Act*):
E1 Schedule 1: Endangered Species
E2 Schedule 1: Endangered Population
V Schedule 2: Vulnerable Species

Status (EPBC):
V Vulnerable Species

A total of 70 threatened fauna species on the Atlas of NSW Wildlife database have been recorded within the Study Area (**Table 4-7, Figure 4-2**). Twelve of these species are listed as Endangered and 58 as Vulnerable under the *TSC Act*. It should be noted that 14 entirely marine species (2 reptiles, 8 birds and 4 mammals) were not included in **Table 4-7**. Marine species are assessed in the aquatic report (Cardno Ecology Lab 2010).

WARNING
No part of this plan should be used
for critical design dimensions.
Confirmation of critical positions
should be obtained from RPS Newcastle.



LEGEND

Project Application Area

Threatened Flora

- *Acacia bynoeana*
- *Angophora inopina*
- *Caladenia tessellata*
- *Callistemon linearifolius*
- *Chamaesyce psammogeton*
- *Corybas dowlingii*
- *Cryptostylis hunteriana*
- *Cynanchum elegans*
- *Diuris praecox*
- *Epacris purpurascens var. purpurascens*
- *Eucalyptus camfieldii*
- *Eucalyptus parramattensis subsp. decadens*
- *Eucalyptus parramattensis subsp. parramat*
- *Genoplesium insignis*
- *Grevillea parviflora subsp. parviflora*
- *Maundia triglochinoides*
- *Melaleuca biconvexa*
- *Pultenaea maritima*
- *Rutidosis heterogama*
- *Senecio spathulatus*
- *Syzygium paniculatum*
- *Tetratheca glandulosa*
- *Tetratheca juncea*
- *Zannichellia palustris*

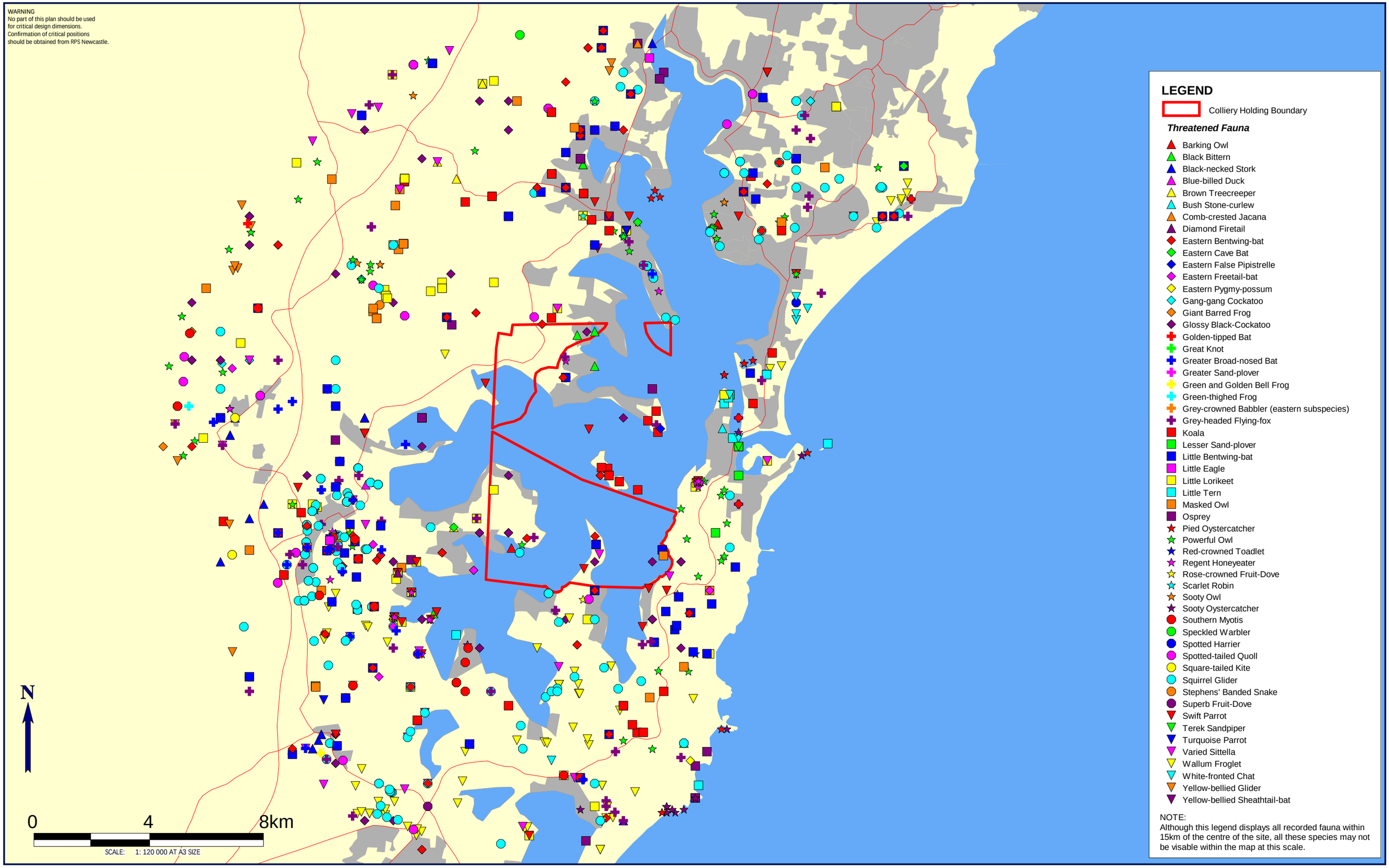
NOTE:
Although this legend displays all recorded flora within 15km of the centre of the site, all species may not all be visable within the map at this scale.

TITLE: FIGURE 4-1 THREATENED FLORA
LOCATION: MYUNA
DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 1/6/2010
PURPOSE: REPORT FIGURE
LAYOUT REF:J:\JOBS\Centennial\All Jobs\103000 Myuna\10- Drafting\Eco Workspaces
VERSION (PLAN BY): A-A3 (S.C)

CLIENT: CENTENNIAL COAL
JOB REF: PR 103000

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

WARNING
No part of this plan should be used
for critical design dimensions.
Confirmation of critical positions
should be obtained from RPS Newcastle.



LEGEND

Colliery Holding Boundary

Threatened Fauna

- Barking Owl
- Black Bittern
- Black-necked Stork
- Blue-billed Duck
- Brown Treecreeper
- Bush Stone-curlew
- Comb-crested Jacana
- Diamond Firetail
- Eastern Bentwing-bat
- Eastern Cave Bat
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Eastern Pygmy-possum
- Gang-gang Cockatoo
- Giant Barred Frog
- Glossy Black-Cockatoo
- Golden-tipped Bat
- Great Knot
- Greater Broad-nosed Bat
- Greater Sand-plover
- Green and Golden Bell Frog
- Green-thighed Frog
- Grey-crowned Babbler (eastern subspecies)
- Grey-headed Flying-fox
- Koala
- Lesser Sand-plover
- Little Bentwing-bat
- Little Eagle
- Little Lorikeet
- Little Tern
- Masked Owl
- Osprey
- Pied Oystercatcher
- Powerful Owl
- Red-crowned Toadlet
- Regent Honeyeater
- Rose-crowned Fruit-Dove
- Scarlet Robin
- Sooty Owl
- Sooty Oystercatcher
- Southern Myotis
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll
- Square-tailed Kite
- Squirrel Glider
- Stephens' Banded Snake
- Superb Fruit-Dove
- Swift Parrot
- Terek Sandpiper
- Turquoise Parrot
- Varied Sittella
- Wallum Froglet
- White-fronted Chat
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat

NOTE:
Although this legend displays all recorded fauna within 15km of the centre of the site, all these species may not be visable within the map at this scale.

TITLE: FIGURE 4-2 THREATENED FAUNA
LOCATION: MYUNA
DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 1/6/2010
PURPOSE: REPORT FIGURE
LAYOUT REF:J:\JOBS\Centennial\All Jobs\103000 Myuna\10- Drafting\Eco Workspaces
VERSION (PLAN BY): A-A3 (S.C)

CLIENT: CENTENNIAL COAL
JOB REF: PR 103000

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

Table 4-7: Fauna Species Identified Within the Study Area by a Search of the NSW Atlas of Wildlife

Common Name	Scientific Name	Status *TSC Act*	Status *EPBC Act*	First Date	Last Date	10km Radius	2.5km Radius
	AMPHIBIANS						
Crinia tinnula	Wallum Froglet	V		1995	2009	74	6
Mixophyes iteratus	Giant Barred Frog	E	E	1996	2005	3	0
Litoria aurea	Green and Golden Bell Frog	E	V	1976	1976	1	0
Litoria brevipalmata	Green-thighed Frog	V		1991	1991	2	0
Pseudophryne australis	Red-crowned Toadlet	V		1999	1999	1	0
	REPTILES						
Hoplocephalus stephensii	Stephens' Banded Snake	V		2009	2009	1	0
	BIRDS						
Oxyura australis	Blue-billed Duck	V		2007	2007	1	0
Ephippiorhynchus asiaticus	Black-necked Stork	E		1979	2005	21	0
Burhinus grallarius	Bush Stone-curlew	E		2006	2006	1	1
Ixobrychus flavicollis	Black Bittern	V		1983	2005	13	3
Irediparra gallinacea	Comb-crested Jacana	V		1984	1984	1	0
Circus assimilis	Spotted Harrier	V		1987	1987	1	0
Lophoictinia isura	Square-tailed Kite	V		1993	2006	2	0
Hieraaetus morphnoides	Little Eagle	V		1990	2005	5	0
Pandion haliaetus	Osprey	V		1981	2010	37	10
Sterna albifrons	Little Tern	E	M	1959	2007	10	7
Calidris tenuirostris	Great Knot	V		1981	1990	3	3
Charadrius leschenaultii	Greater Sand Plover	V		1983	1984	2	2
Charadrius mongolus	Lesser Sand Plover	V		1970	1995	7	7
Xenus cinereus	Terek Sandpiper	V	M	1994	1994	1	1
Haematopus fuliginosus	Sooty Oystercatcher	V		1958	2005	21	2
Haematopus longirostris	Pied Oystercatcher	E		1994	2007	18	11
Ptilinopus regina	Rose-crowned Fruit-dove	V		1997	2005	3	1
Ptilinopus superbus	Superb Fruit-dove	V		1996	2005	3	0
Calyptorhynchus lathami	Glossy Black Cockatoo	V		1984	2009	63	21
Callocephalon fimbriatum	Gang-gang Cockatoo	V		1992	2007	11	0
Neophema pulchella	Turquoise Parrot	V		1966	2005	4	0
Lathamus discolor	Swift Parrot	E	E	1983	2005	53	11
Glossopsitta pusilla	Little Lorikeet	V		1985	2009	59	13
Ninox connivens	Barking Owl	V		2002	2005	3	1
Ninox strenua	Powerful Owl	V		1982	2009	84	16
Tyto novaehollandiae	Masked Owl	V		1994	2010	43	3
Tyto tenebricosa	Sooty Owl	V		1989	2008	7	0
Climacteris picumnus	Brown Treecreeper	V		1990	2008	7	1
Xanthomyza phrygia	Regent Honeyeater	E	E, M	1958	2005	35	6
Epthianura albifrons	White-fronted Chat	V		1970	2005	11	2
Petroica boodang	Scarlet Robin	V		1986	2005	4	0
Pyrrholaemus saggitatus	Speckled Warbler	V		1971	2005	3	0
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V		1986	2005	3	0
Daphoenositta chrysoptera	Varied Sittella	V		1991	2008	32	4
Stagonopleura guttata	Diamond Firetail	V		2005	2005	2	0
	MAMMALS						
Dasyurus maculatus	Spotted-tailed Quoll	V	E	1980	2006	23	2
Phascolarctos cinereus	Koala	V		1949	2007	46	13
Petaurus australis	Yellow-bellied Glider	V		1974	2007	12	0
Petaurus norfolcensis	Squirrel Glider	V		1977	2009	181	22
Cercartetus nanus	Eastern Pygmy-possum	V		2005	2005	1	0
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	1994	2009	66	13
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		2005	2005	3	0
Mormopterus norfolkensis	Eastern Freetail-bat	V		1995	2009	44	7
Miniopterus australis	Little Bentwing-bat	V		1996	2009	81	19
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		1994	2009	72	13
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		2001	2009	7	3

Common Name	Scientific Name	Status *TSC Act*	Status *EPBC Act*	First Date	Last Date	10km Radius	2.5km Radius
Scoteanax rueppellii	Greater Broad-nosed Bat	V		1995	2009	32	2
Myotis macropus	Large-footed Myotis	V		1993	2009	27	0
Kerivoula papuensis	Golden-tipped Bat	V		1999	1999	1	0
Vespadelus troughtoni	Eastern Cave Bat	V		1996	2009	4	1

Notes:

E Endangered Species
V Vulnerable Species
M Migratory Species

EPBC Protected Matters Report

An EPBC Protected Matters Report was generated on 24 May 2010 via a search of the EPBC Protected Matters Search Tool. The EPBC Protected Matters Report identified one TEC, 53 threatened species and 66 migratory species with potential to occur within the Study Area (**Table 4-8**). Entirely marine species (27 threatened and 31 migratory) were not included in **Table 4-8** and are assessed in the aquatic report (Cardno 2010).

Table 4-8: TECs, Threatened Species and Migratory Species Identified within the Study Area by a EPBC Protected Matters Report

TECs			
TECs	**Name**		**Status**
	Littoral Rainforest and Coastal Vine Thickets of Eastern Australia		CE
Threatened Species			
	Scientific Name	**Common Name**	**Status**
Flora	***Species or Species Habitat Known to Occur***		
	Melaleuca biconvexa	Biconvex Paperbark	V
	Species or Species Habitat Likely to Occur		
	Acacia bynoeana	Bynoe's Watlle	V
	Angophora inopina		V
	Caladenia tessellata	Thick-lipped Spider-orchid	V
	Diuris praecox	Newcastle Doubletail	V
	Eucalyptus camfieldii	Camfield's Stringybark	V
	Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V
	Microtis angusii	Angus's Onion Orchid	E
	Syzygium paniculatum	Magenta Lilly Pilly	V
	Tetratheca juncea	Black-eyed Susan	V
	Species or Species Habitat May Occur		
	Cryptostylis hunteriana	Leafless Tongue-orchid	V
Fauna	***Species or Species Habitat Known to Occur***		
	Pteropus poliocephalus	Grey-headed Flying-fox	V
	Species or Species Habitat Likely to Occur		
	Anthochaera phrygia	Regent Honeyeater	E
	Lathamus discolor	Swift Parrot	E
	Heleioporus australiacus	Giant Burrowing Frog	V
	Mixophyes balbus	Stuttering Frog	V
	Mixophyes iteratus	Giant Barred Frog	E
	Hoplocephalus bungaroides	Broad-headed Snake	V
	Species or Species Habitat May Occur		
	Rostratula australis	Australian Painted Snipe	V
	Litoria aurea	Green and Golden Bell Frog	V
	Litoria littlejohni	Littlejohn's Tree Frog	V
	Chalinolobus dwyeri	Large-eared Pied Bat	V
	Dasyurus maculatus maculatus (SE mainland population)	Spotted-tailed Quoll	E
	Petrogale penicillata	Brush-tailed Rock-wallaby	V
	Potorous tridactylus tridactylus	Long-nosed Potoroo	V
	Prototroctes maraena	Australian Grayling	V

TECs			
Migratory Species			
Fauna	***Breeding Likely to Occur Within Area***		
	Myiagra cyanoleuca	Satin Flycatcher	M
	Ardea alba	Great Egret	M
	Ardea ibis	Cattle Egret	M
	Breeding May Occur Within Area		
	Monarcha melanopsis	Black-faced Monarch	M
	Rhipidura rufifrons	Rufous Fantail	M
	Species or Species Habitat Known to Occur		
	Actitis hypoleucos	Common Sandpiper	M
	Arenaria interpres	Ruddy Turnstone	M
	Calidris acuminata	Sharp-tailed Sandpiper	M
	Calidris alba	Sanderling	M
	Calidris canutus	Red Knot	M
	Calidris ferruginea	Curlew Sandpiper	M
	Calidris ruficollis	Red-necked Stint	M
	Calidris tenuirostris	Great Knot	M
	Charadrius bicinctus	Double-banded Plover	M
	Charadrius leschenaultii	Greater Sand Plover	M
	Charadrius mongolus	Lesser Sand Plover	M
	Gallinago hardwickii	Latham's Snipe	M
	Heteroscelus brevipes	Grey-tailed Tattler	M
	Limicola falcinellus	Broad-billed Sandpiper	M
	Limosa lapponica	Bar-tailed Godwit	M
	Limosa limosa	Black-tailed Godwit	M
	Numenius madagascariensis	Eastern Curlew	M
	Numenius phaeopus	Whimbrel	M
	Pluvialis fulva	Pacific Golden Plover	M
	Pluvialis squatarola	Grey Plover	M
	Tringa stagnatilis	Marsh Sandpiper	M
	Xenus cinereus	Terek Sandpiper	M
	Species or Species Habitat Likely to Occur		
	Anthochaera phrygia	Regent Honeyeater	M
	Haliaeetus leucogaster	White-bellied Sea-eagle	M
	Numenius minutus	Little Curlew	M
	Species or Species Habitat May Occur		
	Apus pacificus	Fork-tailed Swift	M
	Hirundapus caudacutus	White-throated Needletail	M
	Merops ornatus	Rainbow Bee-eater	M
	Rostratula benghalensis s. lat	Painted Snipe	M
	Sterna albifrons	Little Tern	M

Notes:

E Endangered Species
V Vulnerable Species
M Migratory Species

4.1.2 Preliminary & Final Determinations of Species Listings on the *TSC Act*

The Scientific Committee under the *TSC Act* may at any time alter the list of species on Schedules 1, 1A and 2 of the *TSC Act*. Such changes may include the addition of new species, the removal of previously listed species or changes in the schedule status of a species. During a period of consideration by the Scientific Committee the species under consideration is listed as a Preliminary Determination. If the proposed Preliminary Determination is approved the change is listed as a Final Determination.

Where a development application has been lodged for a Section 91 *TSC Act* licence and is awaiting approval the implications of any final determinations declared during that period depend on the schedule on which the species is to be listed. Final Determinations

affecting Schedules 1 and 1A (endangered and critically endangered species) must still be considered in the assessment of significance of all applications prior to approval, even after lodgement. Final Determinations affecting Schedule 2 (vulnerable species) are not subject to impact assessment if they are declared after the date of lodgement of a development application, as long as the application is determined within 12 months of lodgement (s. 113C *TSC Act*).

For the purposes of this assessment and using a precautionary approach all species listed as preliminary determinations under the *TSC Act* are assessed as approved final determinations.

At the date of submission of this report there were no relevant preliminary determination of fauna species listed on the DECCW website.

At the date of submission of this report there was one relevant preliminary determination of flora species listed on the DECCW website. The herb *Euphrasia arguta* R. Br. is proposed as a vulnerable species listing.

4.1.3 Vegetation Mapping

Figure 4-3 shows the vegetation mapping of the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) (House 2003) across the PAA, except in the Point Wolstoncroft area where the more accurate Natural Vegetation of the Wyong Local Government Area (Bell 2002) is available and has been shown. LMCC indicated that the Draft mapping by Bell for Lake Macquarie, which is likely to be more accurate than the LHCCREMS mapping is not yet available to the public.

A total of 11 vegetation communities were mapped across the PAA (House 2003; Bell 2002). These 11 communities occupy a total of 702 hectares as shown in **Table 4-9**. Endangered Ecological Communities (EECs) are highlighted bold. These 11 vegetation communities are effectively only eight communities, with the same vegetation types being mapped as different communities in the LHCCREMS and Bell mapping projects. This is also shown in **Table 4-9**.

WARNING
No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.
Note that this Vegetation Community Map depicts clearly defined boundaries between vegetation communities that are the product of individual interpretation and are not distinguished by clearly defined boundaries 'on the ground'. Therefore, this map should only be treated as an indication of approximate peripheries between delineated vegetation communities. Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account for intergrading areas between delineated vegetation communities has been made.

LEGEND

Project Application Area

VEGETATION OF THE WYONG REGION

- Narabeen Foreshore Redgum-Ironbark Forest
- Narabeen Impeded Wet Heath
- Narabeen Snappy Gum Forest
- Narrabeen Coastal Sheltered Peppermint-Apple Fores
- Narrabeen Doyalson Coastal Woodland
- Narrabeen Wallarah Sheltered Grassy Forest

LHCCREMS VEGETATION

- Apple - Palm Gully Forest
- Beach sands
- Beach Spinifex
- Coastal Clay Heath
- Coastal Foothills Spotted Gum - Ironbark Forest
- Coastal Plains Scribbly Gum Woodland
- Coastal Plains Smooth-barked Apple Woodland
- Coastal Sand Apple - Blackbutt orest
- Coastal Sand Wallum Woodland - Heath
- Coastal Sheltered Apple - Peppermint Forest
- Coastal Warm Temperate- Subtropical Rainforest (EEC)
- Freshwater Wetland Complex (EEC)
- Mangrove-Estuarine Complex
- Melaleuca Scrub
- Redgum Rough Barked Apple Forest (EEC)
- Riparian Melaleuca Swamp Woodland (EEC)
- Saltmarsh (EEC)
- Seagrass
- Swamp Mahogany - Paperbark Forest (EEC)
- Swamp Oak Rushland Forest (EEC)
- Swamp Oak Sedge Forest (EEC)
- Water
- Wyong Paperbark Swamp Forest (EEC)

0 1.5 3km

SCALE: 1: 40 000 AT A3 SIZE

TITLE: FIGURE 4-3 VEGETATION MAP
LOCATION: MYUNA
DATUM: DATUM
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 31/5/2010
PURPOSE: REPORT FIGURE
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Table 4-9: Vegetation Communities Mapped Within the PAA (LHCCREMS [House 2003] and the Natural Vegetation of the Wyong Local Government Area [Bell 2002]).

Map Unit	Community Name	Area (ha)
	Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) (House 2003)	
11	Coastal Sheltered Apple – Peppermint Forest	3.2
15	Coastal Foothills Spotted Gum – Ironbark Forest	27.0
30	Coastal Plains Smooth-barked Apple Woodland	289.2
31	Coastal Plains Scribbly Gum Woodland	234.1
37	**Swamp Mahogany – Paperbark Forest (EEC)**	5.5
38	**Redgum Rough Barked Apple Forest (EEC)**	4.9
40	**Swamp Oak Rushland Forest (EEC)**	5.1
42	**Riparian Melaleuca Swamp Woodland (EEC)**	21.8
	Natural Vegetation of the Wyong Local Government Area (Bell 2002)	
24	Narrabeen Foreshore Redgum - Ironbark Forest (equivalent to LHCCREMS Map Unit 15)	25.6
29	Narrabeen Coastal Sheltered Peppermint – Apple Forest (equivalent to LHCCREMS Map Unit 11)	4.7
33	Narrabeen Wallarah Sheltered Grassy Forest (equivalent to LHCCREMS Map Unit 30)	80.9
	Total area of mapped vegetation communities	702

TSC Act

Of the eleven vegetation communities mapped across the PAA four are commensurate with three EECs as listed within Schedule 1, Part 3 of the *TSC Act*. None of the vegetation communities described and mapped by Bell (2002) correspond to EECs. Four of the vegetation communities mapped and described by House (2003) correspond to three EECs as follows:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SSFCF).
  - » MU 37 - Swamp Mahogany – Paperbark Forest 5.5 hectares
  - » MU 42 - Riparian Melaleuca Swamp Woodland 21.8 hectares

- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (RFEF).
  - » MU 38 - Redgum Rough Barked Apple Forest 4.9 hectares

- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SOFF).
  - » MU 40 - Swamp Oak Rushland Forest 5.1 hectares

The total area of EECs within the PAA that are listed within the *TSC Act* is 37.3 hectares (of a total of 702 hectares of mapped vegetation communities).

EPBC Act

None of the vegetation communities mapped within the PAA by House (2003) or Bell (2002) correspond to any TECs as listed within the EPBC Act.

4.2 Proposed Drainage Works

4.2.1 Emergency Stockpile Dam Proposed Drainage Works

No threatened flora species, populations or ecological communities were identified in or adjacent to the proposed drainage works (see **Figure 1-3** and **Plate 4-1**) during the field survey. A full list of the flora species identified during the field survey is shown in **Appendix 1**. No threatened fauna species, endangered populations or migratory species were identified.

The proposed drainage works occur adjacent to Coastal Plains Scribbly Gum Woodland (LHCCREMS map unit 31) and a small area of Coastal Plains Smooth-barked Apple Woodland (LHCCREMS map unit 30).

Plate 4-1: Proposed Drainage Works Location Along the South-western Edge of the Emergency Stockpile.

4.2.2 Coal Handling Plant Dam Proposed Drainage Works

The proposed Coal Handling Plant Dam drainage works area occurs in a highly disturbed area of grassland with scattered trees associated with the existing settling ponds. No threatened flora species, population or ecological communities are likely to occur. No threatened fauna species or populations are likely to occur.

4.3 Likelihood of Occurrence Assessment

Section 4.1 identified 25 threatened flora species, 66 threatened fauna species and 12 TEC listed on the *TSC Act* and/or *EPBC Act* that are known or predicted to occur within the Study Area. **Appendix 2** contains an assessment of the likelihood of occurrence of each species/population/community within the PAA based on a comparison of the habitat requirements of each species/population/community and the habitat types present within the PAA.

The likelihood of occurrence assessment (**Appendix 2**) identified the following species/populations/ecological communities with a moderate or high chance of occurring within the PAA.

Flora

TSC Act – Endangered Species (9)

- *Acacia bynoeana*
- *Caladenia tessellate*
- *Corybas dowlingii*
- *Cynanchum elegans*
- *Dendrobium melaleucaphium*
- *Genoplesium insignis*
- *Microtis angusii*
- *Syzygium paniculatum*
- *Zannichellia palustris*

TSC Act – Vulnerable Species (16)

- *Angophora inopina*
- *Callistemon linearifolius*
- *Cryptostylis hunteriana*
- *Diuris praecox*
- *Epacris purpurascens var. purpurascens*
- *Eucalyptus camfieldii*
- *Eucalyptus parramattensis subsp. decadens*
- *Genoplesium bauera*
- *Thesium australe*
- *Grevillea parviflora subsp. parviflora*
- *Maundia triglochinoides*
- *Melaleuca biconvex*
- *Pultenaea maritima*
- *Rutidosis heterogama*
- *Tetratheca glandulosa*
- *Tetratheca juncea*

TSC Act – Endangered Populations (1)

- *Eucalyptus parramattensis* subsp. *Parramattensis*

TSC Act – EECs (10)

- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions
- Hunter Lowland Redgum Forest
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions
- Lower Hunter Spotted Gum Ironbark Forest
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion
- River-flat Eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bio-regions
- Swamp Sclerophyll Forest on Coastal Floodplains
- Sydney Freshwater Wetland

TSC Act – Vulnerable Ecological Communities (1)

- Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions

EPBC Act – Endangered Species (2)

- *Microtis angusii*
- *Cynanchum elegans*

EPBC Act – Vulnerable Species (13)

- *Acacia bynoeana*
- *Angophora inopina*
- *Caladenia tessellata*
- *Cryptostylis hunteriana*
- *Diuris praecox*
- *Eucalyptus camfieldii*
- *Eucalyptus parramattensis subsp. decadens*
- *Grevillea parviflora* subsp. *parviflora*
- *Melaleuca biconvex*
- *Syzygium paniculatum*
- *Rutidosis heterogama*
- *Tetratheca juncea*
- *Tetratheca glandulosa*

EPBC Act – Critically Endangered Ecological Communities (CEECs) (1)

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia

Fauna

TSC Act – Endangered Species (8)

- Green and Golden Bell Frog
- Black-necked Stork
- Australian Painted Snipe
- Pied Oystercatcher
- Little Tern
- Bush Stone-curlew
- Swift Parrot
- Regent Honeyeater

TSC Act – Vulnerable Species (51)

- Green-thighed Frog
- Wallum Froglet
- Pale-headed Snake
- Stephens' Banded Snake
- Freckled Duck
- Blue-billed Duck
- Comb-crested Jacana
- Great Knot
- Square-tailed Kite
- Little Eagle
- Osprey
- Black Bittern
- Terek Sandpiper
- Bar-tailed Godwit
- Australasian Bittern
- Sooty Oystercatcher
- Glossy Black-Cockatoo
- Little Lorikeet
- Gang-gang Cockatoo
- Rose-crowned Fruit-Dove
- Superb Fruit-Dove
- Wompoo Fruit-dove
- Barking Owl
- Masked Owl
- Powerful Owl
- Sooty Owl
- Speckled Warbler
- Brown Treecreeper
- Black-chinned Honeyeater
- Scarlet Robin
- Flame Robin
- White-fronted Chat
- Varied Sittella
- Diamond Firetail
- Spotted-tailed Quoll
- Koala
- Squirrel Glider
- Eastern Pygmy-possum
- Brush-tailed Phascogale
- Grey-headed Flying-fox
- Yellow-bellied Sheathtail-bat
- Eastern Bentwing-bat
- Little Bentwing-bat
- Eastern Freetail-bat
- Eastern False Pipistrelle
- Greater Broad-nosed Bat
- Large-eared Pied Bat
- Large-footed Myotis
- Golden-tipped Bat
- Eastern Cave Bat

TSC Act – Preliminary Determinations (1)

- White-browed Woodswallow

EPBC Act – Endangered Species (3)

- Swift Parrot
- Regent Honeyeater
- Spotted-tail Quoll

EPBC Act – Vulnerable Species (4)

- Green and Golden Bell Frog
- Australian Painted Snipe
- Grey-headed Flying-fox
- Large-eared Pied Bat

EPBC Act – Migratory Species (35)

- Bar-tailed Godwit
- Black-tailed Godwit
- Cattle Egret
- Curlew Sandpiper
- Eastern Curlew
- Great Egret
- Greater Sand Plover
- Grey-tailed Tattler
- Lesser Sand Plover
- Little Tern
- Pacific Golden Plover
- Rainbow Bee-eater
- Red-necked Stint
- Ruddy Turnstone
- Sanderling
- Sharp-tailed Sandpiper
- Whimbrel
- White-throated Needletail
- Black-faced Monarch
- Broad-billed Sandpiper
- Common Sandpiper
- Double-banded Plover
- Fork-tailed Swift
- Great Knot
- Grey Plover
- Latham's Snipe
- Little Curlew
- Marsh Sandpiper
- Painted Snipe
- Red Knot
- Regent Honeyeater
- Rufous Fantail
- Satin Flycatcher
- Terek Sandpiper
- White-bellied Sea-Eagle

4.4 Key Threatening Processes

Key Threatening Processes (KTPs) are listed under Schedule 3 of the *TSC Act*. Of the currently listed 34 KTPs the following are relevant to the Proposal Project:

- Clearing of native vegetation;
- Infection of frogs by amphibian chytrid causing the disease chytridiomycosis;
- Infection of native plants by *Phytophthora cinnamomi*;
- Removal of dead wood and dead trees; and
- Anthropogenic climate change;

A very minor level of vegetation clearing would be required for the proposed minor drainage works at the Surface Facilities Area. The resulting level of native vegetation clearing is unlikely to significantly contribute to the operation of the KTP – clearing of native vegetation.

The proposed minor drainage works at the Surface Facilities Area may contribute to the infection of frogs by amphibian chytrid due to the movement of machinery and/or soil onto and from the PAA. As the drainage works are to be carried out on ephemeral drains that

are likely to dry out after rain, the proposed minor drainage works are unlikely to significantly contribute to the operation of the KTP – infection of frogs by amphibian chytrid causing the disease chytridiomycosis.

The movement of earth moving machinery onto the Surface Facilities Area to undertake the proposed drainage works may result in the movement soil that contains *Phytophthora cinnamomi*. Any spread of *Phytophthora cinnamomi* would contribute to the KTP - Infection of native plants by *Phytophthora cinnamomi*.

The removal of a minor area of native vegetation for the minor drainage works may result in the relocation of some dead wood (small logs). The relocation of this dead wood is unlikely to contribute towards the KTP - Removal of dead wood and dead trees.

The proposed Project is likely to contribute to the KTP "human caused climate change" due to extended life of the mine, associated extended operation of machinery and vehicles and to the nature of the future use of the extracted coal. The extent to which the proposed Project could contribute to this process is considered unlikely to be significant.

5 Legislative Considerations

5.1 State Environmental Planning Policy No. 44 – Koala Habitat Protection

Assessment of potential koala habitat under SEPP 44 requires the following steps be undertaken:

a) Identification of "potential Koala Habitats" within the proposed development area; if the total tree cover contains 15% or more of the koala food tree species listed in Schedule 2 of SEPP 44 then it is deemed to be "potential" koala habitat. Identification of 'potential koala habitat requires the determination of the presence of 'core koala habitat';

b) Identification of "core Koala habitat" within the development area. "Core Koala habitat" is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (females with young), recent sightings and historical records of a Koala population;

c) Identification of "core Koala habitat" will require that a plan of management must accompany the DA application;

d) If the rezoning of lands, other than to environmental protection, involves potential or core Koala habitat then the Director of planning may require a local environmental study be carried out.

Wyong and Lake Macquarie LGAs are both listed on Schedule 1 of SEPP 44 and therefore the proposed Project is subject to SEPP 44 assessment. Areas of 'potential koala habitat' likely occur in parts throughout the PAA. Based on the low number of Atlas of NSW Wildlife records for the koala within the PAA it is unlikely but not impossible that areas of 'core koala habitat' may also occur throughout the PAA.

With the exception of the field survey for the minor drainage works, field surveys to confirm the likely presence of areas of 'potential koala habitat' were beyond the scope of this report. However as negligible surface impacts are expected, the proposed Project is unlikely to impact on any 'potential' or 'core' koala habitat areas that may occur within the PAA.

5.2 State Environmental Planning Policy No. 14 – Coastal Wetlands

No coastal wetlands as mapped by SEPP 14 occur within the PAA however, several coastal wetlands as mapped by SEPP 14 occur within the Study Area. As negligible surface impacts are expected to occur within the PAA, the proposed Project is unlikely to impact upon any SEPP 14 coastal wetlands outside the PAA.

5.3 Environment Protection and Biodiversity Conservation Act 1999

An *EPBC Act* Protected Matters Database Search was undertaken using the SEWPAC on-line database (accessed 24 May 2010) to generate a list of relevant matters of National Environmental Significance (NES) within the Study Area.

The matters of NES relevant to this flora and fauna assessment are:

- Wetlands of International Significance (RAMSAR sites);
- TECs;
- Threatened species;
- Migratory species; and
- Critical Habitats

Section 4.1.1 lists the threatened species, migratory species and TECs identified during the database search. Following is an assessment of whether the proposed Project is likely to impact on any of the above matters of NES.

5.3.1 Wetlands Protected by International Treaty (the RAMSAR convention)

No wetlands protected by international treaty (the RAMSAR convention) were identified during the *EPBC Act* Protected Matters Database Search.

5.3.2 Nationally Listed Threatened Species and Ecological Communities

The EPBC Protected Matters Database Search identified one TEC and 53 threatened species as potentially occurring within the Study Area. Following the removal of marine species and the addition of other *EPBC Act* listed ecological communities and threatened species identified during the literature review process, the following *EPBC Act* listed species and communities were identified as potentially occurring within the PAA:

- 15 threatened flora species;
- Seven threatened fauna species; and
- One TEC.

See **Section 4.3** for the listing of each individual species or community.

Negligible surface impacts are expected to occur due to the proposed Project. Surface subsidence will be limited to a maximum of 20 millimetres and no surface cracking or water inflows into the workings are expected to occur (Seedsman Geotechnics, 2010). No changes to sub-surface hydrology are expected. As negligible surface impacts are expected, the proposed Project is unlikely to impact upon any nationally listed threatened species or ecological communities.

5.3.3 Nationally Listed Migratory Species

A total of 68 migratory species listed under the *EPBC Act* have been recorded or have suitable habitat within the Study Area. The proposed Project is unlikely to substantially modify, destroy or isolate an area of important habitat, result in an invasive species that is

harmful to the migratory species becoming established in an area of important habitat or seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.

***EPBC Act* Summary Statement:**

As negligible surface impacts are expected to occur the proposed Project is unlikely to impact on any RAMSAR wetlands, national listed threatened species, ecological communities or migratory species, a referral of the proposed Project to SEWPAC is unlikely to be required.

5.4 Potential Impacts Under Part 3A of the *EP&A Act*

5.4.1 Flora

A desktop assessment identified 29 threatened flora species, one endangered flora population, 12 TECs and one preliminary flora determination as possibly occurring within the PAA. Of the 29 threatened flora species, four have been recorded within the PAA, 21 are considered a moderate chance of occurring and four are considered a low chance of occurring within the PAA. The single endangered population is considered a moderate chance of occurring within the PAA. Three of the 12 TECs have been recorded within the PAA and eight could possibly occur, though have not been mapped as occurring. The single preliminary determination is considered a low chance of occurring within the PAA.

Negligible surface impacts are expected to occur due to the proposed Project. Surface subsidence within the PAA will be limited to a maximum of 20 millimetres and no surface cracking is expected to occur. No changes to sub-surface hydrology are expected. As negligible surface impacts are expected to occur, including no impact to sub-surface hydrology, no impacts are expected on flora species, populations or communities within or adjacent to the PAA from the proposed Project.

5.4.2 Fauna

A desktop assessment identified 81 threatened fauna species as possibly occurring within the PAA. Of the 81 threatened fauna species, 15 have been recorded within the PAA, 45 are considered a moderate chance of occurring and 21 are considered a low chance of occurring within the PAA.

Negligible surface impacts are expected due to the proposed Project. Surface subsidence within the PAA will be limited to a maximum of 20 millimetres and no surface cracking is expected to occur. No changes to sub-surface hydrology are expected. As negligible surface impacts are expected to occur, including no impact to sub-surface hydrology, no impacts are expected on fauna species within or adjacent to the PAA from the proposed Project.

5.5 Vegetation Corridors

5.5.1 Lake Macquarie Native Vegetation and Corridors Mapping

Within the Morisset Peninsula, the Lake Macquarie Native Vegetation and Corridor Map (LMCC 2009) shows the remnant vegetation of the Peninsula as a corridor of remnant native vegetation. Within the corridor several interface crossing points are mapped. The remnant vegetation on the Peninsula is however poorly linked to vegetation to the south-west separated by an approximate 300 metre gap containing residential and industrial properties. Two potential rehabilitation corridors containing partly cleared vegetation are mapped across the gap, however it is not known if rehabilitation activities have been undertaken to increase the functionality of the potential corridors.

The Wangi Peninsula contains an area of remnant native vegetation at its eastern end which is separated by an approximate 2.7 kilometre gap from large woodland areas in the Buttaba area (to the north-west). Discontinuous potential rehabilitation corridors are mapped along the 2.7 kilometre gap.

The Point Wolstoncroft Peninsula in not covered by the Lake Macquarie Native Vegetation and Corridor Map (LMCC 2009), however the remnant native vegetation of the Peninsula is connected to large remnant native vegetation areas to the south by a corridor of native vegetation approximately 600 metres in width.

The small portions of the Study Area at Coal Point and Fishing Point do not contain areas of remnant native vegetation and no potential corridors occur within the small areas of the subject site at each location.

The Proposal is unlikely to affect or fragment any existing native vegetation corridors within or adjacent to the PAA as negligible surface subsidence (less than 20 millimetres) and minimal clearing for surface water management works is proposed.

5.5.2 Key Habitats and Corridors

Regional and sub-regional corridors within the Study Area have been mapped for DECCW by Scotts (2003). A single regional corridor is mapped within the Study Area extending from Buttaba, along the Wangi Peninsula and across Lake Macquarie to the Swansea area. The mapped regional corridor is likely of limited function within the landscape for all species other then highly mobile bird and bat species. The mapped regional corridor includes 1.5 kilometres of open water and 2.7 kilometres of urban areas containing scattered tree cover. The Project is unlikely to affect the functionality or fragment this regional corridor due to the negligible subsidence levels proposed (less than 20 millimetres).

No sub-regional corridors are mapped within the subject site.

5.6 Groundwater Dependant Ecosystems (GDEs)

There is no current GDE mapping that covers the study area or surrounding lands, although four vegetation units mapped within the Project Application Area (Riparian Melaleuca Swamp Woodland; Swamp Oak Rushland Forest; Redgum Rough Barked Apple Forest; Swamp Mahogany – Paperbark Forest) are likely to be influenced by groundwater or be partially groundwater dependent. There is unlikely to be any significant impacts on these vegetation units or GDEs as a result of the proposed Project as the groundwater assessment undertaken for the EA (GHD, 2010) concluded that:

"The hydrogeological model predicted negligible changes in groundwater levels in the alluvial aquifers during the operation of the proposed Project. No long term decreasing trend in alluvial groundwater levels was identified, suggesting that the proposed Project is unlikely to lead to the loss of alluvial groundwater. Due to the limited hydraulic connection between the alluvium and the proposed Project, it is considered that any variation in alluvial groundwater levels is attributable to changes in rainfall recharge and evaporation. Therefore, it is considered that impacts on alluvial aquifers, existing alluvial groundwater users and GDEs that may depend on them will be minimal.

Although there is no current mapping of GDEs that covers the Project Application Area or surrounds, potential impacts to GDEs as a result of the proposed Project are considered negligible as the shallow alluvial aquifers which will typically support GDEs will not be affected by the proposed Project."

Any GDEs present within the Study Area are unlikely to be impacted by the Project.

5.7 Riparian Areas

Geomorphic Impacts

The Project proposes less than 20 millimetres of surface subsidence under terrestrial habitat areas, which includes all land-based riparian areas and watercourses. Riparian ecology within terrestrial watercourses is therefore unlikely to be significantly impacted by the Project due to the negligible surface subsidence proposed.

With respect to Wangi Creek, part of the lower reaches of this watercourse contains some Riparian Melaleuca Swamp Woodland which corresponds to the Endangered Ecological Community known as Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SSFCF). Upper reaches are mapped by House (2003) as primarily consisting of Coastal Plains Scribbly Gum Woodland. This vegetation currently experiences average daily discharges from Myuna Colliery of 5.3 ML/Day with a maximum of 13 ML/Day (as a combination of the maximum discharges through both LDP001 and LDP002). As a result of the Project, there is a potential for an increase in the average daily discharges (to a predicted rate of 8.5 ML/Day after 21 years) however the maximum discharge will remain constant in accordance with the limits nominated in EPL 366 (GHD 2010).

As the predicted increase in discharges will occur over time it is anticipated that the geomorphology of Wangi Creek will not be adversely affected. Monitoring will be required to determine if any geomorphological impacts are occurring and to allow remedial action if required.

Hydrologic Impacts

The main effect on the Wangi Creek waterway of the existing mine is the discharge of mine water make into this watercourse. These discharges are in excess of the flows that would occur as a result of runoff generated by the catchment, These flows have been occurring for the past 29 years and as such, the existing environment within Wangi Creek has adapted to these flows (GHD 2010).

The existing water management program at Myuna Colliery will not undergo any significant change other than the increase in discharge which will occur over time. This discharge is expected to meet current volumetric limits for discharge (GDH 2010). As with the potential geomorphic impacts, monitoring will be required to determine if any hydrological impacts are occurring and to allow remedial action if required.

Management of Riparian Corridors

There is predicted to be an increase in the average daily discharges (to a predicted rate of 8.5 ML/Day after 21 years) however the maximum discharge will remain constant in accordance with the limits nominated in EPL 366 (GHD 2010). The increase in discharge is not expected to result in any adverse impacts upon the EEC known as Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SSFCF). Monitoring of the hydrological and geomorphic status of Wangi Creek will be undertaken, to identify potential impacts to this watercourse. Should hydrological and geomorphic impacts be identified during the course of monitoring, an assessment of riparian vegetation condition and potential impacts associated with changes to hydrology and geomorphology would be undertaken. This approach will ensure that riparian corridors, lacustrine habitats, coastal floodplains and estuarine environments are not adversely impacted by the proposal and any associated increase in mine water discharge.

It should also be noted that the lowest reaches of Wangi Creek are actually not in a natural state, having previously been substantially modified for the now-decommissioned Wangi Power Station. These previous modifications have included channelling and concreting for a distance of approximately 1km inland from the lake (including to Wangi Power Station), above which the creek is affected by numerous tracks, electrical easements and other cleared areas. The lower channel also receives runoff from the Eraring Power Station ash tailings pond. Nevertheless, the remaining creekline still has ecological value and performs an important ecological function, particularly in protecting the water of Lake Macquarie. As stated above no significant impacts are expected to occur upon this ecosystem as a result of the proposal.

5.8 Government Conservation Estates

Three Government conservation estates listed under the *National Parks and Wildlife Act 1974* (*NPWS Act*) occur within the locality. Due to the minimal direct surface impacts (such as land clearing) and the negligible surface subsidence levels proposed (less than 20 millimetres), the Project is unlikely to significantly impact on any Government conservation estates.

6 Key Thresholds Assessment (Part 3A)

As required by the Draft Guidelines for Threatened Species Assessment for Part 3A Applications (DEC / DPI 2005), the following assessment of Key Thresholds is provided for the proposed Project.

1. Whether or not the proposed Project, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.

Negligible terrestrial surface impacts are expected to occur as a result of the proposed Project. Surface subsidence will be limited to a maximum of 20 millimetres and no surface cracking is expected to occur. No changes to sub-surface hydrology are expected and existing infrastructure at the Surface Facilities Area will be utilised to service the proposed Project. The proposed Project is expected to maintain biodiversity values within the PAA.

2. Whether or not the proposed Project is likely to reduce the long-term viability of a local population of the species, population or ecological community.

Negligible terrestrial surface impacts are expected to occur as a result of the proposed Project. Surface subsidence will be limited to a maximum of 20 millimetres and no surface cracking is expected to occur. No changes to sub-surface hydrology are expected and existing infrastructure at the Surface Facilities Area will be utilised to service the proposed Project. The proposed Project is unlikely to reduce the long-term viability of a local population of any species, population or ecological community.

3. Whether or not the proposed Project is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.

Negligible terrestrial surface impacts are expected to occur as a result of the proposed Project. Surface subsidence will be limited to a maximum of 20 millimetres and no surface cracking is expected to occur. No changes to sub-surface hydrology are expected and existing infrastructure at the Surface Facilities Area will be utilised to service the proposed Project. The proposed Project is unlikely to accelerate the extinction of any species, population or ecological community or place them at risk of extinction.

4. Whether or not the proposed Project will adversely affect critical habitat.

There is no declared “Critical Habitat” within the Study Area, and as such the proposed Project will not adversely affect any such habitat.

7 Conclusion and Recommendations

7.1 Conclusion

Negligible surface impacts are expected to occur. Surface subsidence will be limited to a maximum of 20 millimetres and no surface cracking is expected to occur. Minimal changes to sub-surface hydrology are expected and existing infrastructure at the Surface Facilities Area will be utilised to service the proposed Project.

Due to the predicted negligible surface impacts, the proposed Project is unlikely to impact on any threatened species, endangered population or TECs.

7.2 Mitigation Measures

The following mitigation measures have been recommended to minimise the potential impacts of the proposed Project on flora and fauna species:

- In the event that subsidence monitoring at existing monitoring points indicates that subsidence levels are greater than the 20 millimetres proposed under terrestrial areas, a review will be undertaken to identify any potential ecological impacts.
- Monitoring is to be undertaken at and below the mine water discharge point in Wangi Creek to determine any geomorphological, hydrological impacts. If adverse impacts are identified, an assessment of riparian vegetation condition and potential impacts associated with changes to hydrology and geomorphology would be undertaken, and appropriate mitigation measures identified to avoid impacts to riparian vegetation..

Due to the negligible terrestrial impacts predicted as part of the proposed Project, no further mitigation measures are recommended.

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Appendix 1

Flora Species List.

Flora Species List

Following is a list of the flora species recorded during a field survey of the proposed minor drainage works at the emergency coal stockpile (see **Section 4.2**).

Family/Sub Family	Scientific Name	Common Name
Adoxaceae	*Sambucus australasica*	Yellow Elderberry
Apiaceae	*Centella asiatica*	Swamp Pennywort
Apocnynaceae	*Gomphocarpus fruiticosus**	Narrow Leaf Cotton Bush
Asteraceae	*Ageratina adenophorum**	Crofton Weed
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Asteraceae	*Chrysanthemoides monilifera* subsp. *rotundata**	Bitou Bush
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza sumatrensis**	Fleabane
Asteraceae	*Ozothamnus diosmifolius*	Ball Everlasting
Asteraceae	*Senecio linearifolius*	Fireweed
Asteraceae	*Senecio madagascariensis**	Fireweed
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Euphorbiaceae	*Glochidion ferdinandii*	Cheese Tree
Euphorbiaceae	*Ricinus communis**	Castor Oil Plant
Fabaceae	*Gompholobium grandiflorum*	Golden Glory Pea
Fabaceae	*Kennedia prostrata*	Running Postman
Iridaceae	*Patersonia sericea*	Wild Iris
Juncaceae	*Juncus usitatus*	Common Rush
Lomandraceae	*Lomandra glauca* subsp. *glauca*	-
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush
Lomandraceae	*Lomandra obliqua*	Twisted Mat-rush
Mimosaceae	*Acacia falcata*	Sickle Wattle
Mimosaceae	*Acacia linifolia*	Flax Wattle
Mimosaceae	*Acacia longifolia* var. *longifolia*	Sydney Golden Wattle
Mimosaceae	*Acacia longifolia* var. *sophorae*	-
Mimosaceae	*Acacia lunata*	Box-leaved Wattle
Mimosaceae	*Acacia terminalis*	Sunshine Wattle
Myrtaceae	*Angophora costata*	Smooth-barked Apple
Myrtaceae	*Corymbia gummifera*	Red Bloodwood
Myrtaceae	*Eucalyptus capitellata*	Brown Stringybark
Myrtaceae	*Eucalyptus haemastoma*	Scribbly Gum

Family/Sub Family	Scientific Name	Common Name
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany
Myrtaceae	*Leptospermum trinervium*	Flaky-barked Tea-tree
Myrtaceae	*Tristaniopsis laurina*	Water Gum
Phormiaceae	*Dianella caerulea* var. *producta*	Blue Flax Lily
Pinaceae	*Pinus elliotti**	Slash Pine
Poaceae	*Andropogon virginicus**	Whisky Grass
Poaceae	*Aristida vagans*	Three-awn Speargrass
Poaceae	*Austrodanthonia tenuior*	Wallaby Grass
Poaceae	*Chloris gayana**	Rhodes Grass
Poaceae	*Cortaderia selloana**	Pampas Grass
Poaceae	*Cynodon dactylon*	Common Couch
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass
Poaceae	*Entolasia stricta*	Wiry Panic
Poaceae	*Hyparrhenia hirta**	Coolatai Grass
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass
Poaceae	*Melinus repens**	Red Natal Grass
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Rice Grass
Poaceae	*Paspalum urvillei**	Vasey Grass
Poaceae	*Themeda australis*	Kangaroo Grass
Proteaceae	*Persoonia levis*	Broad-leaved Geebung
Sapindaceae	*Dodonaea triquetra*	Hop Bush
Sinopteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	Poison Rock Fern
Solanaceae	*Solanum mauritianum**	Wild Tobacco
Typhaceae	*Typha orientalis*	Cumbungi
Verbenaceae	*Lantana camara**	Lantana
Verbenaceae	*Verbena bonariensis**	Purpletop
Verbenaceae	*Verbena rigida**	Veined Verbena
Xanthorrhoaceae	*Xanthorrhoea media* subsp. *media*	Forest Grass Tree

* - Weed Species.

Appendix 2

Likelihood of Occurrence Assessment

Likelihood of Occurrence Assessment

Each threatened species/population/community identified in **Section 4.1** is considered for its potential to occur in the PAA and the likely level of impact as a result of the proposed Project. This assessment deals with each species/population/community separately and identifies the ecological parameters of significance associated with the proposed Project. This assessment deals with the following heads of consideration in tabulated form:

'**Species** / **Community'** – Lists each threatened species/population/community known from the vicinity. The status of each threatened species under the *TSC Act* and the *EPBC Act* are also provided.

'Habitat Description' – Provides a brief account of the species/community and the preferred habitat attributes required for the existence/survival of each species/community. Habitat description data has been sourced from a variety of sources such as field guides, scientific publications and information on the DECCW website. Individual references are not listed.

'Chance of Occurrence on Site' – Assesses the likelihood of each species/community to occur in the PAA in terms of the aforementioned habitat description and taking into account local habitat preferences, results of current field investigations, data gained from various sources (such as DECCW Atlas of NSW Wildlife, herbariums, etc.) and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impacts from the proposed Project' – Assesses the likely level/significance of impacts to each species / community that would result from the proposed development, taking into account direct and indirect short and long-term impacts.

Table 8-1: Assessment of Likelihood of Occurrence of Threatened Species and Communities and Assessment of Potential Impacts

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Plants			
Acacia bynoeana Bynoe's Wattle (E, V*)	Small, prostrate shrub found in low heath and open woodland, generally on loamy clays and sand. Occurs from the Lower Hunter south to Southern Highlands. Recently found in several locations within the HEZ and other parts of the Cessnock LGA where it has been found growing in Kurri Sand Swamp Woodland (KSSW). Has also been recently recorded as isolated populations within Yellow Bloodwood Woodland and Blue-leaved Stringybark Woodland.	High This species is recorded in the Lake Macquarie State Conservation Area Plan of Management as present within the reserve.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Angophora inopina Charmhaven Apple (V, V*)	Small to medium tree found in shallow sandy soils in open woodland, swamp woodland and wet heath. The main occurrences of this species are in the Wyong and Lake Macquarie LGA's (from Charmhaven to Wyee and Morisset, and north to near Toronto), with disjunct populations also in Port Stephens LGA (south of Karuah).	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Caladenia tessellata Thick Lip Spider Orchid (E, V*)	A small terrestrial orchid, which regrows its single leaf on an annual basis. It is known to occur in grassy woodland and locally it has potential to occur within Coastal Plains Scribbly Gum Woodland. Flowers from September to October and is known to flower particularly after fire.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Callistemon linearifolius (V)	Shrub that grows in dry sclerophyll forest on the coast and adjacent ranges. Re-sprouting / juvenile specimens difficult to distinguish from other Callistemon species such as *C. rigidus* (Stiff Bottlebrush) or *C. linearis* (Narrow-leaved Bottlebrush) without the aid of flowering parts. Significant populations recently found within the HEZ and Werakata National Park.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Chamaesyce psammogeton Sand Spurge (E)	Perennial prostrate herb, which grows in sand foredune vegetation near the sea and on exposed headlands often with *Spinifex sericeus* (Spinifex). It is thought that seed dispersal may come from beach to beach as the seed of *C. psammogeton* float. Found on the east coast from Qld to Jervis Bay NSW. There is one record of this species located east of Belmont.	Low This species has been recorded within the Study Area however the PAA does not contain foredune vegetation to provide potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Corybas dowlingii Red Helmet Orchid (E)	*Corybas dowlingii* forms clonal colonies and typically grows in gullies in tall open forest on well-drained gravelly soil at elevations of 10-200m. *C. dowlingii* is restricted to New South Wales where it is currently known from several localities including Port Stephens (2 localities), Bulahdelah and Freemans Waterhole south of Newcastle, Recorded from Lake Macquarie, Cessnock, Great Lakes and Port Stephens (LGA's). Flowering occurs from June to August. This species has been recorded at the eastern extremity of Wangi Point within the PAA (see **Section 4.1**).	Moderate This species has been recorded within the Study Area and some areas within the PAA contain known habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Cryptostylis hunteriana Leafless-tongue Orchid (V, V*)	A very rare leafless, saprophytic orchid, which has a symbiotic relationship with a mycorrhizal fungi which provides the plant with all its nutrient requirements. This orchid remains underground for the majority of its lifecycle, flowering periodically, when conditions are optimal to reproduce. This species is extremely cryptic as it does not flower every year. This species is known to occur within a range of habitats including woodlands to swamp heaths. Within the Hunter region larger populations have been typically found in woodland dominated by *Eucalyptus racemosa* (Scribbly Gum) and prefers areas with an open grassy understorey. The species typically prefers moist sandy soils in sparse to dense heath and sedgeland, or moist to dry clay loams in coastal forests.	Moderate This species has been recorded the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Cynanchum elegans White-flowered Wax Plant (E, E*)	Occurs scattered along the NSW Northern Coast to Wollongong usually in dry, littoral or subtropical rainforest. A climbing or twining plant species that flowers from August to May with peak flowering in November. One record within the Atlas of NSW Wildlife data occurs within the Lower Hunter Region and Central Coast at Green Point to the north of Belmont.	Moderate This species has been recorded the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Dendrobium melaleucaphilum Spider Orchid (E)	Epiphytic orchid mostly growing on *Melaleuca stypheloides*, but occasionally on rainforest trees or rocks. Extends from south of the Blue Mountains to Queensland.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Diuris praecox Newcastle Doubletail (V, V*)	Found predominantly in coastal Eucalypt forests on hilltops or slopes which usually have a grassy to fairly dense understorey. This species has been recorded at a number of dry woodland locations near Nords Wharf and west of Dudley in the east of Lake Macquarie LGA.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Epacris purpurascens var. purpurascens (V)	An erect shrub, 50-150 cm high, that grows in sclerophyll forest, scrubs and swamps, influenced by strong shale soils. Killed by fire and regenerates from soil stored seed. Found in the Gosford and Sydney districts.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Eucalyptus camfieldii Camfield's Stringybark (V, V*)	Tree or mallee to 10m high, but often less. Rare and localised, in coastal shrub heath on sandy soils on sandstone, often in areas of restricted drainage. Records from the Hunter Region largely in near coastal areas from the Port Stephens LGA to the Central Coast (Atlas of NSW Wildlife data). This species generally occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas, with associated species including; stunted *E. oblonga* (Narrow-leaved Stringybark), *E. capitellata* (Brown Stringybark) and *E. haemastoma* (Scribbly Gum).	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Eucalyptus parramattensis ssp. decadens Drooping Red Gum (V, V*)	*Eucalyptus parramattensis ssp. decadens* (Drooping Red Gum) generally occupies deep low nutrient sands, where water tables are high or in areas of periodic inundation. Can be found in dry sclerophyll woodland with heath understorey, usually a community dominant species. Little is known of the ecology and biology of this species. This species has been recorded at two locations to the north of Catherine Hill Bay (see **Section 4.1**).	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Euphrasia arguta (PD(V), Extinct*)	An erect annual herb 20-35 cm high, branches densely hairy with recurved stiff non-glandular hairs. Upper stem leaves ovate to elliptic, often broadly so, 6-14 millimetres long, 3.5-13 millimetres wide, margins ± deeply lobed, usually with 2-4 pairs of teeth. Flowers are produced October to January and are 10-14 millimetres long, white to lilac with yellow markings. Recently re-discovered in the Nundle area in 2008. Historically, habitat has been noted as: 'open forest country around Bathurst in subhumid places', 'on the grassy country near Bathurst' and 'in meadows near rivers'.	Low This species has not been recorded within the PAA or within the Study Area. The PAA does not contain foredune vegetation to provide potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Genoplesium baueri (V)	A terrestrial orchid with a yellowish brittle stem 6 to 15cm tall with sparse reddish or green and red flowers. This species grows in sparse sclerophyll forest and moss gardens over sandstone. Flowers Dec. – Mar. The species has been recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Genoplesium insignis Variable Midge Orchid (E)	Recorded from four localities between Chain Valley Bay and Wyong in Wyong local government area. Grows in patches of *Themeda australis* (Kangaroo Grass) amongst shrubs and sedges in heathland and forest. Associated vegetation at Chain Valley Bay is described as dry sclerophyll woodland dominated by *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia gummifera* (Red Bloodwood), *Angophora costata* (Smooth-barked Apple) and *Allocasuarina littoralis* (Black She-oak). Flowers September to October.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Grevillea parviflora ssp. parviflora (V, V*)	Occurs in light, clayey soils in woodlands. Most plants appear capable of suckering from a rootstock. Relatively widespread within the Cessnock LGA. Occurs within Werakata National Park. Much confusion surrounds the taxonomy of this species and other similar Grevillea taxa and a NPWS-funded study of the species is currently in progress.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Maundia triglochinoides (V)	Perennial rush with rhizomes about 5 millimetres thick and emergent tufts of spongy leaves, triangular in cross section, arising along their length. Grows in fresh water swamps, creeks and shallow freshwater 30 - 60 cm deep on heavy clay.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Melaleuca biconvexa Biconvex Paperbark (V, V*)	A shrub to small tree, which grows in poorly drained areas from Jervis Bay to Port Macquarie. Records in the Hunter Region are confined to western Lake Macquarie (Atlas of NSW Wildlife data). It may occur in dense stands adjacent to watercourses, in association with other Melaleuca species or as an understorey species in wet forest.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Microtis angusii Angus's Onion Orchid (E, E*)	Recorded from the Terry Hill's district of Sydney. Occurs upon disturbed soil horizons that were originally ridgetop lateritic soils supporting a distinctive open to low open forest community, Duffy's Forest Vegetation Community, which is listed as an EEC. Suspected occurrences in the southern Lake Macquarie hinterland are derived from a tentative record in the Lake Macquarie State Recreation area, which occurs to the south of Gwandalan. Flowers from May to October.	Moderate This species has been tentatively recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Prostanthera densa Villous Mintbush (V,V*)	Villous Mintbush is an erect mint-smelling shrub to 2 m tall, though in the southern part of its range it is rarely more than 1 m tall. Branches and leaves are covered with long, spreading hairs. The leaves are in pairs and almost triangular in shape, to 15 millimetres long and 12 millimetres wide. They are dark green above and paler below, with curled-under edges. The tubular flowers are mauve with orange markings and grow in the angles where the leaves meet the stems. generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea. Flowering has been observed throughout the year, but occurs chiefly in spring or from May - December.	Low This species has not been recorded within the Study Area. The PAA does not contain foredune vegetation to provide potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Pultenaea maritima Coastal Headland Pea (V)	The species occurs in grasslands, shrub-lands and heath on exposed coastal headlands from Newcastle to Byron Bay in NSW. There are three records of this species south of Caves Beach (see **Section 4.1**).	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Rhizanthella slateri Eastern Australian Underground Orchid (V,E*)	An Underground Orchid with a whitish, fleshy underground stem to 15 cm long and 15 millimetres diameter. The flowering heads mature below the soil surface or may extend to 2 cm above the ground. Each flower head has up to 30, tubular, purplish flowers. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Flowers October to November.	Low This species has not been recorded within the Study Area. The PAA does not contain foredune vegetation to provide potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Rutidosis heterogama (V, V*)	Small asteraceous herb which grows in heath on sandy soils and moist areas in open forest. Has been recorded in disturbed areas along roadsides. Rediscovered in the Hunter Region growing in disturbed areas and adjacent parcels of bushland within the Cessnock LGA. Also known from within the Wyong LGA. In the Hunter Region prefers Spotted Gum/Ironbark Forest. One record of this species is located approximately 6 kilometres north-west of Wyee and another is located approximately 3 kilometres north-west of Mount Sugarloaf (see **Section 4.1**).	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Senecio spathulatus Coast Groundsel (E)	*Senecio spathulatus* (Coast Groundsel) is a low-growing smooth-stemmed daisy, often forming hummocks to 30 cm tall. *Senecio spathulatus* is a specialised coastal species occurring mostly on frontal dunes and forming low, broad clumps. It is characterised by short fleshy leaves, large fleshy flower heads and large fruit with a persistent pappus.	Low This species has been recorded within the Study Area however, the PAA does not contain frontal dunes to provide potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Syzygium paniculatum Magenta Lilly Pilly (V, V*)	A shrub to small tree, found in sub-tropical and littoral rainforest on sandy soils or sheltered gullies mostly near water courses. Distribution between Bulahdelah and Jervis Bay. Hunter Region records confined to the Lake Macquarie hinterland (Atlas of NSW Wildlife data).	High This species is recorded in the Lake Macquarie State Conservation Area Plan of Management as being present within the reserve.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Tetratheca glandulosa Black-eyed Susan (V, V*)	Associated with shale / sandstone transition habitat. Known to occur on ridge-tops, upper slopes and to a lesser extent mid-slope sandstone benches. Habitat of heath and open scrub to woodland/open woodland and open forest. Associated species include *Corymbia gummifera* (Red Bloodwood), *Corymbia eximia* (Yellow Bloodwood), *Eucalyptus haemastoma* (Scribbly Gum) and *E. racemosa* (Scribbly Gum). An understorey of species from the families Proteaceae, Fabaceae and Epacridaceae are common.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Tetratheca juncea Black-eyed Susan (V, V*)	Occurs in a variety of forested and heathy habitats. Locally found in Open Forests and Woodlands with dense, undisturbed understorey, often in association with *Angophora costata* / *Corymbia gummifera* on slopes with south-easterly aspects.	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Thesium australe Austral Toadflax (V)	An erect, pale green to yellow-green wiry perennial herb to 40 cm high. This species is a root parasite that grows in grassland or woodland in moist sites, usually in association with Kangaroo Grass (*Themeda australis*) which it parasitises. Flowering time is Spring to Summer.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Zannichellia palustris (E)	An aquatic plant growing in estuarine waters. Favours fresh or slightly saline stationary or slowly flowing water. Recorded in Hexham Swamp, Kooragang Island and one record at Valentine. Populations die back every summer.	Moderate This species has been recorded within the Study Area and some areas within the PAA contain potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Frogs			
Pseudophryne australis Red-crowned Toadlet (V)	Generally restricted to Hawkesbury Sandstone where it may be found beside temporary creeks, gutters and soaks and under rocks and logs. Breeds in deep leaf litter inundated with heavy rain. Records from the Hunter Region exist in Olney State Forest.	Low This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species, but it is unlikely to occur.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project..
Mixophyes balbus Stuttering Frog (E, V*)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Breed in streams during summer after heavy rain, outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Eggs are laid on rock shelves or shallow riffles in small, flowing streams.	Low This species was not recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Mixophyes iterates Giant Barred Frog (V,E*)	Mostly restricted to wet sclerophyll forest and rainforest, including Antarctic Beech forest. Usually found within close proximity to permanent running water. Hunter Region records are largely confined to the Watagan National Park and to the north of Heaton State Forest (Atlas of NSW Wildlife data).	Low This species has been recorded within the Study Area (see **Section 4**). However, the PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Litoria aurea Green and Golden Bell Frog (E, V*)	Inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. Thought to be displaced from more established sites by other frog species, thus explaining its existence on disturbed sites. Previously widespread within the region, but now sparsely distributed within the Lower Hunter and Central Coast areas. A relatively stable population occurs on Kooragang Island.	Moderate This species was not recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Litoria brevipalmata Green-thighed Frog (V)	Occurs in a range of habitats in areas where surface water gathers after rains. Frogs mainly occur in rainforests and wet sclerophyll forests. Breeding occurs after rains in late spring and summer, frogs aggregate around grassy semi-permanent ponds and flood prone grassy areas. Frogs are thought to forage in leaf litter.	Moderate This species has been recorded within the Study Area (see **Section 4.2.1**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Litoria littlejohni Little John's Tree Frog (V, V*)	A pale brown frog with dark speckles which occurs along permanent rocky creeks with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. Occurs on the plateaus and eastern plains of the Great Dividing Range. Records within the Hunter Region occur from within the Watagan State Forest.	Low This species was not recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Heleioporus australiacus Giant Burrowing Frog (V, V*)	The current distribution of *H. australiacus* is south-eastern NSW to Vic. Locally it occurs north to Jervis Bay, and is mostly restricted to sandy creek banks, often in association with crayfish burrows in this area. The northern population has a marked preference for sandstone ridge-top habitat and broader upland valleys. In these locations the frog is associated with small headwater creek lines and along slow flowing to intermittent creek-lines. *H. australiacus* is grey to dark chocolate brown or black above with a white belly, a few yellow spots along the flanks. During the summer, males call like an owl hoot, from burrows within creek banks. Females lay eggs in a foamy nest in the burrow, and the developing tadpoles are washed from the burrows into the creeks during heavy rain.	Low This species was not recorded within the Study Area. The PAA contains potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Crinia tinnula Wallum Froglet (V)	Occurs in coastal, low-lying acid Paperbark forest, within the 'wallum country' (often on sandy soils). Although some marginal potential habitat could exist within the Paperbark Swamp Forest, it is generally not typical of the wallum habitats preferred by this species. Regional records for this species are confined to three main areas; Lake Macquarie, Central Coast and Medowie and Port Stephens (Atlas of NSW Wildlife data).	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
REPTILES			
Varanus rosenbergii Rosenberg's Goanna Heath Monitor (V)	Coastal heaths, humid woodland and both wet and dry sclerophyll forest. A mostly terrestrial species which shelters in burrows, hollow logs and rock crevices. But will ascend trees as an escape. On the Central NSW Coast this species is largely confined to the Sydney Sandstone.	Low This species was not recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species, although it is considered unlikely to occur.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Hoplocephalus bitorquatus Pale-headed Snake (V)	This species is patchily distributed along the coast, ranges and western slopes and plains of eastern NSW from just north of Sydney, to southeast QLD, and with a population in northeast QLD presumed to be disjunct. It inhabits a wide range of habitats from rainforest to drier Eucalypt forest and woodlands, often in association with floodplains or watercourses. It is nocturnal and partially arboreal sheltering in hollow tree limbs and beneath bark of standing trees.	Moderate This species was not recorded within the Study Area. The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Hoplocephalus bungaroides Broad-headed Snake (E, V*)	Largely confined to Triassic sandstones, including the Hawkesbury, Narellan and Shoalhaven formations, within the coast and ranges. Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	Low This species was not recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Hoplocephalus stephensii Stephens' Banded Snake (V)	A nocturnal, partly arboreal snake. It inhabits eucalypt forest and rainforest from Gosford (NSW) north to southern Queensland. This snake is usually found under loose bark on trees or in hollow limbs. The diet consists of lizards, frogs, birds and small mammals. Females reproduce every second year giving birth to an average of six live young in February-March. The average length of *Hoplocephalus stephensii* is 0.65 metres and colour pattern dark brown-grey with a series of harrow pale brownish cross-bands, and the belly is cream with dark spots. The sides and back of head are dark and white blotches mark the lips and side of head. This snake should be regarded as potentially dangerous, although it has not been attributed to any human fatalities.	Moderate This species was recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Birds			
Oxyura australis Blue-billed Duck (V)	A frequenter of deep freshwater swamps with thick vegetation. This species is wholly aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, buy prefers to dive. Most birds will leave their breeding swamps in favour of larger more open swamps and lakes for over-wintering. Most birds will nest in *Typha* sp. (Cumbungi) over deep water during spring/summer, they will also nest in trampled *Muehlenbeckia* sp. (Lignum) and **Eleocharis obicis** (Spike-rush). In NSW mostly occurring within 300 kilometres of the Murray-Darling basin, but may occur in more coastal areas during dry inland conditions.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Stictonetta naevosa Freckled Duck (V)	Inhabits both open lakes and wetlands surrounded by thick vegetation, especially swamps in which lignum (*Meuhlenbeckia* sp.), Cumbungi (*Typha* sp.) or Paperbarks (*Melaleuca* sp.) grow. Permanent or temporary wetlands of varying salinity are known to be used. It is thought to be a frequent visitor to inland districts and rare in coastal areas.	Moderate This species has not been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Ephippiorhynchus asiaticus Black-necked Stork (E)	Inhabits swamps associated with river systems and large permanent pools but sometimes appears on the coast or in estuaries. It has also been recorded on farm dams and sewage treatment ponds. Within the Hunter Region it occurs spasmodically on freshwater or estuarine wetlands, along coastal and near coastal environments such as Gloucester.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Botaurus poiciloptilus Australasian Bittern (V)	A secretive species inhabiting permanent freshwater swamps possessing stands of tall rush species such as *Typha* sp. (Bull Rushes) and *Eleoacharis* sp. (Spike Rushes). Feeds mainly at night on aquatic fauna, insects and snails. Hides during the day amongst dense reeds and rushes. Does feed during the day when overcast or low light levels. Nests are usually a dense platform of reeds in a secluded area of dense vegetation.	Moderate This species has not been recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Ixobrychus flavicollis Black Bittern (V)	Solitary species, living near water (estuarine to brackish) in mangroves and other trees which need to form only a narrow fringe of cover. A riparian species that occasionally ventures into the open within estuarine habitats. Sedentary resident along Dora and Stockton Creeks in western Lake Macquarie, also been recorded semi-regularly in the Paterson River but is likely to occur in any brackish to estuarine forested coastal creeks in the lower NSW coast.	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Lophoictinia isura Square-tailed Kite (V)	Inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. They may also range in nearby open habitats but not into extensive treeless regions. This species is notably absent from alpine regions and small isolated remnant woodlands in large open areas. Has been recorded in suburbia hawking over yards looking for prey.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Heiraaetus morphonoides Little Eagle (V)	Inhabits open eucalypt forest, woodland and open woodland. Birds of inland NSW can occur across riparian woodland and acacia woodland. Can be found across the mainland except the most densely forested areas of the great divide. It requires a tall living tree within a forested area for nesting. Occurs across the western slopes and southern, central and northern tablelands.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Circus assimilis Spotted Harrier (V)	Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and chenopod shrub. It can be found most commonly in open grassland, but occur quite commonly as well in agricultural land. Also forages over edge habitats of inland wetlands.	Low This species has been recorded within the Study Area (see **Section 4**). The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Pandion haliaetus Osprey (V)	Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the Northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south eastern Australia. There are a handful of records from inland areas.	High This species is likely to occur. This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Erythrotriorchis radiates Red Goshawk (CE, V*)	This species is a large, reddish-brown hawk with strongly streaked and barred plumage, massive yellow legs and feet, and a slight crest. Males are 0.5 metres in length, females 0.6 metres in length, with a wingspan of 1.11-1.36 metres. In NSW this species is found in coastal and subcoastal tall open forests and woodlands and is restricted to the north-east, mostly on or near the coast. Verified historical records extend south to Sydney.	Low This species has not been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Rostratula australis Australian Painted Snipe (E, V*)	A small freshwater and estuarine wader, which prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. This species has been recorded in Pambalong N.R. and Ash Island and Lenaghan's Flat.	Moderate This species has not been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Esacus magnirostris Beach-Stone-curlew (CE)	Typical habitat of this species is undisturbed sandy beaches, especially where a mangrove backed sand flats occur. Also occur on mudflats and occasionally reefs. They have also been recorded on grassy verges alongside creeks and near sand flats.	Low This species has not been recorded within the Study Area (see **Section 4**). The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Burhinus grallarius Bush Stone-curlew (E)	Prefers open woodland, dry watercourses with fallen branches, leaf litter and sparse grass. Also occurs in coastal scrub, mangrove fringes, golf courses, rail reserves, wooded remnants on roadsides, orchards and plantations. Largely nocturnal, being especially active on moonlit nights. Nests on the ground in a scrape or small bare patch.	Moderate This species has been recorded within the Study Area. The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Limosa lapponica Bar-tailed Godwit (M*)	This species is a large wader which breeds in Alaska and migrates to NSW. It makes the longest known non-stop annual migration of any known bird. It forages by probing in mudflats or marshes. It may find insects by sight in short vegetation. It eats mainly insects and crustaceans, but also parts of aquatic plants.	Moderate This species has not been recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Turnix maculosa Red-backed Button-quail (V)	*Turnix maculosus* inhabits woodlands and grasslands. Also can be found in crops of the warm temperate areas. Has a tendency to be close to water in grasslands and sedgelands near creeks, swamp, springs and wetlands. A cryptic species that often flushes when approached by running or burst of flight for a short distance. Records in the hunter are scarce, having been recorded at Woodville and Ash Island.	Low This species has not been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Xenus cinereus Terek Sandpiper (V, M*)	Recorded on coastal mudflats, lagoons, creeks and estuaries. It favours muddy beaches near mangroves but may also be observed on rocky pools and coral reefs occasionally up to 10 kilometres inland around brackish pools. Generally roosts communally amongst mangroves or dead trees, often roosts with related wader species. In the Hunter Estuary sometimes roosts with *Tringia brevipes* (Grey-Tailed Tattlers) on rocky shore.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Calidris tenuirostris Great Knot (V, M*)	Large sandpiper visiting Australian coasts during the austral summer. *Calidris tenuirostris* habitats include coastal inlets, estuaries, bays, intertidal mudflats and sandbanks and lagoons. On occasion they can be found on inland fresh and salt water lakes. Also occasionally seen on rocky platforms on the coast.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Irediparra gallinacea Comb-crested Jacana (V)	This species inhabits mostly deep permanent freshwater wetlands that are abundant with floating aquatic vegetation that forms dense mats or rafts on the surface of the water. Known to breed within the Hunter as far south as Mandalong (RPS ecologist pers. obs.). Has been known to arrive at suitable temporary vegetation eg. Rathluba Lagoon at East Maitland. Hunter records have regularly come from Colliery Dam in the Mulbring area, which contains floating aquatic vegetation. Breeding records have also been recorded from Colliery Dam.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Haematopus fuliginosus Sooty Oystercatcher (V)	Marine, usually rock shoreline, high rocky islets, boulders below cliffs, wave-cut platforms and reefs. Also inhabits sandy beaches and coves between rocky headlands. Also occurs within closed estuarine habitats where rocky substrates are present.	Moderate This species has been recorded within the Study Area and the vegetation within the PAA contains potential habitat.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Haematopus longirostris Pied Oystercatcher (V)	This species prefers undisturbed sandy shell-grit or pebble beaches, sandspits and sandbars, tidal mudflats and estuaries, coastal islands. Occasionally rocky reefs, shores rock-stacks, brackish or saline wetlands. Also grassy paddocks, golf-courses or parks near coast. Forages for molluscs, crustaceans, polychaetes, ascidians, echinoderms and small fish, probes for worms in short wet grass. In the Hunter this species is relatively common in the Hunter Estuary in small numbers and more common on the open beaches and river mouths around sandspits.	Moderate This species is recorded in the Lake Macquarie State Conservation Area Plan of Management as present within the reserve. This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Thinornis rubricollis Hooded Plover (CE)	This species is restricted to the littoral zone of beaches and sandy estuaries, where it nests on the ground just above the tideline. In NSW, the Hooded Plover historically occurred north to at least the Sydney region, and possibly to Port Stephens. Resident birds are now found only south of Wollongong, although occasional vagrants are seen north to the Central Coast and (rarely) south-east Queensland.	Low This species has not been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Charadrius mongolus Lesser Sand Plover Mongolian Plover (V, M*)	When in Australia, this migratory species inhabits sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats. Prey includes molluscs, worms, crustaceans and insects. Low numbers of this species visit the Hunter estuary during the austral summer.	Low This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Charadrius leschenaultii Greater Sand Plover (V, M*)	A small plover distinguished from its close relative *C. mongolus* by longer legs and larger bill size. NSW birds occur largely within estuarine habitats and coastal situations. Most commonly found on intertidal mudflats, sheltered sandy inlets and sandy and shelly beaches. Roosts at high tide on sandy beaches and rocky shores. Becoming less common to rare heading south down the NSW coast from northern parts.	Low This species has been recorded within the Study Area (see **Section 4**). However, the PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Sterna fuscata Sooty Tern (V)	The Sooty Tern is a largish black tern with white underparts, forehead and tail streamers. The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. Occasionally seen along coastal NSW, especially after cyclones. Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. Breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	Low This species has not been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Sterna albifrons Little Tern (E, M*)	Migratory bird from eastern Asia, which most commonly occurs in sheltered coastal environments. Has been recorded several kilometres from the sea in bays, harbours and estuaries. Occasionally recorded from offshore Islands and coral cays. *Sterna albifrons* nest in loose colonies in shelly beaches just above the high tide line. Feeding habitat consists of shallow channels and estuaries and the in the surf on the beach.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Ptilinopus regina Rose-crowned Fruit-Dove (V)	Generally lives in rainforest of many variations, though it also frequents brushes of coastal districts as well as Eucalypt forests and mangroves. Favoured rainforest habitat consists of sub-tropical to dry rainforest and quite commonly littoral rainforest. They feed entirely on fruit from vines, trees and shrubs and mostly feed in the tops of trees or just under the foliage, where the fruit grows. *Ptilinopus regina* can be locally nomadic according to fruiting or part migratory according to fruit ripening. In the Hunter most records have come from Littoral rainforest around Harrington and at Mungo Brush, also records in rainforest at Seal Rocks.	Moderate This species has been recorded within a one kilometre radius of the PAA (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Ptilinopus superbus Superb Fruit-dove (V)	Occurs in rainforest and similar closed forests including, monsoon forest, regrowth, lantana thickets and woodland adjoining rainforest at all altitudes. Forages high in the canopy eating fruits of figs and palms. A part-migratory species that migrates and south. In winter some birds migrate south to the area of the Hunter, Sydney, Illawarra and South Coast.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Ptilinopus magnificus Wompoo Fruit-Dove (V)	Frugivorous bird favouring rainforest, occasionally straying to other forest types containing fruiting trees. A nomadic species that sometimes roosts in dry forest adjacent to rainforest habitats and is known to access small rainforest remnants. Feeds on diverse range of fruits from trees and vines. Follows ripening fruit.	Moderate This species has not been recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Calyptorhynchus lathami Glossy Black-Cockatoo (V)	Occurs in forests and woodlands where it forages predominantly on Allocasuarina cones. Requires large Eucalypt tree hollows for nesting. Sparse occurrences on the valley floor, but resident in ranges and adjacent areas surrounding the Hunter Valley. Most commonly encountered around the south and south western areas of the lake and in the Watagan Mountains N.P. These locations have good stands of Allocasuarina sp., especially *Allocasuarina littoralis* (Black She-oak)	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Callocephalon fimbriatum Gang Gang Cockatoo (V)	Found in the summer months in tall mountain forests and woodlands, and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. Within the Hunter Region this species has been found in the Kurri Kurri/Cessnock area during winter and in the Watagan Mountains areas during the summer.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Glossopsitta pusilla Little Lorikeet (V)	*Glossopsitta pusilla* extends from Cairns to Adelaide coastally and to inland locations. Commonly found in dry, open eucalypt forests and woodlands. Can be found in roadside vegetation to woodland remnants. *G. pusilla* feeds on abundant flowering Eucalypts, but will also take nectar from Melaleuca sp and Mistletoe sp. *Eucalyptus albens* (White Box) and *E. meliodora* (Yellow Box) are favoured food sources on the western slopes in NSW. On the eastern slopes and coastal areas favoured food sources are *Corymbia maculata* (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. robusta* (Swamp Mahogany) and *E. pilularis* (Blackbutt). Nesting takes place in hollow bearing trees.	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Lathamus discolor Swift Parrot (E, E*)	On the mainland this species frequents Eucalypt forests and woodlands with large trees having high nectar production during winter. Mainland winter foraging sites often vary from year to year. Nests only in Tasmania, but regularly visits the Hunter Region in winter. Visits the Hunter Region when food sources are abundant or food sources are lacking in other areas. Food sources used in the Hunter include *Eucalyptus robusta* (Swamp Mahogany) on the coast, and near coastal to inland *Lathamus discolour* uses *Corymbia maculata* (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark) and *E. crebera* (Narrow-leaved Ironbark). Occasional records have come from *E. alba* (White Box) and *E. sideroxylon* (Mugga Ironbark). These food source trees have been recorded as roosting sites for *L. disolor*.	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Neophema pulchella Turquoise Parrot (V)	Inhabits forests and woodlands with suitable nest hollows and grassy foraging areas. Needs a sparse understorey as it refers to feed in the shade of trees and spend most of its time on the ground searching for seeds of grasses and herbaceous plants. Generally found in more western locations within the Hunter Region (found coastally north of Port Stephens), although some isolated records from the forested areas within the Cessnock LGA do exist.	Low This species has been recorded within the Study Area (see **Section 4**). The PAA is unlikely to contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Ninox strenua Powerful Owl (V)	Occurs in wet or dry sclerophyll forests and woodlands where suitable prey species occur (being predominantly arboreal mammals). Requires large hollows, usually in Eucalypt trees, for nesting. Roosts in dense vegetation within such areas. Roosts in dense vegetation within such species as *Syncarpia glomulifera* (Turpetine), *Allocasuarina littoralis* (Black She-Oak), *Acacia melanoxylon* (Blackwood), *Angophora floribunda* (Rough-barked Apple), *Exocarpus cupressiformis* (Cherry Ballart) and *Melaleuca nodosa* (Ball Honeymyrtle).Many records across the Hunter region, a lot coastal.	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Ninox connivens Barking Owl (V)	Occurs mainly in dry sclerophyll woodland. Nests in large Eucalypt hollows, and roosts in hollows or thick vegetation. Can be found roosting in dense Acacia sp. and Casuarina sp. or the dense clumps of Eucalypt trees. Hunts a range of prey species including birds and both terrestrial and arboreal mammals. Spasmodic Hunter Region records are largely limited to the south-western ranges and adjacent forests on the valley floor. Records from Ellalong, Yengo N.P. and Wybong area (HBOC records).	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Tyto novaehollandiae Masked Owl (V)	Found in a range of habitats, locally within sclerophyll forests and woodlands where appropriate / preferred prey species occur (being predominantly terrestrial mammals). Requires large Eucalypt hollows for nesting and prefers to roost in these hollows as well.	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Tyto tenebricosa Sooty Owl (V)	Occurs in wet Eucalypt forest and rainforest with tall emergent trees, often in easterly facing gullies. Within these areas this species hunts for a range of mainly mammalian prey at all levels of the forest strata, even recorded feeding on ground. Roosts in tree hollow or dense canopy vegetation. Also nests in large Eucalypt tree hollows. Most Hunter records exist from the Watagan mountains (Atlas of NSW Wildlife data), but this species has also been observed to the southwest of Awaba.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Climacteris picumnus Brown Treecreeper (V)	Frequents drier forests and woodlands, particularly open woodland lacking a dense understorey. Also found in grasslands in proximity to wooded areas where there are sufficient logs, stumps and dead trees nearby. Occasionally found in mallee and *Eucalyptus camaldulensis* (River Red Gum) forest bordering wetlands with an open understorey of *Acacia* sp., *Muehlenbeckia* sp. (Lignum), *Typha* sp. (Cumbungi) and *Poa* sp. (grasses). Feeds on invertebrate larvae and small insects, particularly ants. Utilises hollows for roosting/nesting.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Melithreptus gularis Black-chinned Honeyeater (V)	Occurs within dry Eucalypt woodland within an annual rainfall range of 400-700 mm, particularly within associations containing Ironbark and Box species. Habitat species include *Eucalyptus sideroxylon* (Mugga Ironbark), *E. albens* (White Box), *E. microcarpa* (Grey Box), *E. melliodora* (Yellow Box), *E. fibrosa* (Broad-leaved Ironbark) and *E. tertecornins* (Forest Red Gum). Also inhabits other open forest types. Rarely coastal, found more commonly on the slopes of the divide, coming to the lowlands of the Hunter Valley. Feeds on insects, nectar and lerp. Appears not to occur in forested remnants less than 200ha.	Moderate This species has not been recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the [roposed Project.
Anthochaera phrygia Regent Honeyeater (E, E*)	Nomadic Honeyeater that disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. Within the region, mostly recorded in Box-Ironbark Eucalypt associations along creek flats, river valleys and foothills. Coastal swamp forests in Lower Hunter are used when more western resources fail. The main feed tree for coastal areas is *Eucalyptus robusta* (Swamp Mahogany). Hunter records are more common in near coastal areas such as Cessnock LGA. Feed trees in this region are *Corymbia maculata* (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. crebra* (Narrow-leaved Ironbark) and various *stringybark* sp.. Nests mainly west of the divide, although local breeding attempts have occurred at Quorrobolong.	Moderate This species has been recorded adjacent to the boundary of the PAA (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Petroica boodang Scarlet Robin (V)	In NSW this species occupies open forests and woodlands from the coast to the inland slopes. Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Petroica pheonicea Flame Robin (V)	In summer this species habits upland moist Eucalypt forest and woodlands, usually near ridges and slopes with open understorey. It migrates in winter to more open lowland habitats, such as grasslands with scattered trees and open woodland on the inland slopes and plains. Feeds on invertebrates taken from the ground, tree trunks and logs. Open cup nest of plant material and spider webs, near ground ledge or cavity in a tree, stump or bank.	Moderate This species has not been recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Melanodryas cucullata Hooded Robin (V)	Primarily known from Eucalypt forest, woodland and scrub, although has been known to use cleared paddocks with regrowth or stumps in close proximity to wooded areas. These areas are favoured due to the feeding habit of perch and pounce. Areas with sparse shrub cover and fallen timber. Occurs on the western slopes and west of the divide, also on the eastern slopes, with occasional records east of the divide. Appears unable to persist in remnants less than 100-200ha.	Low This species has not been recorded within the Study Area. The PAA is unlikely to contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Pomatostomus temporalis Grey-crowned Babbler (V)	Occupies open forests and woodlands, Acacia shrubland and adjoining farmland. Also Box-Gum Woodlands on the divide slopes and Box-Cypress Pine and open Box Woodlands on the plains. They feed on terrestrial invertebrates and insects on lower trunks and branches. Generally they prefer wooded areas with an intact ground cover, although in such areas as the Hunter Valley they occur in sparsely vegetated areas such as properties and golf courses. Appears unable to persist in cleared and highly fragmented habitats. Nest comprise of a dome shape stick nest which is often only a couple of metres from the ground in shrubs or Eucalypt saplings.	Low This species has been recorded within the Study Area (see **Section 4**). The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Chthonicola sagittata Speckled Warbler (V)	Occupies Eucalypt and Cypress woodlands in drier coastal areas and on the western slopes of the Great Dividing Range. Appears unable to persist in districts where no forested fragments larger than 100 hectares remain. Occurs in the central and southern Hunter Region where suitable habitat exists. Associated with extensive stands of *Bursaria spinosa* (Blackthorn) in some areas.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Epthianura albifrons White-fronted Chat (V)	Occur in damp open habitats, especially near wetlands bordered by samphire (Halosarcia) or saltbush (Atriplex) and grasslands. Often occur in coastal, near coastal and inland areas in saltmarsh and other similar chenopod shrublands, such as around saltlakes and saltpans. Also occur round freshwater wetlands, especially in surrounding grassland, including pasture.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Daphoenositta chrysoptera Varied Sitella (V)	This species inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy.	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Aratmus supercilious White-browed Woodswallow (PD[V])	A traditional western species. Habitat includes Eucalypt, Acacia and Casuarina woodlands and other open areas including grassland with scattered trees or shrubs, also mallee. Also can be found across agricultural areas with woodland patches. Distribution can be highly variable. This species is highly irruptive in areas across NSW. Birds can influx areas due to string winds or drought affected areas. These movements can see this species cover areas of habitat not normally encountered, eg. Rainforest. Coastal movements because of these factors can happen in summer. Coastal Eucalypt habitats are then used as a result. Breeding usually occurs inland but has been recorded on the coast in otherwise unfamiliar habitats.	High This species was not recorded within the Study Area. The PAA contains areas of potentially suitable habitat for this species. This species is likely to occur.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Stagonopleura guttata Diamond Firetail (V)	Occupies open woodlands / forests and associated habitats with grassy understorey. Generally found west of the Divide or in drier semi-coastal areas such as the upper Hunter Valley. Appears unable to persist in remnants less than 200ha. A small number of records exist from the Lower Hunter Region	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Mammals			
Dasyurus viverrinus Eastern Quoll (E)	Slightly built animal with large sensitive ears, striking white-spotted black or fawn fur that grows to 370 millimetres head to body length. Distinguished from the larger Spotted-tail Quoll by the absence of spots on its tail and only four toes on hindfoot. Not recorded in NSW for many years. Occurs in dry sclerophyll forest, scrub, heathland and cultivated land. Opportunistic carnivore with insects as it's most important prey. Home ranges vary between sexes. Males may travel over a kilometre in a night, whilst females restrict their movements to a few hundred metres surrounding their dens.	Low This species is likely extinct on the mainland of Australia. This species has not been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Dasyurus maculatus maculatus Spotted-tailed Quoll (V, E*)	Found in a variety of forested habitats. This species creates a den in fallen hollow logs or among rocky outcrops. Generally does not occur in otherwise suitable habitats that are in close proximity to urban development. Hunter Region records are largely confined to the surrounding ranges (Atlas of NSW Wildlife data).	Moderate This species has been recorded within a one kilometre radius of the PAA (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Phascogale tapoatafa Brush-tailed Phascogale (V)	Inhabits dry open forest and woodlands, often in areas with sparse groundcover of grasses, herbs or leaf litter. They have also been recorded in heathland, swamps, rainforest and wet sclerophyll forest. It is one of the most arboreal Dasyurids and mainly hunts invertebrates, although some vertebrate prey is taken on occasion. Utilises small tree hollows for nesting and refuge sites.	Moderate This species has not been recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Phascolarctos cinereus Koala (V)	Occurs in forests and woodlands where it requires suitable feed trees (particular Eucalyptus spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions. Records from the Lower Hunter Region are largely confined to the greater Port Stephens area, the Lake Macquarie hinterland and the Watagan Mountains, with a small number of records from Cessnock LGA (Atlas of NSW Wildlife data).	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Cercartetus nanus Eastern Pygmy Possum (V)	Occurs from rainforest through sclerophyll forest to tree heath. Favoured food being banksias, myrtaceous shrubs and trees and insects. Nesting sites are generally in drier habitats. Records exist from the Watagan Mountains (Atlas of NSW Wildlife data).	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Petaurus norfolcensis Squirrel Glider (V)	Occurs in eucalypt forests and woodlands where it feeds on sap exudates and blossoms. In these areas tree hollows are utilised for nesting sites. This species also requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species. Widely distributed across the lower hunter region (Atlas of NSW Wildlife data).	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Aepyprymnus rufescens Rufous Bettong (V)	Occurs in a variety of habitats ranging from coastal eucalypt forests to tall wet sclerophyll forests along the east coast of Australia. It tends to favour those areas where there is a sparse or grassy understorey. The Rufous Bettong constructs a nest of fibrous vegetation that is occupied during the day. It emerges just after dusk and forages on grasses and herbs as well as tubers and roots. Its former range included the Hunter.	Low This species has not previously been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Petaurus australis Yellow-bellied Glider (V)	Usually associated with tall, mature wet Eucalypt forest. Also known from tall dry open forest and mature woodland. The diverse diet of this species is primarily made up of Eucalypt nectar, sap, honey dew, manna and invertebrates found under decorticating bark and pollen. Tree hollows for nest sites are essential, as are suitable food trees in close proximity. Most records in the Lower Hunter Region occur in the Watagan Mountains and other areas exhibiting significant stands of forest (Atlas of NSW Wildlife data).	Low This species has been recorded within the Study Area (see **Section 4**). The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Potorous tridactylus Long-nosed Potoroo (V,V*)	Prefers cool rainforest, wet sclerophyll forest and heathland. Sleeps by day in a nest on the ground, and digs for succulent roots, tubers, fungi and subterranean insects. Some diggings seemingly attributable to this species may belong to *Isoodon macrourus* (Northern Brown Bandicoot). Records exist from the Karuah vicinity and the Gosford LGA (Atlas of NSW Wildlife data).	Low This species has not been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Macropus parma Parma Wallaby (V)	Forested areas with dense understorey, often with nearby grassy areas and in wet sclerophyll and rainforests, sometimes drier forests. Feed at night on grasses and herbs and edges of nearby grassy areas.	Low This species has not been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Petrogale penicillata Brush-tailed Rock Wallaby (E, V*)	Occurs in forests and woodlands along the Great Divide and on the western slopes in escarpment country with rocky outcrops, steep rocky slopes, gorges, boulders and isolated rocky areas. The majority of populations favour north-facing aspects, but some southern aspects have been recorded. Apart from the critical rock structure *Petrogale pencillata* also requires adjacent vegetation types, associated types include, dense rainforest, wet sclerophyll, vine thicket, dry sclerophyll forest and open forest. They also require suitable caves and rocky overhangs for shelter and also for 'lookout' posts. Records exist from the Watagan Mountains where it is associated with the above habitats.	Low This species has not been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Pteropus poliocephalus Grey-headed Flying-fox (V, V*)	This species forages over a large area for nectar/fruits. Seasonally roosts in communal base camps situated within wet sclerophyll forests or rainforests. Frequently observed to forage in flowering Eucalypts. May occur anywhere within the Hunter Region where food or roosting resources are available.	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat (V)	Range of habitats from rainforest to arid shrubland, roosts in tree-hollows. A limited number of records occur on the central coast and the Lower Hunter Region (Atlas of NSW Wildlife data).	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Mormopterus norfolkensis Eastern Freetail-bat (V)	This species is distributed south of Sydney extending north into south-eastern Queensland. There are no records west of the Great Dividing Range. Most records of this species have been reported from dry Eucalypt forest and woodland. It is expected that open forested areas and the cleared land adjacent to bushland, constitutes important habitat for this species, It is a predominantly tree-dwelling species, roosting in hollows or behind loose bark in mature Eucalypts. Widely distributed across the Lower Hunter Region (Atlas of NSW Wildlife data).	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Chalinolobus dwyeri Large-eared Pied Bat (V, V*)	This species forages in tall open forests and the edges of rainforest. It roosts in mine shafts and similar structures. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of *Hirundo ariel* (Fairy Martin), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy. Hunter Region records for this species are largely confined to the Watagan Mountains, but it has been recorded on the southern side of Port Stephens (Atlas of NSW Wildlife data).	Moderate This species has not been recorded within the Study Area. The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Phoniscus papuensis (syn. Kerivoula papuensis) Golden-tipped Bat (V)	Rainforest, rainforest gullies within wet sclerophyll forests. Also records from recently logged dry sclerophyll forests. Hunter records west of Port Stephens and from the Watagan Mountains (Atlas of NSW Wildlife data).	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA may contain areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Vespadelus troughtoni Eastern Cave Bat (V)	A cave dweller, known from wet sclerophyll forest and tropical woodlands from the coast and Dividing Range to the drier forests of the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally in buildings. In all situations, the roost sites are frequently in reasonably well-lit areas. The distribution of this species is largely to the north of the Hunter Region.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Miniopterus schreibersii Eastern Bentwing-Bat (V)	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Requires caves or similar structures for roosting habitat. Widely distributed across the Lower Hunter Region (Atlas of NSW Wildlife data).	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Miniopterus australis Little Bentwing-bat (V)	Prefers to forage in well-vegetated areas, such as within wet and dry sclerophyll forests and rainforests. Requires caves or similar structures for roosting habitat. Largely confined to more coastal areas in the Lower Hunter Region (Atlas of NSW Wildlife data).	High This species has been recorded within the PAA (see **Section 4**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Myotis macropus Large-footed Myotis (V)	Usually found near bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Although usually recorded foraging over wet areas, it also utilises a variety of wooded habitats adjacent to such areas including rainforest, wet and dry sclerophyll forest, woodland, and swamp forest. Roosts in small colonies of between 15 and several hundred individuals in caves, mines and disused railway tunnels.	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Falsistrellus tasmaniensis Eastern False Pipistrelle (V)	This species is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m). This species roosts in tree hollows. Appears to locally favour upland habitats. A limited number of records occur on the central coast and the Lower Hunter Region (Atlas of NSW Wildlife data).	High This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Scoteanax rueppellii Greater Broad-nosed Bat (V)	Forages in moister gullies and wet sclerophyll forests as well as in lightly wooded areas and open spaces/ecotones. This species roosts in tree hollows and is relatively widespread within the Lower Hunter Region (Atlas of NSW Wildlife data).	Moderate This species has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Pseudomys gracilicaudatus Eastern Chestnut Mouse (V)	Favours dense, wet heath and swamp habitats that are in a state of intermediate disturbance recovering from fire. It is displaced by *Rattus lutreolus* (Swamp Rat) in mature heathland, such that its numbers fall in these habitats. It has a broad diet of grass stems, invertebrates, fungi and seeds. Their diet depends on seasonal availability.	Low This species has not been recorded within the Study Area. The PAA is unlikely to provide potential habitat for this species.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This species is unlikely to be affected by the proposed Project.
Endangered Populations			
Eucalyptus parramattensis subsp. *parramattensis* Endangered Population in Wyong and Lake Macquarie LGA's (E)	The current population within Lake Macquarie LGA is 10 individuals and a record exists for this population near Moonee to the east of the PAA while another record is located near Beauty Point to the west of the PAA.	Moderate This population has been recorded within the Study Area (see **Section 4**). The PAA contains areas of potentially suitable habitat for this population.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This population is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
EECs			
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions (E)	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner occurs in the intertidal zone on the shores of estuaries and lagoons, including when they are intermittently closed along the NSW coast. Corresponds to the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) Map Unit (MU) 47a - Saltmarsh.	Moderate Lake Macquarie Council list this TEC as occurring within their Local Government Area. Some vegetation within the PAA may be commensurate with this TEC, although it has not been mapped as occurring on the PAA.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions (E)	Associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands. They typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Wetlands or parts of wetlands that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including *Paspalum distichum* (Water Couch), *Leersia hexandra* (Swamp Ricegrass) and *Carex appressa* (Tall Sedge). Wetlands or parts of wetlands subject to regular inundation and drying may include large emergent sedges over 1 metre tall, such as *Baumea articulate* (Jointed Twig-rush), *Eleocharis equisetina* and *Lepironia articulata*. Corresponds to House (2003) Map Unit (MU) 46 – Freshwater Wetland Complex.	Moderate Lake Macquarie Council list this TEC as occurring within their Local Government Area. Some vegetation within the PAA may be commensurate with this TEC, although it has not been mapped as occurring on the PAA.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Hunter Lowland Redgum Forest (E)	Found on gentle slopes arising from depressions and drainage flats on permian sediments of the Hunter Valley floor in the Sydney Basin and NSW North Coast Bioregions. Dominant canopy species include *Eucalyptus tereticornis, E. amplifolia* (Cabbage Gum) and *E. moluccana* (Grey Box) with scattered other Eucalypt species also present. Classified by the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) as Map Unit (MU) 19.	Moderate Lake Macquarie Council list this TEC as occurring within their Local Government Area. Some vegetation within the PAA may be commensurate with this TEC, although it has not been mapped as occurring on the PAA.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions (E) Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (CE*)	The ecological community represents a complex of rainforest and coastal vine thickets, including some that are deciduous, on the east coast of Australia. Typically, the ecological community occurs within two kilometres of the coast or adjacent to a large salt water body, such as an estuary and, thus, is influenced by the sea. It is naturally distributed as a series of disjunct and localised stands occurring on a range of landforms derived from coastal processes that can include dunes and flats, cheniers, berms, cobbles, headlands, scree, seacliffs, marginal bluffs, spits, deltaic deposits, coral rubble and islands.	Moderate Lake Macquarie Council list this TEC as occurring within their Local Government Area. Some vegetation within the PAA may be commensurate with this TEC, although it has not been mapped as occurring on the PAA.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.
Lower Hunter Spotted Gum Ironbark Forest (E)	This community is widespread throughout the central to lower Hunter Valley, with forests between Cessnock and Beresfield forming the core of its distribution. This community is dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus fibrosa* (Broad-leaved Ironbark) with occasional occurrences of *E. punctata* (Grey Gum) and *E. crebra* (Grey Ironbark). Classified by the Lower Hunter Central Coast Regional Biodiversity Conservation Strategy (LHCCREMS) as Map Unit (MU) 17.	Moderate Lake Macquarie Council list this TEC as occurring within their Local Government Area. Some vegetation within the PAA may be commensurate with this TEC, although it has not been mapped as occurring on the PAA.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion (E)	In a relatively undisturbed state, this community has a closed, highly diverse, mesophyllous canopy. Typically, the trees form three major strata: emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes results in an irregular canopy appearance. The trees may have buttressed roots. Forms present may include palms, vines and vascular epiphytes. In disturbed stands of this community the canopy cover may be broken, or the canopy may be smothered by exotic vines. The Hawkesbury River notionally marks the southern limit of this EEC. It is characterised by the presence of species such as Araucaria, Palms and Figs.	Moderate Lake Macquarie Council list this TEC as occurring within their Local Government Area. Some vegetation within the PAA may be commensurate with this TEC, although it has not been mapped as occurring on the PAA.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion (E)	Lowland Rainforest on Floodplain generally occupies riverine corridors and alluvial flats with rich, moist silts often in subcatchments dominated by basic volcanic substrates. Major examples once occurred, and remnants remain, on the floodplains of the Tweed, Richmond, Clarence, Bellinger, Macleay, Hastings, Manning, and Hunter Rivers. Other minor river systems also support the community. This community occurs on fertile soils in lowland river valleys. Occurs only as small remnants in scattered localities on the NSW north coast, with less than 1000ha in total thought to remain.	Moderate Lake Macquarie Council does not list this TEC as occurring within their Local Government Area. However, some vegetation within the PAA may be commensurate with this TEC, although it has not been mapped as occurring on the PAA.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.
River-flat Eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions (E)	Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis* (Forest Red Gum), *E. amplifolia* (Cabbage Gum), *Angophora floribunda* (Rough-barked Apple) and *A. subvelutina* (Broad-leaved Apple). Corresponds to LHCCREMS communities - 'Central Hunter Riparian Forest' Map Unit (MU) 13, 'Wollombi Redgum-River Oak Woodland' MU14 and 'Redgum Rough-barked Apple Swamp Forest' MU38.	High Lake Macquarie Council list this TEC as occurring within their Local Government Area and at least some vegetation within the PAA is likely to be commensurate with this TEC. This TEC corresponds to Map Unit 38 – Redgum Rough Barked Apple Forest as mapped by House (2003) within PAA (see **Figure 4-3**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bio-regions (E)	This community is dominated by *Casuarina glauca* (Swamp Oak) and is associated with periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains, typically occurring on grey-black clay-loams and sandy loams. Usually occurring below 20m altitude. Corresponds to HOUSE (2003) Map Units (MU) 40 – Swamp Oak Rushland Forest and MU 41 – Swamp Oak Sedge Forest.	High Lake Macquarie Council list this TEC as occurring within their Local Government Area and at least some vegetation within the PAA is likely to be commensurate with this TEC. This TEC corresponds to Map Unit 40 – Swamp Oak Rushland Forest as mapped by House (2003) within PAA (see **Figure 4-3**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.
Swamp Sclerophyll Forest on Coastal Floodplains (E)	The community is associated with humic clay or sandy loams on waterlogged or episodically flooded alluvial flats and drainage lines within coastal floodplains. It is generally characterised by an open to dense canopy of eucalypts and / or paperbarks. Canopy heights generally vary from 8m to 25m depending on species composition. In the Hunter Region the canopy often contains *Eucalyptus robusta* (Swamp Mahogany) and / or *Melaleuca quinquinervia* (Broad-leaved Paperbark) although other plant species, such as *Callistemon salignus* (Willow Bottlebrush), *Casuarina glauca* Swamp Oak), *Eucalyptus resinifera* subsp. *hemilampra* (Mahogany), *Livistona australis* (Cabbage Palm) may be present. Small trees and shrubs, including *Melaleuca* sp., *Glochidion ferdinandi* (Cheese Tree), *Acacia* sp. *Leptospermum polygalifolium* subsp. *polygalifolium* (Tantoon) and *Dodonaea triquetra* (Large-leaf Hopbush), are often present in the lower strata. Corresponds to LHCCREMS Map Unit (MU) 42 'Riparian Melaleuca Swamp Woodland', MU42a – 'Melaleuca Scrub', MU43 – 'Wyong Paperbark Swamp Forest' and MU43a – 'Melaleuca Scrub'.	High Lake Macquarie Council list this TEC as occurring within their Local Government Area and at least some vegetation within the PAA is likely to be commensurate with this TEC. This TEC corresponds to Map Unit 37 –Swamp Mahogany – Paperbark Forest and Map Unit 42 – Riparian Melaleuca Swamp Woodland as mapped by House (2003) within the PAA (see **Figure 4-3**).	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Sydney Freshwater Wetland (E)	A complex of vegetation types largely restricted to freshwater swamps in coastal areas. These also vary considerably due to fluctuating water levels and seasonal conditions. Characteristic species include sedges and aquatic plants such as *Baumea* species, *Eleocharis sphacelata*, *Gahnia* species, *Ludwigia peploides* ssp. *montevidensis* and *Persicaria* species.	Moderate Lake Macquarie Council list this TEC as occurring within their Local Government Area. Some vegetation within the PAA may be commensurate with this TEC, although it has not been mapped as occurring on the PAA.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.
Themeda Grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner bioregions (E)	Community occurring on sandstone, old sand dunes and basalt, which is characterised by *Themeda australis* (Kangaroo Grass). *T. australis* within the community is sometimes limited to only a few metres square, but on some substrates, such as old sand dues the community can be relatively extensive in size. *T. australis* within the community is often stunted and prostrate as are the shrubs and trees occurring within the community. In the Lower Hunter and Central Coast regions this community occurs on coastal landforms with *Pimelea linifolia* (Slender Rice Flower), *Westringia fruticosa* (Coast Rosemary), and *Banksia integrifolia* (Coastal Banksia) the most commonly associated species.	Low Lake Macquarie Council list this TEC as occurring within their Local Government Area. Vegetation within the PAA is unlikely to be commensurate with this TEC.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.

Species / Community	Habitat Description	Chance of Occurrence On Site	Likely Level of Impact
Vulnerable Ecological Communities			
Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions (V)	Common canopy species found in this community are *Elaeocarpus obovatus* (Hard Quandong), *Alectryon subcinereus* (Wild Quince), *Baloghia inophylla* (Brush Bloodwood), *Melia azedarach* (White Cedar) and *Melicope micrococca* (Hairy-leaved Doughwood). These are but a few of a very diverse upper stratum. Species within the shrub layer include *Breynia oblongifolia* (Coffee Bush), *Notelaea longifolia* (Large Mock Olive), *Clerodendrum tomentosum* (Hairy Clerodendrum) and *Pittosporum revolutum* (Hairy Pittosporum). Vines such as *Pandorea pandorana subsp. pandorana* (Wonga Vine), *Cayratia clematidea* (Native Grape) and *Jasminum volubile* (Stiff Jasmine) are common. A dense groundcover of ferns, grasses and forbs are typical, common species include *Dichondra repens* (Kidney Weed), *Commelina cyanea* (Scurvy Weed), *Adiantum aethiopicum* (Common Maidenhair) and *Oplismenus aemulus* (Basket Grass). The community occurs on the footslopes of the Barrington Range along the northern rim of the Hunter Valley floor. It usually is encountered in gullies and steep hillslopes with a south facing aspect. Generally found at elevations less than 300m ASL and with a mean annual rainfall less than 900 millimetres Corresponds to House (2003) Map Unit 3 – Hunter Valley Dry Rainforest.	Moderate Lake Macquarie Council list this TEC as occurring within their Local Government Area. Some vegetation within the PAA may be commensurate with this TEC, although it has not been mapped as occurring on the PAA.	Low Negligible surface impacts are expected to occur. Subsidence is predicted to be less than 20 millimetres and no surface cracking is expected. This ecological community is unlikely to be affected by the proposed Project.

Notes: (V) = Vulnerable species listed under the *TSC Act*.
(E) = Endangered species listed under the *TSC Act*.
(CE) = Critically Endangered species listed under the *TSC Act*.
(PD) = Preliminary Determination of listing under the *TSC Act*.
(V*) = Vulnerable species listed under the *EPBC Act*.
(E*) = Endangered species listed under the *EPBC Act*.
(CE*) = Critically Endangered species listed under the *EPBC Act*.
(M*) = Migratory species listed under the *EPBC Act*.

Appendix 3

Staff Qualifications

RPS

Curriculum Vitae

TOBY LAMBERT

Senior Ecologist / Senior Project Manager

Newcastle, NSW

Bachelor of Environmental Science, University of Newcastle, 1993 - 1996

Accredited BioBanking Assessor, Tafe NSW – Ryde, 2009

NSW Driver's Licence (Class C)

OH&S Induction Training (Green Card)

NPWS Scientific Investigation Licence and NSW Animal Ethics Research Authority

AREAS OF EXPERTISE:

Toby has over fourteen years experience in undertaking and managing a diverse array of ecological and environmental surveys and assessments. As a Senior Ecologist – Senior Project Manager, he supervises all facets of flora and fauna assessment and related reports: planning, supervision of field and reporting staff, project scheduling, budget management, liaising with clients and Government departments and providing advice of all kinds. He has also been called upon to prepare expert evidence for matters at the NSW Land and Environment Court. Toby has produced ecological and environmental documentation for private and public projects ranging in complexity. These include a number of wind farms throughout Australia and New Zealand, coal mines and a range of infrastructure projects within the Hunter region. Toby has also managed ecological master planning for residential projects in Sydney, the Central Coast and the Hunter. Toby's fields of expertise are Environmental Impact Assessment and mediation, flora, fauna and habitat survey method, design and identification, detailed understanding of legislation and threatened species issues, terrestrial fauna surveys and project management. He has experience in conducting comprehensive fauna surveys and preparing related documentation in a broad array of environments throughout New South Wales, with most projects located in the greater Sydney area, Blue Mountains, Central Coast, Hunter and Forster / Great Lakes regions. Toby has also undertaken ecological projects in Western Australia, Queensland, the ACT and New Zealand.

SELECTED PROJECT EXPERIENCE:

Ecology

- **Hunter Economic Zone Industrial Estate -** Project Manager for the environmental component of the development of the Hunter Economic Zone industrial estate at Kurri Kurri, to be the largest industrial estate in NSW.
- **Centennial Coal -** Environmental Project Manager for consultancy works to Centennial Coal covering a broad range of disciplines, but primarily focussed on ecological impact assessments, monitoring and management at six coal mines in the western Blue Mountains and Lake Macquarie NSW.
- **Peabody Energy Australia -** Senior Project Manager for project specific and ongoing monitoring requirements for Wambo Coal Mine at Warkworth in the Upper Hunter Valley. Toby liases directly with the Environmental Manager of the mine in relation to requirements to fulfil consent conditions for the ongoing development and operation of the project.
- **Allco Wind Energy -** This involved undertaking fauna surveys for a 100 turbine wind farm on the North Island of New Zealand and coordinating other ecological specialists to prepare an ecological impact assessment for submission to Taranaki Council. Aspects included regular liason with the Department of Conservation regarding issues of significance, survey methodology, and mitigation and management measures to protect significant ecological features. Local bird groups were also involved and Toby was involved in the public consultation sessions.

- **Stockland Wallarah Peninsula -** This Lake Macquarie, NSW project required a multi-disciplinary approach to an innovative residential proposal on environmentally sensitive land. Project management of, and participation in, a large and diverse planning team were major features of this work. Toby was a pivotal member of the project management team that provided the detailed ecological input and advice that was required from the early stages of the planning process to the point of submission to determining authorities. The proposal required sophisticated and creative impact assessment and reporting. Toby made a major contribution to the production of a series of comprehensive ecological reports that ensured the ecological integrity of the site was maintained in the post-development landscape.

PREVIOUS EXPERIENCE:

Senior Project Manager - Cumberland Ecology, Epping **2005**
Duties included flora and fauna surveying and survey design; overseeing and contribution to the preparation of complex ecological and environmental reports for both small and large projects; flora and fauna surveying and survey design; liaison with both the private sector and federal, state and local government departments.

Principal Consultant / Co-Founder - Keystone Ecological, Kariong **2004 - 2005**
Preparation and development of Keystone Ecological Flora and Fauna Impact Assessment report format; development of client database, including organisation of promotional material, logo design and customer relations; administration including preparation of quotes and invoices and organising accounts and BAS statements; Flora and fauna surveying and survey design; along with Anabat II Data Analysis.

Project Manager - Ecology - Conacher Travers Environmental, Somersby **1998 - 2004**
Supervision of flora and fauna survey design; report quality control; production of technical reports such as Review of Environmental Factors, Flora & Fauna Assessments, Statement of Environmental Effects, Species Impact Statements and Plans of Management, Land and Environment Court Evidence preparation, EPBC Act Referrals and Preliminary Information preparation; Flora & fauna surveying; liaison with Department of Environment and Conservation, Department of Environment and Heritage, Department of Infrastructure, Planning and Natural Resources, Department of Agriculture, Local Governments and private clients; Anabat II Data Analysis; Water Testing; Data Recording and Statistical Analysis.

Volunteer for Green and Golden Bell Frog Survey - Australian Museum, North Avoca **1999 - 2001**
Survey and searches for the endangered species Green & Golden Bell Frog; assisting in weighing, measuring and micro-chipping frogs for on-going research purposes.

Environmental Scientist - Australian Defence Industries (ADI), St Marys **1998**
Bore Water Sampling; statistical analysis of test results; and report production.

Environmental Scientist - Anne Clements & Associates, North Sydney **1997**
Field Assistant to Botanist and data recording.

Research Assistant - University of Newcastle **1996**
Initiation of design of final year project for Biology Dept; research into fire regimes on species composition & regeneration in open woodland; use of advanced scientific equipment including infra red gas analyser in the field, and replication of experiments using computer database; theoretical knowledge on soils, nutrient cycles & vegetation types.

MEMBERSHIPS & ACHIEVEMENTS:

- Ecological Consultants Association of NSW (ECA) – Council Member
- Newcastle Green Drinks for Environmental Professionals organising committee

Curriculum Vitae

STEVEN COX

Senior Ecologist – Project Manager

Newcastle, NSW

Bachelor of Applied Science (Environmental Science) (Honours)

NSW Driver's Licence (Class C)

OH&S Induction Training (Green Card)

NPWS Scientific Investigation Licence

Senior First Aid

AREAS OF EXPERTISE:

Steven has 12 years experience in the environmental industry with key experience in ecological project management, survey design, field survey, report writing, report review and client relations. In his position as Senior Ecologist, Steven is responsible for the management of ecological projects at all levels, ranging from proposal preparation to report delivery and client liaison. His areas of expertise are design & management of ecological impact assessment projects; flora, fauna and habitat survey methodology design and management; detailed understanding of threatened species legislation and issues; terrestrial fauna and fauna habitat surveys; ecological project management and report writing; along with tree felling supervision and ecological report review.

Steven has project managed and / or participated in numerous mining, energy, local government and private projects, including impact assessments for new coal and gold mines, extensions to existing mines, power substations, power lines, pipelines, access roads and private infrastructure. Steven has designed and / or undertaken the ecological component of structure plans for local government; prepared an affidavit for court proceedings (in an alleged illegal clearing case); and undertaken ecological report reviews for a local council. He has participated in Koala and Platypus field survey and impact assessment; together with nest box installation and monitoring.

SELECTED PROJECT EXPERIENCE:

Ecology

- **Rocglen Coal Mine Extension Project** – Gunnedah NSW (2010).
- **Ecosystem Function Analysis** – Wambo Coal, Singleton NSW (2010).
- **Annual Flora and Fauna Monitoring** – Karuah, NSW (2010).
- **Narrabri Coal Mine Stage 2 Extension Project** – Narrabri, NSW (2009).
- **Muswellbrook Transmission Line Upgrade** – Muswellbrook, NSW (2009).
- **Anvil Hill Flora and Fauna Impact Assessment** – Muswellbrook NSW (2006).
- **Preparation of Expert Witness Affidavit (illegal clearing)** – Forster NSW (2006)
- **Project Management** – Management of numerous land development and mining ecological projects across NSW (2005-2010).

PREVIOUS EXPERIENCE:

Senior Ecologist – Ecotone Ecological Consultants **2008 - 2009**
Duties included flora and fauna surveying and survey design; overseeing and contribution to the preparation of complex ecological and environmental reports for both small and large projects; liaison with both the private sector and federal, state and local government department**.**

PhD Candidate – Koala Ecology, University of Sydney **2007 – 2008**
Steven investigated selected aspects of the ecology of the koala in the Bathurst area of NSW. The project involved the capture and subsequent radio-tracking of up to 50 koalas across a fragmented agricultural landscape. At this stage of the project (2007-2008) activities were limited to data entry, data analysis and report/chapter writing.

Senior Ecologist – Umwelt Australia Pty Ltd **2005 – 2006**
Duties included: preparation of fee proposals; desktop studies and literature searches; flora and fauna surveying and survey design; contribution to the preparation of complex ecological and environmental reports for both small and large projects.

Casual Lecturer / Demonstrator - University of Newcastle **2002 – 2005**
Duties included the delivery of first and second year biology and ecology lectures; demonstration of first and second year biology and ecology laboratory sessions; field trip organisation and management; lecture and laboratory session design; report and exam marking.

Casual Ecologist – Cenwest Environmental Consultants Pty Ltd **1997-2005**
Duties principally comprised all aspects of preparation and completion of fauna surveys across mine sites and development sites within NSW, and the writing of fauna impact assessment reports.

PhD Candidate – Koala Ecology, Charles Sturt University **1997 – 2008**
Steven investigated selected aspects of the ecology of the koala in the Bathurst area of NSW. The project involved the capture and subsequent radio-tracking of up to 50 koalas across a fragmented agricultural landscape. Duties included: project design, site selection, landholder liaison, licensing, koala capture, koala tracking, habitat assessment, data entry, data analysis and report/chapter writing

Platypus Researcher **1996 – 2001**
Steven ran the field component of a long-term platypus research project from 1996 to 2001. Duties included: landholder liaison, volunteer liaison, field preparation, platypus capture and handling, data entry, database creation and management, scientific paper production.

MEMBERSHIPS & ACHIEVEMENTS:

- NSW Animal Ethics Research Authority
- Landscape Function Analysis (LFA)
- Hunter Bird Observer Club (HBOC)
- Birds Australia (BA)
- Ecological Society of Australia (ESA)
- Royal Zoological Society of Australia (RZS)
- Australian Mammal Society (AMS)
- Australian Society of Herpetologists (ASH)

Appendix M

Cultural Heritage Assessment (RPS Australia East Pty Ltd, 2011b)

Myuna Colliery Extension of Mining

Cultural Heritage Assessment

Prepared by:

RPS

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Version/Date: Final, February 2011

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Final 2	Amended Final	DR	DR	25-10-10	BJ 25-10-10	DR	25-10-10
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Final 4	Revised Final for issue	TBM	DR	22-2-11	BJ 25-10-10	DR	22-2-11

Disclaimers

Executive Summary

Centennial Myuna Pty Ltd (CMPL) is seeking approval under Part 3A of the *Environmental Planning and Assessment Act 1979* for an extension of underground mining at Myuna Colliery. The extension of mining has the potential to cause subsidence of <20mm under land and as part of the environmental assessment the potential impact of <20mm subsidence on Aboriginal and European cultural heritage sites requires assessment.

The proposed extension of underground mining within the Project Application Area for a further 21 years is divided into two Subsidence Zones: Zone A with potential subsidence of <20mm on land-based and seagrass areas and Zone B with potential subsidence of <650mm under the remaining areas of Lake Macquarie.

The Project Application Area for this Cultural Heritage Assessment comprises all the land and seagrass areas (Zone A) of the Project Application Area. A portion of the Myuna Colliery Surface Facilities Area, proposed for clean water diversion works, was also included in the Project Application Area.

This report is written in accordance with the Director-General Requirements (NSW Department of Planning) The Aboriginal cultural heritage impact assessment component of this report is written in accordance with the *National Parks and Wildlife Act of 1974* (NPW Act) and meets the requirements of the NPWS survey and assessment writing guidelines (1997). The DECCW *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* was adopted with three registrations of interest: Awabakal Descendants Traditional Owners Aboriginal Corporation; Awabakal Traditional Owners Aboriginal Corporation and Bahtabah Local Aboriginal Land Council.

The European heritage component of the report was written in accordance with the NSW Heritage Manual (1994) issued by the NSW Heritage Branch. No listed or new items or works of European Heritage significance were recorded within the Project Application Area.

Six new Aboriginal cultural heritage sites were recorded. Five sites were assessed to have low to medium local significance, while one site assessed as having a high local and regional significance.

During the survey two areas considered to be culturally sensitive by the registered Aboriginal stakeholders were identified. Shane Frost (ADTOAC) and Kerrie Brauer (ATOAC) requested that the information on these sites be restricted. The information on these sites has been restricted to Addendum A and B. Persons, other than DECCW, DoP, CMPL, AECOM and RPS who wish to view that information must first gain permission from the principals of ADTOAC and ATOAC.

The management recommendations that stem from this heritage assessment are based upon the legislation designed to address the impact of development on sites of cultural significance. It is considered that the proposed extension of mining project is unlikely to have significant impacts on items or works of Aboriginal or European heritage significance, if the following mitigation measures are implemented.

It is recommended that works may proceed with regard to the following:

Mitigation Measure 1

If first and secondary extraction is to occur under the culturally sensitive sites recorded in Addendum A and Addendum B, an archaeological monitoring programme will be implemented for the potentially impacted sites.

Mitigation Measure 2
If there is evidence of mine-induced damage to sandstone outcrops and rock overhangs as described in Addendum A & Addendum B , then all mining works in the area should cease, the area cordoned off and contact made with DECCW Enviroline 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed.

Mitigation Measure 3
If during the course of mining work, significant European heritage material is identified and is likely to be impacted on by the proposed Project, the particular mining work should cease. A significance assessment by a suitably qualified archaeologist adhering to the NSW Heritage Branch significance criteria should be carried out and the NSW Heritage Branch should be notified if significant historical items are identified. Works should only recommence when an appropriate and approved management strategy is instigated.

Mitigation Measure 4
Myuna Colliery will develop an Aboriginal Cultural Heritage Management Plan (ACHMP) for the for the identified Aboriginal heritage items within the Project Area, as well as, contingency strategies for any additional heritage issues which may arise. The ACHMP would comprise:

- An assessment of the cultural significance of the Aboriginal heritage sites within the Project Area;
- Identification of roles and responsibilities (Centennial, Aboriginal stakeholders, heritage consultant); and
- Strategies for:
- Management of identified Aboriginal heritage sites;
- Review of the management of Aboriginal Heritage sites, should subsidence levels at existing monitoring points exceed 20 mm on land areas; and
- Management of additional sites, if identified.

The Myuna Colliery ACHMP will be developed in consultation with the relevant Aboriginal stakeholders to ensure that Aboriginal cultural values are adequately addressed.

Abbreviations

Name	Acronym
Aboriginal Heritage Information Management System	AHIMS
Awabakal Descendants Traditional Owners Aboriginal Corporation	ADTOAC
Awabakal Traditional Owners Aboriginal l Corporation	ATOAC
Bahtabah Local Aboriginal Land Council	Bahtabah LALC
Darkinjung Local Aboriginal Land Council	Darkinjung LALC
Department of Environment, Climate Change and Water (NSW)	DECCW
Department of Planning (NSW)	DoP
High Water Mark	HWM
Koompahtoo Local Aboriginal Land Council	Koompahtoo LALC
Lake Macquarie City Council	LMCC
Local Government Area	LGA
NSW National Parks and Wildlife Service	NPWS
Potential Archaeological Deposit	PAD
RPS Group	RPS
Wyong Shire Council	WSC

Contents

Figures

Tables

Plates

Appendices

APPENDIX 1

Legislative Requirements

APPENDIX 2

Aboriginal Consultation Log

APPENDIX 3

AHIMS

APPENDIX 4

Glossary of Site Types

APPENDIX 5

AHIMS Site Cards

APPENDIX 6

Aboriginal Feedback and Community Responses

ADDENDUM A

ADDENDUM B

1 Introduction

RPS has been engaged by AECOM Australia Limited (AECOM) to undertake a Cultural Heritage Assessment of proposed extension of underground mining at Myuna Colliery. AECOM was commissioned by Centennial Myuna Pty Ltd (CMPL) to prepare an Environmental Assessment (EA) for the Myuna Colliery Extension of Mining (proposed Project) located near Lake Macquarie, approximately 90 km north east of Sydney (Figure 1.1). This Cultural Heritage Assessment was undertaken as part of the EA to support an application for Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979*.

1.1 Project Description

The Project would extend mining and coal handling at Myuna Colliery within the Project Application Area* and proposes to:

- mine using bord and pillar methods in the Wallarah, Great Northern and Fassifern seams in CCL762 and ML1370, for a further 21 years
- produce, handle and distribute to Eraring Power Station, up to 2MTPA using existing infrastructure
- continue the use of ancillary infrastructure and services for a further 21 years

upgrade the water management system

- rehabilitate the surface facilities within 5 years of completion of mining.

CMPL undertakes underground mining at Myuna Colliery:

- Within the Development Consent Mining Area; and
- Within Consolidated Coal Lease (CCL) 762 and Mining Lease (ML) 1370 but external to the Development Consent Mining Area, pursuant to the combined operation of Section 74(1) of the Mining Act 1992 (Mining Act) and clause 8K of the Environmental Planning and Assessment Regulation 2000.

The Project Application Area is shown on Figure 1.2 and encompasses ML 1370, a portion of CCL 762 and the Surface Facilities Area. The Project Application Area comprises an area within the boundaries of CCL 762 and ML 1370, but external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area).

1.1.1 NSW Department of Planning - Director-General Requirements

The Director-General Requirements with regard to heritage for the proposed Project require assessment of Aboriginal and European heritage in accordance with the Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DoP & DECC); Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW); NSW Heritage Manual (NSW Heritage Office) and; The Burra Charter (The Australia ICOMOS charter for places of cultural significance).

The Director-General Requirements also required consultation with relevant authorities, specifically Lake Macquarie City Council; Wyong Shire Council; and NSW Department of Environment Climate Change and Water. The additional requirements of those authorities have been addressed in this report.

1.1.2 Surface Subsidence

Mining within the Project Application Area will be designed to remain below two levels of subsidence as shown on Figure 1-3. The two zones include:

- Zone A – Long term stable mining systems generating < 20 millimetres of surface subsidence (i.e. no noticeable surface impact); and
- Zone B – Mining systems generating a maximum of 650 millimetres of surface subsidence.

Zone A level of negligible subsidence is proposed under sensitive areas such as residential areas, State Conservation Areas, foreshore areas and seagrass beds. Zone B potential level of subsidence is proposed under the less sensitive areas of Lake Macquarie.

1.1.3 Mine Access and Surface Facilities

Existing mining areas (including existing underground workings for ventilation) will continue to be utilised for the proposed Project including (but not limited to) mine access, emergency management and underground services and infrastructure. As such, no changes are proposed to the current mine access, infrastructure or facilities. Minor changes to the licensed discharge point configuration and temporary coal stockpile area (involving minor clean water diversion works) will be required to improve water management at the Surface Facilities Area.

1.2 The Project Application Area

The Project Application Area comprises all land and seagrass areas (Zone A). The Myuna Colliery Surface Facilities Area clean water diversion works is included in the Project Application Area.

1.3 Legislative Context

It is incumbent on any land manager to adhere to legislative requirements that protect both Aboriginal cultural heritage and European cultural heritage in NSW.

The primary state legislation relating to Aboriginal cultural heritage in NSW is the *National Parks and Wildlife Act (1974)*, as amended. The legislation is overseen by the Department of Environment, Climate Change and Water (DECCW), and specifically the Director-General of the DECCW.

The primary NSW State legislation in relation to historic matters is covered by *the NSW Heritage Act 1977* and matters relating to this legislation should be directed to the NSW Heritage Branch.

Appendix 1 details the various relevant legislative Acts.

1.4 Scope of Assessment

This Cultural Heritage Assessment has incorporated a desk top review, consultation with registered Aboriginal stakeholders and a pedestrian survey of the Project Application Area. The objective was to determine through a desk top review and consultation if there was likelihood for Aboriginal and European heritage sites to occur and, through field survey, test that premise.

The Aboriginal cultural heritage impact assessment component of this report meets the requirements of the *National Parks and Wildlife Act 1974* (NPW Act) and is in accordance with requirements of the NPWS Aboriginal Cultural Heritage Standards and Guidelines Kit (1997) and the Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DoP & DECC). A review of the documentary evidence includes a search of the DECCW Aboriginal Heritage Information Management System (AHIMS) database.

The European heritage component of the report was written with guidelines detailed in the NSW Heritage Manual (1994) issued by the NSW Heritage Branch and The Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance).

1.5 Aboriginal Community Consultation

This survey and report has been carried out in accordance with the DECCW *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*. Table 1.1 provides an outline of the process with full detail of the consultation process to be found at Appendix 2.

There were three registrations of interest arising from the consultation process. They were: Awabakal Descendants Traditional Owners Aboriginal Corporation (ADTOAC); Awabakal Traditional Owners Aboriginal Corporation (ATOAC) and Bahtabah Local Aboriginal Land Council (Bahtabah LALC).

Table 1-1: Consultation Process

1.5.1 Stage 1 Notification of project proposal and registration of interest

Action	Date
Notification letters sent	16 March 2010
Advertisement placed	6 May 2010
Notification letters second round sent	10 May 2010
DECCW and LALC advised of registered stakeholders	3 June 2010

1.5.2 Stage 2 Presentation of information about the proposed project

The groups who registered an interest in the Project:

Group	Contact
Bahtabah Local Aboriginal Land Council	Michael Green
Awabakal Descendants Traditional Owners Aboriginal Corporation	Shane Frost
Awabakal Traditional Owners Aboriginal Corporation	Kerrie Brauer

Action	Date
Presentation of information to registered Aboriginal parties	31 May 2010
Field Visit to Project Application Area	22 & 24 June 2010

1.5.3 Stage 3 Gathering information about cultural significance

Action	Date
Presentation of information to registered Aboriginal parties	31 May 2010
Seek cultural information from registered Aboriginal parties - phone calls	Week of 7 June 2010
Protocol for sourcing and holding cultural information - discussion with S. Frost ADTOAC & K. Brauer ATOAC	22 & 24 June 2010.
Seek views on potential management options	22 & 24 June 2010
Field survey of Project Application Area	22 & 24 June 2010

Group	Date and method	Comment received
Shane Frost (SF) ADTOAC	Phone (26/5/2010; 9/6/2010); letter (17 & 20/6/2010); conversation (24 & 26/6/2010).	Special place; Methodology
Michael Green Bahtabah LALC	10 June 2010 phone	Culture
Kerrie Brauer	Letter (20/6/2010); conversation (24 & 26/6/2010)	Methodology

1.5.4 Stage 4 Review of draft cultural heritage assessment report

Organisation	Contact	Date	Comment
Awabakal DTOAC	Shane Frost	16 August 2010	Draft sent for comments
Awabakal TOAC	Kerrie Brauer	16 August 2010	Draft sent for comments
LALC - Bahtabah	Michael Green	16 August 2010	Draft sent for comments
Awabakal DTOAC	Shane Frost	16 September 2010	Comments received & Included in Appendix 6
Awabakal TOAC	Kerrie Brauer	13 September 2010	Comments received & Included in Appendix 6
LALC - Bahtabah	Michael Green	No response received	Study area is outside of Bahtabah LALC boundary
NSWALC for Koompahtoo LALC	Mal Davis	No response received	Koompahtoo LALC in liquidation

1.5.5 Additional consultation

Additional consultation has been undertaken for this project to meet Aboriginal community expectations. This has involved discussions with the Aboriginal community, letters of invitation to attend a site visit and participation in a site visit, as per table below.

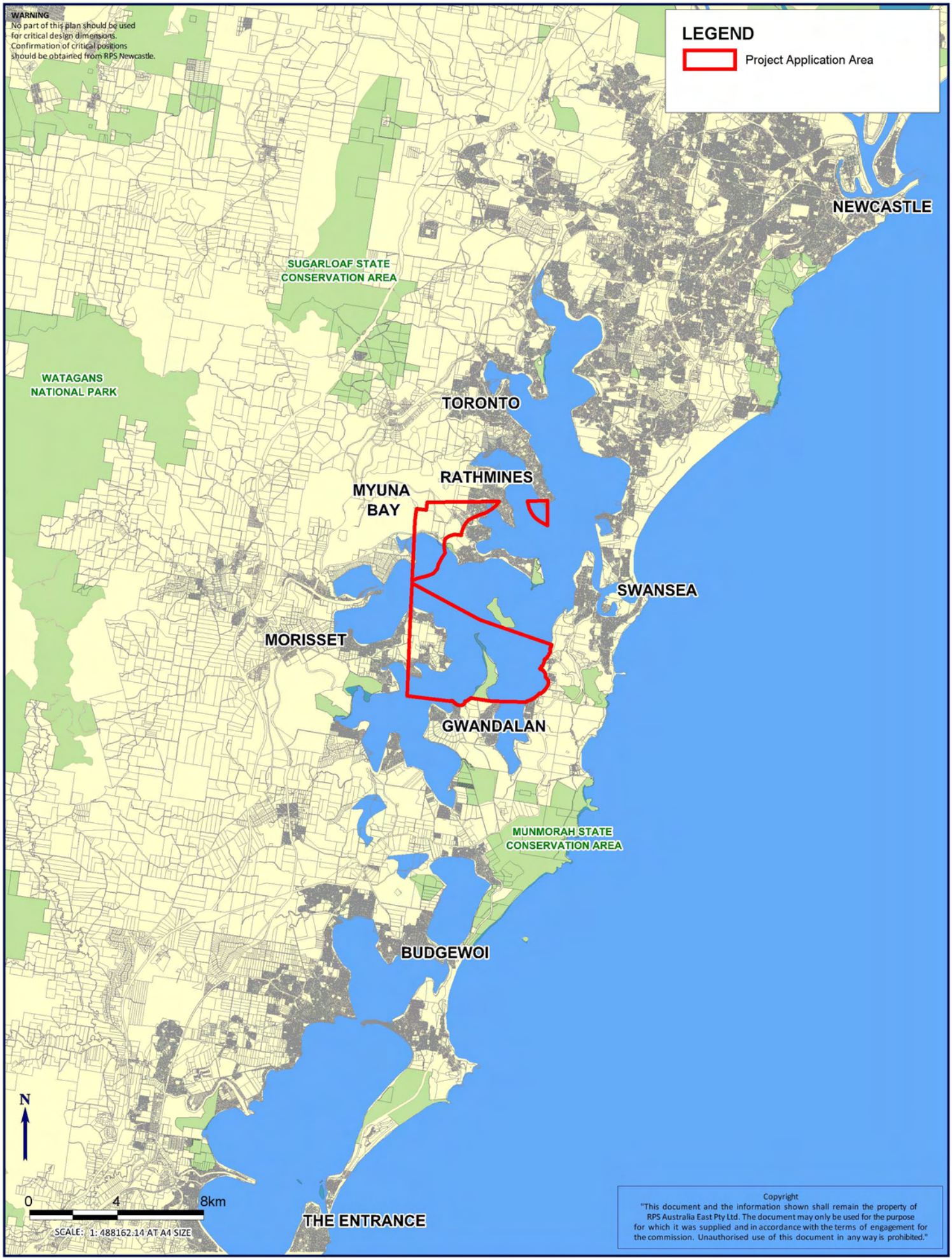
Organisation	Contact	Date	Comment
Awabakal DTOAC	Shane Frost	19 January 2011	Letters sent from Centennial inviting to attend re-survey of Morisset Peninsula for 11 February 2011
Awabakal TOAC	Kerrie Brauer	19 January 2011	Letters sent from Centennial inviting to attend re-survey of Morisset Peninsula for 11 February 2011
West Lakes Aboriginal Community (c/o-Awabakal Local Aboriginal Land Council)	Rob Samson	19 January 2011	Letters sent from Centennial inviting to attend re-survey of Morisset Peninsula for 11 February 2011
Bahtabah Local Aboriginal Land Council	Michael Green	19 January 2011	Letters sent from Centennial inviting to attend re-survey of Morisset Peninsula for 11 February 2011
Awabakal DTOAC	Shane Frost	11 February 2011	Shane Frost attended survey of the Morisset peninsula and indicated he was satisfied with the outcome of the survey

1.5.6 Limitations

The desk top review was limited to all available heritage documents relating to the Project Application Area. The pedestrian based survey covered all landform types occurring in the Project Application Area with existing tracks providing good visibility. Away from these tracks visibility was nil to low with dense ground cover and leaf litter limiting ground surface visibility.

1.6 Authorship and Acknowledgements

This report was written by Laraine Nelson, Senior Archaeologist and reviewed by Tessa Boer-Mah, Senior Archaeologist and Darrell Rigby, Archaeology Manager.



TITLE: FIGURE 1-1 SITE LOCATION | LOCATION: MYUNA | DATUM: DATUM | PROJECTION: MGA ZONE 56 (GDA 94) | DATE: 1/6/2010 | PURPOSE: REPORT FIGURE | LAYOUT REF: | VERSION (PLAN BY): A-A4 (S.C)

CLIENT: CENTENNIAL COAL
JOB REF: PR 103000

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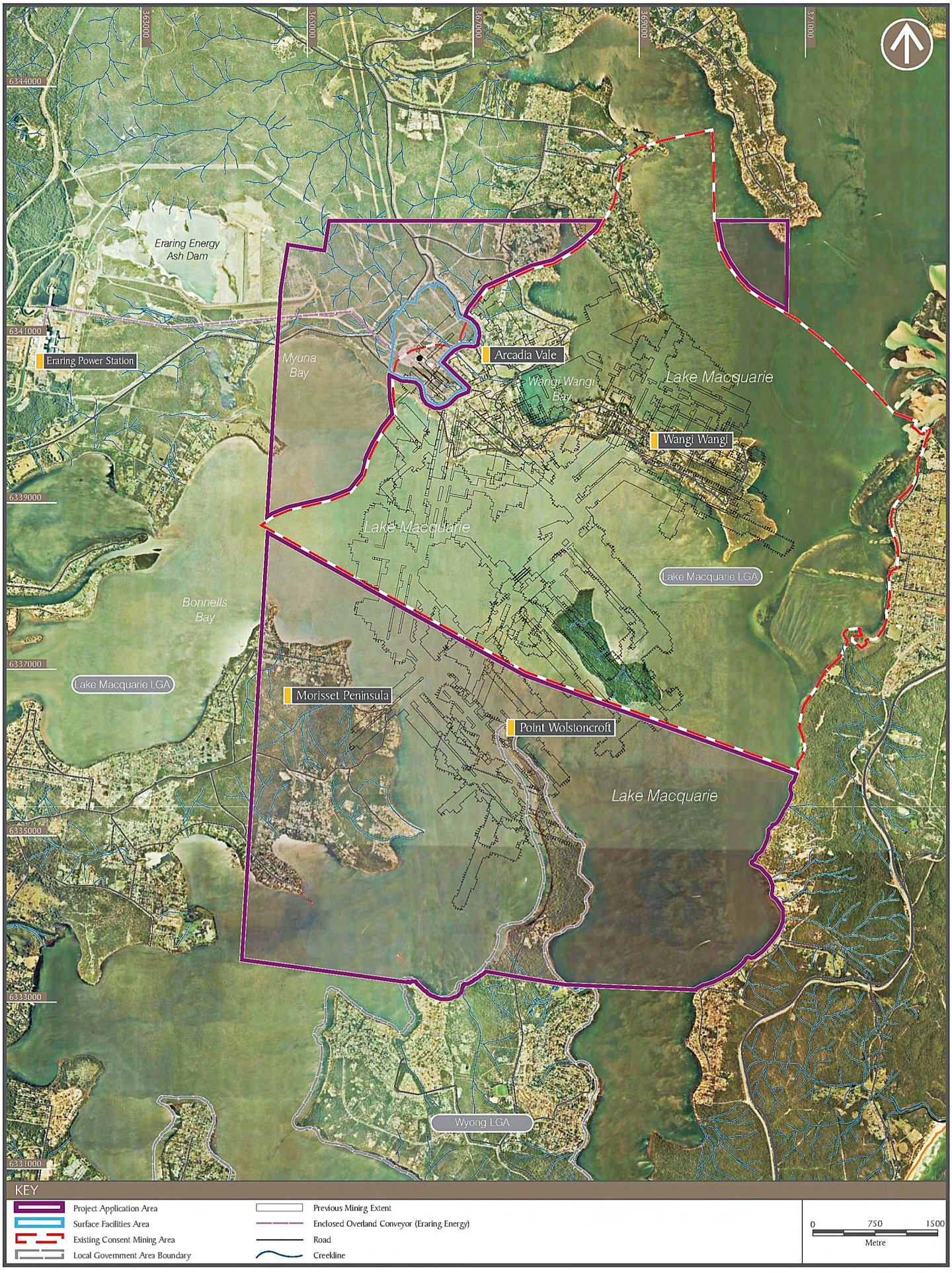


AECOM

PROJECT APPLICATION AREA

AECOM

PROPOSED SUBSIDENCE ZONES

2 Environmental Context

The environmental context section of the report describes data relevant to the Project Application Area and to broader areas. Environmental factors included are geology, climatic conditions, topography and hydrology, and the likely availability of flora and fauna resources. This information is assessed and used to predict what the environment was like in the past. Interactions between people and their specific surroundings are important in considering both the initial formation of the archaeological record and its preservation.

2.1 Geology and Soils

Myuna Colliery is located toward the northern extent of the Sydney Basin. Coal deposits within the Project Application Area belong to the late Permian Age Newcastle Coal Measures. The coal measures comprise a number of seams including the Wallarah Seam at the top of the Newcastle Coal Measures and the Borehole/West Borehole Seam at the base, all other seams of the Newcastle Coal Measures are represented either individually, coalesced with other seams, or split and deteriorated. Underlying the Borehole/West Borehole Seam is the Waratah Sandstone and then the upper sediments of the Tomago Coal Measures (Preliminary Environmental Assessment, AECOM 2010:18).

The Project Application Area comprises the Awaba, Doyalson and Wyong Soil landscapes. Awaba and Doyalson are erosional landscapes while Wyong comprises poorly drained deltaic floodplains and alluvial flats.

The Awaba soil landscape is associated with the Narrabeen Group – Munmorah Conglomerate Formation and the Newcastle Coal Measures. Rock outcrops are usually absent and lenses of mudstone and tuff may occur (Murphy 1993:46).

The Doyalson soil landscape is part of the Narrabeen Group – Clifton Subgroup – Munmorah Conglomerate Formation. Like Awaba rock outcrops are usually absent lenses of mudstone and siltstone may occur (Murphy 1993:48).

In contrast Wyong, on Quaternary sediments, is situated on poorly drained floodplains with low slope. Low lying slightly elevated terraces are sometimes present. This soil type is commonly associated with drainage lines on the lake edge (Murphy 1991:81).

The Munmorah conglomerates comprise siltstone, claystone and some coarse quartz sandstone (Murphy 1991:46/49) these eroding conglomerates may produce pebbles of knapping material suitable for use in stone artefact manufacture.

The soil landscape is detailed in Table 2.1.

Table 2-1: Soil types

	Awaba	Doyalson	Wyong
Colour	Range from Brownish black to light grey	Range from Brownish black to light grey	Range from Brownish black to yellowish Brown
Landform element	Low hills	Low Hills	Alluvial
Structure	Hard setting	Hard setting	Waterlogged
pH level	High	High	High
Permeability	High	High	Low
Erosion	High	High	Low
Fertility	Low – Very low	Low – Very low	Low

2.2 Topography and Hydrology

The Awaba soil landscapes comprise rolling hills and closely spaced drainage lines. The gradients are generally between 10%-25% with relief between 20 metres to 80 metres. Steep slopes on conglomerate soils tend to gravely (Murphy 1993:46).

The Doyalson soil landscape comprise gently undulating rises (to 30 metres) with broad crests, ridges and long gently inclined slopes (<10%). Drainage lines are broad (Murphy 1993:48).

The Wyong soil landscape has low slope gradients (<3%) with relief of less than 10 metres. The Wyong soil type, an alluvial landscape is characterised by drainage lines (Murphy 1991:81).

The topography and hydrology suggest that sections of the Project Application Area would provide a favourable environment to past Aboriginal occupation with freshwater available from creeks and a diverse local habitat providing a variety of food and other natural resources.

2.3 Estuarine Lake Macquarie

Lake Macquarie is one of the largest salt water lakes in Australia providing important food resources. The lake is an estuary with an opening to the sea at Swansea to the north east of the Project Application Area. The lake is the second largest estuarine fish producer in NSW (430 tonnes per year) and an important source of crustaceans and molluscs (Department of Natural Resources 2010).

2.4 Climate

Approximately 18,000 years ago climatic conditions began to change affecting the movement and behaviour of past human populations in their environments. During this time, notably at the start of the Holocene (approximately 12,000 years ago), the melting of the ice sheets in the Northern Hemisphere and Antarctica caused the sea levels to rise, with a corresponding increase in rainfall and temperature. The change in climatic conditions reached its peak about 6,000 years ago (Short, 2000:19-21). Up until 1,500 years ago, temperatures decreased slightly and then stabilised about 1,000 years ago, which is similar to the temperature currently experienced. Consequently, the climate in the locality of the Project Application Area for the past 1,000 years would be much the same as present day providing a year round habitable environment.

The climatic conditions will impact upon the soils, vegetation and the potential occupation of an area. They may also affect the durability of associated cultural materials. The area has a warm temperate to sub humid climate which is dominated by high and low pressure systems in accordance with coastal environments. In the summer months the area will experience onshore winds with hot and humid weather. In the winter months the offshore winds will produce cool to mild and drier weather). Average temperatures throughout the year can range between a minimum of 4.2 degrees in July and maximum 30.2 degrees Celsius in January. Summer and autumn seasons are the wettest and produce an average rainfall of 88mm in February and a minimum of 40.3mm in August (Australian Bureau of Meteorology, 2010).

These regional temperatures would be suitable for occupation for the majority of the year, with appropriate shelter required during the cool and wet periods.

2.5 Flora and Fauna

A flora and fauna assessment of the Project Application Area (RPS HSO 2010) identified vegetation communities based on Lower Hunter Central Coast Regional Environment Management Strategy (House 2003). They are:

- Narrabeen foreshore Red gum-Ironbark forest (Point Wolstoncroft).
- Narrabeen Wallarah sheltered grassy forest (Point Wolstoncroft).
- Coastal plains scribbly gum woodland (Morisset Peninsula, Myuna Bay, Buttaba Hills)
- Coastal plains smooth barked apple woodland (Morisset Peninsula, Myuna Bay, Buttaba Hills)

Fauna known to potentially inhabit those vegetation communities included koala, possum, wallaby, flying fox, quoll, snakes and a wide variety of birds.

2.6 Condition of the Project Application Area

The Project Application Area can be broadly grouped into three categories:

- Residential areas where previous impacts from urban development has lessened potential for the presence of intact Aboriginal cultural heritage sites and to a lesser extent European cultural heritage sites.
- State recreation areas, nature reserves and foreshore parks where there has been minimal development and therefore have a greater potential for intact Aboriginal cultural heritage sites to occur. It is possible that European cultural heritage sites, particularly archaeological sites, may also occur in these areas.
- Lake Macquarie

2.7 Discussion

The Project Application Area incorporates a range of natural, aquatic and built environments with varying degrees of disturbance. With regard to the potential for Aboriginal and European occupation it is considered the area may have provided a favoured environment with a wide variety of resources and fresh water available from creeks.

The geology and soil mapping indicate conglomerate formations occur with potential for lenses of mudstone and tuff, important sources of stone for the production of artefacts. Rocky outcrops are absent; however, conglomerate boulders may occur on lower slopes and benches and such boulders may have been utilised by Aboriginal people for raw materials. Large boulders with eroded faces may also have provided shelter.

The flat areas and gentle slopes of the area would have provided ready areas for camping while fresh water, a critical resource, is available across the area in drainage lines and creeks providing intermittent and permanent fresh water in a number of locations.

The flora and fauna of the Project Application Area suggests a wide variety of both terrestrial and aquatic species available as potential resources. Lake Macquarie was an important source of food with shellfish and fish abundant (Threlkeld in Gunson 1974 :54-56). Plants and animals would have provided resources for the production of weapons, utensils and shelter in addition to the provision of food.

The environmental context suggests that the Project Application Area would have been an ideal location for Aboriginal occupation. Following the European occupation of Lake Macquarie area, this environment would have provided timber and land resources, as well as, fishing grounds.

3 Aboriginal Prehistory

Archaeological evidence for the chronology of Aboriginal occupation of the Lake Macquarie area has been obtained from the dating of occupation and midden sites. An excavation at Swansea Heads, near the entrance to Lake Macquarie (approximately six kilometres north east from the Project Application Area); provided evidence for Aboriginal occupation dating back to 8,000 years ago (Dyall and Bentley 1975). Archaeological excavations at Pinny Beach, approximately six kilometres east of the Project Application Area, have provided evidence of Aboriginal occupation dating to 1,200±60 years BP (Donlon 1992:6). Other sites in the region have also provided material which has been dated including; Ettalong (1740±80 years BP) approximately 50 kilometres to the south (Donlon 1992:6) and Newcastle Bight (2584±45 years BP) located approximately 65 kilometres to the north-east (ERM 2005:56).

The ecological diversity of the Lake Macquarie environment would have provided rich food resources. The environmental range includes dry sclerophyll forests, freshwater creeks, the wetlands and lacustrine environment of Lake Macquarie. The lake, freshwater creeks and lagoons provide a resource rich environment with a range of water birds, fish, shellfish, terrestrial animals and plant species (Haglund 1986:7). Extensive shell middens around the lake foreshore attest to the regular occupation of the local landscape by Aboriginal people.

3.1 Early Evidence of Aboriginal Occupation

It is important to acknowledge that early historical documents were produced for a number of reasons and thus may contain inaccuracies and/or bias in their reporting of events or other aspects of Aboriginal culture (L'Oste-Brown et al 1998). Nonetheless, some historical documents provide important information and insights into local Aboriginal customs and material culture at the time of non-Indigenous settlement and occupation of region.

Henry Dangar (1828:95-96) when surveying the Lake Macquarie region commented on the abundance of wildlife including ducks, kangaroos, swans, pigeons, quails, as well as, fish and oysters and that the area would suit a gentleman fond of shooting, hunting and fishing.

Reverend Lancelot Threlkeld established a mission for Aboriginal people first at Belmont (1824) on the eastern shores of Lake Macquarie and later at Toronto on the western shore. Threlkeld recorded in detail the daily life of the Awabakal people. In detailing their resource gathering strategies he observed that the lake provided an abundance of fish and that Aboriginal people used canoes to exploit estuarine resources. Threlkeld also accompanied them on hunting expeditions and noted their adeptness in using spears (Threlkeld in Gunson 1974:190).

Cooksey (1926a) surveyed the river and coastal area south from the Hunter River (twenty five kilometres north east of the Project Application Area) to the entrance of Lake Macquarie (eight kilometres east of the Project Application Area) recording what he termed as sites and factories of stone tools at the areas now known as Bar Beach, Dudley, Redhead Lagoon, and Swansea Heads. In a later paper Cooksey (1926b) describes the factories or campsites as containing:

"heaps of burnt stones, all that is left of rough fireplaces and occasionally large pieces of sandstone are met with that appeared to have been used as anvil blocks. A few highly coloured small pebbles and pieces of crystalline quartz that may have been used by the medicine men to work magic. Animal remains are represented by a few bones of birds and marsupials, the shells of many sorts of saltwater fish and one small piece of bone that formed the gorge of a native fish hook. The only other relics worth mentioning are pieces of yellow and red oxide of iron ready for grinding into colouring matter".

3.1.1 Implements for Gathering Food and Weapons

The toolkit of the Awabakal included a diverse range of implements with high frequencies of flaked stone artefacts recorded by Dyall (1972: 168-175) during survey work in the Dudley - Jewells Swamp area on the north eastern side of Lake Macquarie. Stone such as chert, silcrete, mudstone, and similar, was used to fashion implements such as knives, scrapers, hatchet heads and choppers.

Turner and Blyton (1995:19) described the resources utilised. Wooden implements included a variety of spears and woomeras (spear throwers). Nullah nullah (hard wooden clubs) were used with bark shields part of the armoury. Hatchet handles were fashioned from wood with the gum of the Xanthorrhea and fibre used to secure the stone hatchet head to the handle. Coolamon or bowls for carrying water were made from wood or sheets of stringy bark. Bone needles were used for fashioning garments and stone and shell scrapers used for processing skins. Fishing lines using fibre and hooks fashioned from Turban shell were used.

3.1.2 Food and Useful Plants

Miller (1886:352) listed kangaroos, emus and reptiles as sources of protein with a variety of roots most importantly that of the water lily roasted and eaten. Fawcett (1898:152) included wallabies, bandicoots, kangaroo rats, opossums, rats, snakes, lizards, fish, shellfish, caterpillars, grubs, larvae of wasps, other insects and birds.

Sokoloff (1991:11) describes the forest resources available at an area of Lake Macquarie to the north of the current Project Application Area with game such as kangaroo, wallaby, bandicoot and possum. Birds including emus, pigeons and ducks were targeted and reptiles were procured as a special food whose consumption was restricted to Aboriginal elders. Plant varieties used included fern, orchid and lily tubers, macrozamia, and the gigantic lily. Freshwater creeks and lagoons provided a resource rich environment with a range of water birds, fish, shellfish and plant species.

3.1.3 Campsites and Shelters

Fawcett's (1898:152) described the location and nature of preferred Aboriginal campsites: "*proximity to fresh water was one essential; some food supply a second, whilst a vantage ground in case of attack from an enemy was a third important item".*

While huts were described as primitive with:
"*A couple or three forked sticks, a few straight ones and some sheets of bark, stripped from trees growing nearby, supplied the requisites for the construction of their homes. The forked sticks were thrust into the ground, and the straight ones placed horizontally in the forks. The sheets of bark were then set up against the horizontal pole in a slanting position".*

3.1.4 Clothing

Summer weather and the milder days of autumn and spring required little in the way of protective clothing, winter, however, it was observed that that animal skins were used for both clothing and as blankets (Heath,n.d.:43) Miller (1886:352) describes their dress as being of opossum skin cloaks with a girdle of spun opossum hair next to the skin with their principal ornament a nautilus shell suspended around the neck on a string. Bone needles were used for fashioning garments and stone and shell scrapers used for processing skins (Turner and Blyton 1995: 19).

3.1.5 Discussion

The brief overview above provides background to the Aboriginal occupation of the Lake Macquarie region and in particular the current Project Application Area. A knowledge of the preferred location of campsites and utilisation of resources assists in assessing the potential of an area to have archaeological deposits.

3.2 Aboriginal History after European Contact

The first recorded evidence of Europeans visiting the Lake Macquarie was in 1800. Captain William Reid, master of the vessel Martha mistakenly entered the mouth of the Lake's channel assuming it to be the mouth of the Hunter River (Clouten 1967:10).

In 1801 again the Lake entrance was confused with that of the Hunter River when the vessel the Lady Nelson with Lieutenant Colonel William Paterson and his party on board was nearly wrecked while attempting to cross the bar. The surgeon John Harris on venturing ashore was met by a friendly party of Awabakal. These included a native who called himself Budgeree Dick and used the word whaleboat. Budgeree Dick joined the Lady Nelson on its voyage to the Hunter River then disappeared the day after disembarking there. Some days later Budgeree Dick returned with two natives, one who had met Lieutenant Colonel Paterson in Sydney (Turner and Blyton 1995:27).

From the discovery of coal at the Hunter River by Shortland in 1797 until the establishment of a penal colony there in 1804 the area was regularly visited by parties to extract coal and timber. While contact between the Awabakal and the Europeans had

previously occurred it was the establishment of a permanent settlement at Newcastle that drastically changed the way of life for the Awabakal people.

4 European History

The European history of the Lake Macquarie area commenced in 1800 when the ship Martha under the command of William Reid entered the Lake's entrance at present day Swansea (Clouten 1967:10). In the western Lake Macquarie area the first land grant in 1826 was to Lieutenant Simpson. The grant on the southern bank of Dora Creek extended west toward what is now Cooranbong and south toward present day Wyee. Simpson's grant was followed by others. The logging of the area for cedar and other valuable timbers continued as settlers such as Simpson introduced cattle and crops such as wheat. Growth of the area continued with the opening of a trail from Wisemans Ferry via Cooranbong to Wallis Plains in 1831 (Clouten 1967:44-45).

The extraction of timber from the western lake area led to the establishment of the villages of Cooranbong, Dora Creek and Eraring. The timber, where possible, was floated down Dora Creek to the lake where it was loaded on to boats for shipment. The area became renowned as a haunt for bushrangers and cattle thieves who preyed on people using the established tracks to access the Hunter Valley (NSW National Parks and Wildlife Service. 2005:22).

A major market for timber was the railways with a need for sleepers for the rapidly expanding rail network. The completion of the rail line led to a collapse in the demand for rail sleepers that had been a main stay of the logging industry in the area. At the same time the arrival of rail as a mode of transport meant that lake transport became largely redundant (NSW National Parks and Wildlife Service. 2005:23).

The western side of Lake Macquarie remained largely undeveloped relying on fishing and recreational activities in the late nineteenth and early twentieth century. In the mid to late twentieth century the building of power stations and coal mines was paralleled by the growth in residential suburbs (Lake Macquarie City Council 1993:33).

The European history of the area provides a guide to potential historic and archaeological elements to be present in the current Project Application Area.

4.1 European Cultural Heritage

4.1.1 Registered Historic Items

The majority of the Project Application Area lies within the Lake Macquarie Local Government Area (LGA); however, Point Wolstoncroft is within the Wyong Shire LGA.

There are no listings given in the Wyong Shire LEP Schedule 1 *Heritage Items* for Point Wolstoncroft.

A search of the *Lake Macquarie Local Environment Plan Schedule 4 Heritage Items other than of Indigenous and including potential archaeological sites* found no record of heritage

items within the Project Application Area. Although the Wangi Rail line associated with the Wangi Power Station Complex (a heritage listed item, as described below), crosses into the Project Area, it is considered a 'work,' not a 'relic' and therefore is not classed as a heritage item under the *NSW Heritage Act 1977* (Karen Stankwoski, Heritage Officer, pers. comm. 20 January 2010).

There are no heritage items, 'relics' inside the Project Application Area as defined by the *NSW Heritage Act 1977* and no heritage items listed in the Lake Macquarie LEP. However, there are heritage items outside the Project Application Area protected under the *NSW Heritage Act 1977* (details below) and Lake Macquarie LEP, as well as three potential heritage items identified which have not been listed in the Lake Macquarie LEP, nor the NSW State Heritage Register.

4.1.2 Potential Historic and Archaeological Elements

There are two heritage items outside the Project Area, but close to the project boundaries:

- Wangi Power Station Complex- Listed on the NSW State Heritage Register. It is located on Wangi Peninsula is adjacent to the current working area of the Myuna Colliery. This item has state heritage significance.
- Threlkheld's Mine (CP-01)- Listed on the Lake Macquarie LEP: Area is site of Threlkeld's original coal mine, established in 1843 at Skye Point and is near the northern extent of the Project Application Area. The coal mine site is at Threlkeld Park on the northern extent of Grant Road, Coal Point. This item has local heritage significance.

Three potential heritage items were identified in the Lake Macquarie Heritage Study (Suters Architects Snell 1993), but have not been registered on the NSW State Heritage Register, nor the Lake Macquarie LEP:

- Wangi Tennis Club, Wangi (#WG–02);
- Bunya Pines, Eraring (#ER-08); and
- Norfolk Pines, Shingle Splitters Point (#BC-01)

None of the above items are at risk from works associated with the proposed project.

5 Aboriginal Archaeological Context

This chapter presents a review of documentary and physical evidence pertaining to Aboriginal archaeology of the region and in particular the Project Application Area. Such information is considered as it provides context and accuracy to predictions made about the potential for archaeological remains within the Project Application Area.

5.1 Aboriginal Heritage Information Management System

A search was undertaken of the DECCW AHIMS for an area encompassed by coordinates Easting 362726 to 374726 and Northing 6331216 to 6343216 (MGA Zone =56). An AHIMS search when requested covers a broader area than the Project Application Area to ensure that an overview of potential sites is obtained.

The AHIMS results indicate that middens (n=77) are the most frequent site type found in the searched area, followed by Artefact Scatters (n=9); Open camp sites (n=5); and scarred tree (n=3).

Table 5-1 provides site type and frequency in the Search Area and Project Application Area.
Figure 5-1 provides the location of the AHIMS sites.

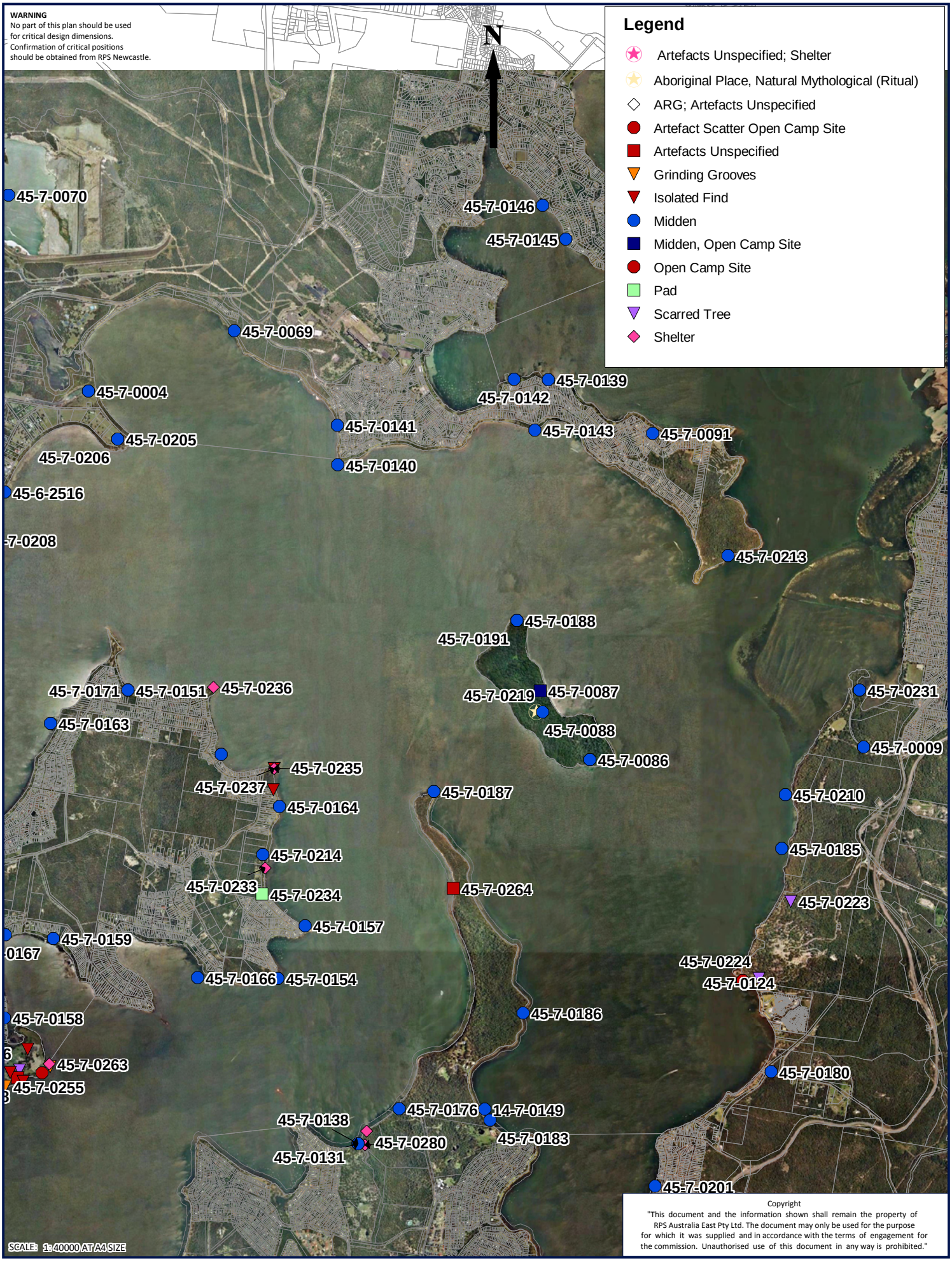
Table 5-1: Summary of AHIMS Results Ordered by Site Types and Frequency

Site Type	Frequency in Search Area	Frequency in Project Application Area
Midden	77	11
Artefact scatter & unspecified	9	-
Open camp sites	5	-
Scarred tree	3	-
Midden/ open camp sites	2	-
Grinding Groove	2	-
Ochre Quarry	1	-
Potential Archaeological Deposit	1	1
Isolated find	1	2
Aboriginal Place, Natural Mythological (Ritual)	1	-
Aboriginal Resource and Gathering	1	-
TOTAL	**103**	**14**

The presence of middens on the AHIMS list far exceeds other site types. The next most common site type is open campsite, this was originally the designation given to artefact

scatters. It is therefore useful to combine these two criteria in the Project Application Area. Combined Open camp site (n=5) and Artefact scatters (n=9) would increase the count to n=14.

A complete list of results from the AHIMS search can be found in Appendix 3.
A glossary of Aboriginal site types can be found in Appendix 4.



TITLE: FIGURE 5-1 LOCATION OF AHIMS

LOCATION: MYUNA

DATUM: DATUM
PROJECTION: AMG ZONE 56 (AGD 84)

DATE: 24/5/2010
PURPOSE: LOCALITY MAP

LAYOUT REF: J:\JOBS\Centennial\All Jobs\PR103000 Myuna\10- Drafting\Fig 5-1 Locality Map with AHIMS
VERSION (PLAN BY): NW (LN)

CLIENT: AECOM
JOB REF: 103000

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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RPS

5.2 Regional Archaeological Context

A number of surveys and reports have been conducted over the central and northern Lake Macquarie area. The following provides an overview of the results of surveys within an approximate ten kilometre radius of the Project Application Area. This information will assist with predictive modelling to assist in identifying potential archaeological sites. It is also important that Aboriginal sites are contextualised within the local and regional landscape, in order to inform the assessment of significance. *Section 5.3 Local Archaeological Context* provides a focus on reports within the immediate vicinity of the Project Application Area.

Insite Heritage. 2005. Archaeology Assessment of various lots bounded by Gradwell and Cooranbong Roads, Dora Creek.
An archaeological investigation was carried out to inform a proposed re-zoning of 30 hectares off Coorumbung Road, Dora Creek. Dora Creek is approximately 4 kilometres from the western boundary of the Project Application Area. The area comprised a spur with drainage lines that lead to Dora Creek approximately 250 metres south. No Aboriginal cultural heritage sites were located during the survey due to a lack of surface visibility. The conclusion drawn from the survey was that there was potential for sub-surface deposits with a recommendation by the report author for sub surface testing in the northern sector of that study area to determine if subsurface archaeological deposits existed.

Roberts, L. 2001. An archaeological survey at Buttaba.
An archaeological survey conducted over an area off Buttaba Hills Road, Buttaba that would be either in or adjacent to the current Project Application Area. The report did not provide enough detail to determine the exact survey location. The survey area included a creek line, slope and ridge line with the area found to have been cleared at an earlier date, vegetation was native re-growth and introduced species. No exposed rock surfaces were present. No Aboriginal cultural heritage sites were identified during the survey.

Officer, K Navin, K and Saunders, P. 1996. Test Excavations at 'The Hole 1' Mannering Bay, Lake Macquarie, NSW.
This study was commissioned by Pacific Power to carry out a subsurface investigation of a previous archaeological site, located at 'The Hole 1, Mannering Bay', approximately five kilometres south of the current Project Application Area.

This investigation comprised a surface survey; a subsurface testing and salvage program; and basic artefact analysis. A total of 137 artefacts were recorded, 95 on the surface while seven of the eight test pits returned 42 artefacts. Based on surface and subsurface artefact density the indication is that the elevated spurline crest, adjacent low lying swampy ground, was the preferred occupation zone with density increasing closer to the shoreline of the lake.

Artefact analysis of the 137 artefacts identified that the rhyolitic volcanic tuff (36%) was commonly used as a raw material followed by acid volcanic rhyolite, igneous rock

(19.5%), chert (13%), quartzite (11.5%), quartz (1%), jasper (1%) and unidentified stone raw materials (1). While a detailed investigation of raw material procurement was not undertaken, it was noted that 12% of the artefacts had alluvial pebble cortex indicating that locally occurring conglomerate cobbles may be a potential raw material source.

Backed blades and microblades, associated with the Small Tool Tradition, were identified. Artefact types included flakes microflakes, blades microblades, backed blades, cores, blade cores, hatchet head, flaked pieces and manuports.

The authors concluded that:

- The key topographic feature of the site was the elevated basal and spurline slope adjacent the shoreline of Mannering Bay and Wyee Creek;
- Artefact manufacture and tool utilisation occurred at the site;
- Raw material was imported probably from local sources;
- Shellfish was not utilised;
- Significant variation in artefact density across the site suggests spatial or temporal differentiation however the small sample precludes definitive analysis; and
- Lithic technology indicates the site was probably occupied in the last 5,000 years.

It was proposed that if the area was used as a base camp, the exploitation of shellfish would be expected. As shell was not present, the author concluded that the site was likely used for temporary camp sites (Officer, Navin and Saunders 1996).

Nelson, L. 1994 – Shell Middens of Lake Macquarie. University of New England
A systematic survey was conducted around the foreshore of Lake Macquarie with sixty-one Aboriginal shell middens located. *Anadara trapezia* sp. were common in the middens, with lesser quantities of *Ostrea angasi* (oyster). The research focussed on identifying environmental factors that could be used in establishing a predictive model for midden site location. It was identified that the larger middens were most likely to be located on the Wyong soil type (see Table 2.1 Soil Types in current report), on Quaternary Alluvium and within three kilometres of a creek line.

Nelson, L and Ruig, J – 1993. Report on an archaeological survey for a proposed retirement village, Bonnells Bay, NSW.
This investigation was conducted at Bonnells Bay for a proposed retirement village complex located an isolated artefact and disturbed midden material. The area is approximately three kilometres south west of the current Project Application Area. The survey area was on a flat slightly elevated above the Lake Macquarie shoreline. A mudstone core was recorded outside the survey area. The banks of Freshwater Creek and Fullers Creek were found to contain shell midden material this appeared to be an extension of a previously recorded midden.

Haglund, L. 1986. Regional Assessment. Lake Macquarie
In 1986 Haglund was commissioned by Lake Macquarie City Council to produce an assessment of the prehistoric heritage of the Lake area. The work of Vinnicombe (1980)

on the land use patterns of the Aboriginal people in the Gosford/ Wyong area to the south of Lake Macquarie was used to provide a general basis for Haglund's assessment. Haglund (1986) discusses the work of Vinnicombe who postulated that Aboriginal people utilised a variety of micro-climates on a seasonal basis. The assumption was that Aboriginal people utilised coastal resources: coast/lakes/swamps in the summer months then moving inland to use terrestrial resources inland forests and deep waterholes in the winter period.

At the local level the published work of Dyall and Bentley (1975), the unpublished field survey work of Hanckel (1985) and the sites recorded by the NSW National Parks and Wildlife Service provided the information for a local assessment for site location. Early ethnographic reports were used to provide further detail.

Haglund concluded that Aboriginal people exploited the resources of the open and rocky coast, as well as, the swamp and hilly hinterland. It was also identified that the coastal strip and swampy margins of the lake were preferred resource areas; the more rugged terrain of the Watagan Mountains, to the west of Lake Macquarie was not commonly used for resource gathering.

5.3 Local Archaeological Context

A number of archaeological surveys and reports have been produced for the Lake Macquarie area. This section details the most relevant investigations to the Project Application Area.

Umwelt. 2009. Draft Sustainable Management of Aboriginal Cultural Heritage in the Lake Macquarie Local Government Area: Lake Macquarie Aboriginal Heritage Management Strategy

The Draft Lake Macquarie Aboriginal Heritage Management Strategy included archaeological sensitivity mapping and was developed over six years by a working group. While providing a comprehensive strategy for managing Aboriginal cultural heritage sites the report is particularly valuable in establishing a concept of *Sensitive Aboriginal Cultural Landscapes.*

The report addresses each landform type within the LGA and identifies potentially sensitive Aboriginal cultural landscapes within that type. The Sensitive Aboriginal Cultural Landscape dominant in the Project Application Area is the Estuarine landscape described as being the Lake Macquarie foreshore extending up to 100 metres landward of the High Water Mark (HWM) and twenty metres from the HWM into the lake and is identified as having Aboriginal cultural significance in terms of resource gathering; but AHIMS data also shows that archaeological evidence for occupation is often identified above the HWM. The area extending beyond 20 metres from the HWM to the lake bed is not identified as a sensitive Aboriginal landscape in the Strategy. Freshwater (Creek Corridor) Landscapes are also identified as having cultural significance for resource gathering and sources of freshwater. In particular, the report identifies the following creeks and their tributaries; Cockle Creek, Slatey Creek, Burkes Creek, Stony Creek and Dora Creek..

Insite Heritage, 2008 – Archaeology Assessment of Part Lot 358 DP755242 Part Lot 9 DP244002 Morisset Park.
This study was conducted to support a rezoning application from Zone 10 Investigation to Zone 2(1) Residential. The site was located at Morisset Park Road, Morisset Park, adjacent the south western boundary of the current Project Application Area.

The soils on the site consist of silty and clayey sands in the Doyalson soil landscape. A pedestrian survey examined the three landscape units, described as a slope between 2-5 degrees (85% of the area); a slope <2 degrees (10% of the area); and elevated terrace crest (5% of the area).

No sites were located during the field survey; however potential for scatter existed within a small area of the site. It was concluded that there was a low to moderate potential for small artefact scatter/s to be concealed under topsoil with a recommendation that the area be designated a PAD.

Besant, A. 2001 - St John of God School Site – Archaeology Assessment.
A series of test probes located two sites at Morisset Peninsula on the lake foreshore, including the St John of God area, adjacent to the south western boundary of the current Project Application Area. A total of eighty-eight artefacts associated with an elevated beach terrace and midden were identified through sub-surface testing. Geometric microliths were identified as well as a knapping floor. It was considered that some artefacts were in situ, while other artefacts, displaying water worn features, appeared to have been re-deposited by wave action. On the basis of the presence of microliths, it was concluded that Aboriginal occupation of the site occurred within the last 5,000 years.

Dallas, Navin and McConchie. 1993. Archaeological Investigation of the Morisset Peninsula Sewerage Scheme.
A survey and selective sub-surface testing to assess the potential impact on Aboriginal cultural heritage sites was undertaken for a proposed sewerage implementation scheme. This investigation covers land which is within the current Project Application Area. The pedestrian and vehicle survey identified twelve sites all recorded as Estuarine Middens containing predominately *Anadara trapezia* (cockle), two sites each contained a single flake. All middens were on elevated benches within 2.5 metres of the high water mark (HWM); some sites were extensive over approximately 600 metres along the foreshore while others were smaller. Some of the middens had been previously disturbed and were in bad condition. It was concluded that the middens were dominated almost exclusively by large *Anadara trapezia:* with larger middens associated with freshwater creeks.

Dyall. 1966-1991. Lake Macquarie Sites. Book 2.
This document is a collection of personal site records complied by Professor Len Dyall. The following sites were within the study area. **Styles Point**: seven artefacts were identified along the lake shore and one observed underwater near an onshore midden. The artefacts identified included an edge ground axe, flakes and scrapers. **Wangi Wangi**: Area 1 comprised a shell midden with cockles and two flaked stone artefacts; Area 2 was

two metres above HWM and included cockles, oysters and approximately 35 flaked stone artefacts. Area 3; a midden, was identified approximately 30 metres above HWM.

Donlon, D. 1991, Archaeological survey of proposed coal receiving facility at Eraring Power Station. Unpublished report to Connell Wagner (NSW) Pty Ltd.
Lands surrounding Eraring Power Station were surveyed (12 hectares) and the investigation was conducted in the vicinity of the current Project Application Area. The Donlon survey area comprised east facing slopes within the Lake Macquarie hinterland which were vegetated by dry sclerophyll forest. A small creek was located at the north-eastern end of the study area. No Aboriginal sites were identified and given the highly disturbed nature of the study area including vehicle tracks, electricity easements and clearing, it was concluded than no in-situ archaeological material was likely to remain.

Dallas, M. 1990, Archaeological survey of the Wangi Power Station site. Unpublished report to Gutteridge Haskins and Davey Pty Ltd.
A 166 hectare area was surveyed and is within the current Project Application Area. It comprised the lake foreshore and adjoining hinterland, between Wangi Bay and Myuna Bay. One degraded shell midden containing two waste flakes was recorded near Myuna Bay. This midden was highly disturbed and was assessed as having low scientific significance.

5.3.1 Literature Review Discussion

The literature review provides a background to archaeological investigations within the area, identifies site types and establishes a model for Aboriginal land usage within the area.

Haglund's (1986) report considered that the Awabakal people of Lake Macquarie led a nomadic existence moving between different resource zones in different seasons. This is supported by Dyall who considered that Aborigines exploited the resources of open and rocky coasts as well as swamps and hinterlands, however, the emphasis for occupation appeared to be on the narrow coastal strip and swamps (Dyall in Haglund 1986:34).

In terms of site type, the most commonly occurring type associated with Lake Macquarie are middens. It is the presence of numerous middens on the lake foreshore that has resulted in Lake Macquarie Aboriginal Heritage Management Strategy (2009) regarding most of the lake foreshore area as sensitive. This confirms the AHIMS data with middens the most commonly occurring site type across both the AHIMS search area and Project Application Area. The ethnographic evidence (*3.1 Aboriginal Prehistory)* supports the archaeological record with documentary evidence of the Aboriginal peoples' reliance on shellfish as a consistent and plentiful resource. The Strategy also identified Freshwater (Creek Corridor) Landscapes comprising creek corridors with reliable fresh water and abundant resources as sensitive. While creek corridors are within the Project Application Area they are generally small, often ephemeral and when close to the lake foreshores are not fresh but saline.

Whilst the results of surveys have provided useful indicators of site location, excavations carried out: (Besant, 2001; Officer, Navin & Saunders, 1996; Dallas, Navin & McConchie 1993) have provided significantly more information on site location and complexity. These reports found that artefact deposits, including midden shell are often found on elevated terraces adjacent the lake shoreline and as well as occurring near freshwater creeks. Excavations have indicated that subsurface site contents are more diverse than surface assemblages (Besant, 2001; Officer, Navin & Saunders, 1996).

The literature review indicates that middens will likely occur in elevated areas in close proximity of the Lake foreshore and creeks and that these middens may contain deep subsurface archaeological deposits.

6 Predictive Model

A predictive model is created to form an estimate of the potential for an archaeological site to occur. It involves reviewing existing literature and consulting site databases to determine basic patterns of site distribution and correlating this distribution with the associated environment. The use of land systems and environmental factors in predictive modelling is based upon the assumption that these factors provided constraints that influenced land use patterns by past populations resulting in differing spatial distributions of various site types in the archaeological record. Predictive models can be used as a basis for the planning and management of Aboriginal heritage, and for formulating survey strategies to include areas of maximum archaeological potential.

The summary of environmental data (Section 2) and previous archaeological studies (Section 5) was used to create a predictive model for sites in the Project Application Area.

6.1 Predictive Model for Aboriginal Archaeology in the Project Application Area

6.1.1 Site Types and Location

The Lake Macquarie Aboriginal Heritage Management Strategy (2009) has mapped culturally sensitive landscapes by identifying terrain and associated site types. Appendix 4 of that report lists Terrain Units, Predicted Site Types linked to the likelihood of sites occurring and the likely site condition. This provides a useful but very general overview of the potential for sites to occur in any given area. For the Project Application Area the most likely sites are middens on the lake foreshore and to a lesser extent stone artefact/s and rarely scarred trees. In identifying foreshore lands as a Sensitive Aboriginal Cultural Landscape they were described as including a maximum of 100 metres landward of the mean high water in general, however, it was considered that foreshore lands were less than 50 metres wide and extend up to 20 metres into the lake. Mid slopes and upper slopes have the potential for ceremonial sites, scared trees and artefact scatters to occur, while ridgelines and crests may contain artefact scatters, scarred trees and rock shelters with deposit. Creek beds and banks may contain artefact scatters, grinding grooves and scarred trees. For all landform types the following are considered to be rare, or unlikely to occur: scarred trees; rock shelters with deposit; and ceremonial sites.

In assessing the current Project Application Area the most likely site type to occur are middens. Middens may contain other cultural material such as hearths, artefacts, etc. Middens are closely associated with the lake foreshore and occur often on low terraces above the fore shore. It is considered that midden size is closely related to the availability of fresh water.

Open camp sites and artefact scatters are often considered to reflect persistent use of a place with the finding of more than one artefact. These site types can occur across a range of landform types though generally there are sources of fresh water within close proximity. Areas with nil to low slope are preferred for campsites.

Scarred or modified trees may be found where single or stands of mature trees occur. In terms of maturity potentially modified trees would date from the 19th century or pre-19th century (Long 2003:31).

Grinding grooves are most often associated with flat beds of sandstone in association with water, either permanent of ephemeral. The fine grained sandstone is required for the grinding process together with the use of water for lubrication.

Isolated artefacts or finds may be found anywhere within the environment as they are considered the result of intentional or accidental discard.

6.1.2 Site Aspect

The sites recorded on AHIMS have a range of aspects. Bluffs, ridgelines and crests may provide good viewpoints over Lake Macquarie. While sheltered valleys and bays with certain aspects may provide shelter against prevailing north-easterly, westerly and southerly winds.

6.1.3 Slope

The majority of the Project Application Area according to soil landscape data comprises flat areas and low slopes. These land surfaces have greater potential for sites to occur while the steep slopes are considered to have low to nil potential.

6.1.4 Distance from Water

The requirement for fresh drinking water would increase the likelihood of sites within the vicinity of creeks and drainage lines. Freshwater from a permanent source would be required for campsites while water from a semi-permanent supply would be most likely adequate, if available, during ceremonial occasions.

6.1.5 Food

The Project Application Area is in close proximity to complex environmental and therefore food resources. The area would have provided a range of forest-based and lacustrine resources together with freshwater resources from minor creeks.

6.1.6 Summary

In the Project Application Area there is the potential for a range of Aboriginal cultural heritage sites to occur.

The presence of fresh water increases the potential for sites to be located particularly artefact scatters. In close proximity to the lake foreshore middens are the most likely site type to be identified. Isolated artefacts, a result of accidental loss or discard, may be found anywhere in the landscape. Modified trees may also be considered a random occurrence and can be located anywhere mature trees may remain.

Table 6-1: Discussion of Potential Sites

Site Type/ Location	Comments
Midden	This site type will be found in close proximity to the lake foreshore.
Scarred or modified trees	This site type will only occur in sections of vegetation that have not been subject to clearing, and where vegetation is of sufficient age. It is possible that this site type may occur across the Project Application Area.
Rock shelters	There are no records for rock shelters within the Project Application Area however sites have been recorded to the south of the Area.
Grinding Grooves	Grinding grooves may occur where smooth, fine grained outcropping rock is found in association with a reliable, or permanent water source. If such surfaces are located in the Project Application Area together with suitable raw material, it is possible that this site type may occur.
Stone tools	Stone tools are the most common site to be recorded in Australia and in the broader regional context. Artefact scatters are typically small in number when situated more than 100 metres from a reliable water source. Sites numbers and density are more likely to increase within 100 metres of fresh water sources.
Isolated Finds	Isolated finds are found across any landform unit. Isolated finds reflect a transitory use of the land. It is possible that this site type may occur in the Project Application Area.
Site Size/ Frequency	The Project Application Area is located in a variable landscape. A range of sites have been recorded within the Project Application Area and there is potential for more of the same type and frequency to occur.
Preservation	The proposed Project may cause minimal disturbance if any to recorded and potential sites. Those sites considered as a potential risk are rock shelves where grinding grooves may occur, rock shelters if present and eroding cliffs that have incorporated midden material.

6.2 Predictive Model for European heritage in the Project Application Area

The results of database searches of the NSW Heritage Office, the Lake Macquarie City Council LEP Schedule 4 (Section 4.1.1), the City of Lake Macquarie Heritage Study and additional historical research provide a concept of the types of sites and activities that may have been conducted in the subject area.

The most likely European heritage site types to occur are associated with:

Farming – farms existed in many parts of Lake Macquarie.

Timber extraction – the logging of forests within the region was a significant early industry with the potential for relics of that industry to remain.

Coal mining – small mines operated in the lake area in the nineteenth and twentieth century and there may be remnants existing. Lancelot Threlkeld's 1841 coal mine is just west of the northern extent of the Project Application Area.

Habitation – Houses relating to early settlement of the Lake area may occur. Simple holiday houses, fishing shacks, etc may still occur around the lake foreshore. Mature trees associated with early settlement may also occur.

Power Generation - Wangi Power Station a redundant 1950's electricity generation site is adjacent to the Myuna Colliery Surface Facilities Area, outside the Project Application Area.

7 Field Survey

7.1 Field Survey

The methodology chosen was to survey accessible landform types across the separate and distinct sections of the Project Application Area. The survey conducted by Laraine Nelson, Senior Archaeologist of RPS, Shane Frost of ADTOAC and Kerrie Brauer of ATOAC investigated the major areas and their significant landform features. On Tuesday 22 June 2010 the Myuna Bay foreshore, Buttaba Hills and Eraring Bay foreshore area was surveyed with the Point Wolstoncroft and Morisset peninsula surveyed on Thursday 24 June 2010. Further survey work was conducted at Morisset Peninsula on Friday 11 February 2011 and was attend by Shane Frost, however, on this day Kerrie Brauer was unable to attend.

On Monday 28 June 2010 the area proposed for the clean water diversion works within the Myuna Colliery Surface Facilities Area was surveyed. This area was investigated by Laraine Nelson accompanied by Catherine Whatson, Environmental Officer, CMPL.

The landforms of the Project Application Area can be separated into two distinct types, those bounded by Lake Macquarie (Myuna Bay, Eraring Bay, Point Wolstoncroft) and those areas not immediately bounded by the Lake (Buttaba Hills, Morisset Peninsula). The dominant landform types of the Project Application Area are:

- lake foreshore;
- ridgelines
- low hills; and
- small valleys

In addition the Project Application Area has a number of creeks and drainage lines that lead from the hills to the lake.

Figure 7-1 provides a description of survey units in the Project Application Area.
Figure 7-2 and Figure 7-3 shows the area proposed for the clean water diversion works.
Table 7-1 is an Effective Coverage Table.

Note: During the survey two areas considered to be culturally sensitive by the registered Aboriginal stakeholders were identified. Shane Frost (ADTOAC) and Kerrie Brauer (ATOAC) requested that the information on these sites be restricted. The information on these sites has been restricted to Addendum 1 and 2. Persons, other than DECCW, DoP, CMPL, AECOM and RPS who wish to view that information must first gain permission from the principals of ADTOAC and ATOAC.

7.2 Survey Units

The survey area is presented as a number of separate and distinct locations. These locations have been adopted as the survey units. They are: Myuna Bay foreshore and Eraring Bay foreshore; Buttaba Hills; Point Wolstoncroft; and Morisset Peninsula.

7.2.1 Survey Unit 1 –Myuna Bay foreshore and Eraring Bay foreshore

Myuna Bay foreshore

The survey commenced on 22 June 2010 at the Myuna Bay foreshore park. This survey unit incorporates the northern section of the Myuna Bay foreshore park extending east toward Wangi Peninsula.

The western portion of the survey area commenced at the established and well used Myuna Bay foreshore park. The park area next to the lake foreshore is grassed with a tarred car parking area adjacent the road. An area of fragmented *Anadara trapezia* (cockle shell) was noted in a disturbed area near rubbish bins. The shell was patchy in coverage and occurred in a highly disturbed area. It was not recorded as a midden. The team then walked in an easterly direction around the foreshore. The landform comprised a low lying and flat area immediately adjacent the lake edge rising sharply to a terrace approximately four to five metres high. This terrace ran parallel to the shoreline for the majority of the Project Application Area. Surface visibility across the entire survey unit was poor with dense grasses, native and introduced shrubs including dense stands of lantana and bitou bush (Plate 1). An open forest covers the terrace.

Fragments of *Anadara trapezia* and *Ostrea angasi* (drift oyster) were seen in disturbed areas but none were in a quantity or context that could be identified as midden material.

Rocky outcrops limited the extent of the foreshore survey. The team then returned to the Myuna Bay foreshore park and walked again east along the ridgeline described earlier. A narrow walking path provided access and some visibility. Approximately 100 metres along this track from the car park a concentration of *Anadara trapezia* was present. Extending for around 20 metres it varied from a scatter to a cluster of shell. This was recorded as RPS Myuna Bay 1 (Plate 1). Away from the track visibility was poor with dense ground cover.

Trees of sufficient size were investigated for potential cultural scars with none observed. Dense vegetation and the end of the track led to the pedestrian survey being stopped at the track junction with Eucalypt Avenue. At the end of the day Eucalypt Drive was driven along to investigate the potential for survey access. A few small foot tracks were noted.

Eraring Bay foreshore

A small public foreshore park at Eraring Bay was investigated with no sites observed. The perimeter of a known fresh waterhole near Eraring Bay was also walked; this area was covered in dense vegetation with no sites observed (Plate 3).

7.2.2 Survey Unit 2 – Buttaba Hills

This survey unit is at the nearest point approximately one kilometre from Lake Macquarie. The unit comprises rolling hills with a number of drainage lines leading to Wangi Creek. The area reflects the Awaba soil landscape type (Section 2.1) with poor soils and few rock outcrops.

The team conducted a pedestrian survey utilising four wheel drive tracks and clearings for power lines. Overall visibility on the tracks was good (Plate 4) however in some areas introduced gravels had been used to stabilise the tracks and this impeded visibility. Away from the tracks there was some surface visibility in eroded areas however in general visibility was nil with dense undergrowth, open and closed forest canopies.

The rail bed and some remains of the rail line of the Wangi Power Station coal supply rail line were noted. The majority of the line has been removed with the most significant item noted being the rail bed and culverts (Plate 5 & Plate 6).

Wangi Creek comprised a low lying swampy area and was largely inaccessible (Plate 7). The only area the creek could be accessed from was where vegetation had been cleared for a power line easement. This area was investigated carefully for any evidence of artefacts with none observed. There were no rock outcrops seen associated with the creek.

A high ridgeline and slope adjacent and west of Wangi Road was surveyed by foot (Plate 8). This area had good surface visibility on a track approximately two metres wide.

A rock outcrop or ledge approximately 330 metres long was observed near the high ridgeline. No rock shelters were observed in this rock ledge. A small stream of water led across the rock shelf to the valley below. The area was inspected for grinding grooves with none observed. While no Aboriginal cultural heritage material was observed in this area the community team members present considered that the area was significant and sensitive. In accordance with their wishes a description of the area together with plates can be found at Addendum A. Addendum A is submitted as part of this report for the information of the proponent, DECCW and DoP. The Addendum should not be made available to any other party without prior permission of the principals ADTOAC and ATOAC.

7.2.3 Survey Unit 3– Point Wolstoncroft

The survey of Point Wolstoncroft was conducted on 24 June 2010. Access was through a NPWS gate and along a fire trail that runs north south along the central ridgeline of the Point. The track provided good visibility though off track dense undergrowth provided minimal to nil visibility. A number of small walking tracks led from the fire trail to the lake foreshore. These were walked, one track to the eastern foreshore, approximately 500 metres from the NPWS gate, led to a waterhole adjacent to the lake shore, it was not determined if the water was fresh, brackish or salt (Plate 9). To the immediate south of this waterhole and approximately 3-4 metres from the lake foreshore a quantity of *Anadara trapezia* was observed in areas of disturbed earth (Plate 10). This was

previously recorded as a midden (Point Wolstoncroft 1 # 45-7-0186). The area was covered in dense understorey including lantana and bitou bush making it difficult to accurately identify the extent of the cultural deposit. As an approximation it is considered the midden covered an area 120 metres running parallel to the lake shore and 15-20 metres landward. No artefacts were seen.

A short section of the lake foreshore was walked in this area with no further Aboriginal cultural heritage material observed (Plate 11).

The team returned to the fire trail and continued walking north. While fragments of *Anadara trapezia* were observed on the track they were not in sufficient quantities to be recorded as a midden. In a number of areas the team tried to gain access to the western shoreline however a steep cliff prevented access (Plate 12).

Continuing along the track and approximately two kilometres from the NPWS entrance gate the quantities of shell increased in density and occurrence. Clusters of shell occurred on the track, in disturbed areas and around the base of trees, it was considered that the quantity justified recording the area as a midden. The pattern of shell occurrence (midden) continued from here up to northern extremity of the point a distance of approximately one kilometre. The shell was also seen eroding out of the cliff face on the western foreshore (Plate 13). Two artefacts were recorded close to the northern extent of Point Wolstoncroft (Plate 14 & Plate 15). As this area has been previously recorded (Point Wolstoncroft 2 AHIMS # 45-7-0187) an alteration to AHIMS to include those artefacts will be forwarded to DECCW.

Within this area a number of significant and potentially significant Aboriginal cultural heritage items and associated landforms were observed and recorded. The community considered this was a culturally sensitive area.

In accordance with their wishes this is recorded as culturally sensitive information with a description of the area together with plates at Addendum B. Addendum B is submitted as part of this report for the information of the proponent, DECCW and DoP. The Addendum should not be made available to any other party without prior permission of the principals of ADTOAC and ATOAC.

7.2.4 Survey Unit 4 – Morisset Peninsula

A fire trail that leads along a central ridgeline was walked late on the afternoon 24 June 2010. The trail was eroding in some area to the clay subsoil and sandstone bed (Plate 16). Numerous small pebbles typical of the lake area were observed with no Aboriginal stone artefacts noted. Mature trees were investigated for scarring with one tree, a *Eucalyptus tetrodonta* (Stringybark) found to be culturally modified (Plate 17). The tree is in poor condition having suffered from a lightning strike.

On 11 February 2011 further survey work was conducted at Morisset peninsula with a number of fire trails and walking trails investigated in the central peninsula area. The landscape was seen to consist of moderately steep slopes and narrow drainage lines. Sandstone outcrops were investigated with none suited for grinding grooves or rock

shelters noted. One tree, *Angophora* species was noted as having a series of healed scars along the trunk at regular intervals. These scars appeared to be healed notches. A disused tree house was in the tree and a number of nails had been driven in to the tree, however, the growth over the notches would appear to indicate that they pre-date the nails (Plate 18 & Plate 19). At the community's request this tree was recorded as RPS MP 2. The central Morisset peninsula area was then accessed from Porowi Road, Mirrabooka to assess the potential of the drainage lines to be associated with cultural heritage sites. No sites were noted.

The survey team then moved to the lake foreshore at Sugar Bay on the southern shore of the peninsula. The foreshore, park like in appearance, was grassed with a small number of mature trees. Given proximity to the lake, exposures were checked for shell midden material with none noted. Mature trees were checked with one tree considered to be culturally modified. This tree, a melaleuca species was recorded as RPS MP 3 (Plate 20).

With regard European cultural heritage, an inspection of the Norfolk pines, Shingle Splitters Point, Balcolyn listed in *City of Lake Macquarie Heritage Study* (1993) was carried out as part of the Morisset Peninsula survey. This proposed heritage item was found to comprise eleven mature pines and two juvenile pines (Plate 21 and Plate 22). The pines are in various stages of health with one of the mature pines recovering from loss of its upper trunk in the past.

Table 7-1: Survey Coverage Data

Landform Unit	Survey Unit	Total area of LF Unit sq. m.	Exposure %	Area of Exposure sq. m	Visibility %	Area Available for Detection (sq.m)	% of landform area available for site detection
Myuna Bay foreshore & Eraring Bay foreshore park	1	8088	<5	404	80	323	3.9
Buttaba Hills	2	30600	15	4590	80	3672	12
Point Wolstoncroft	3	42900	20	8580	80	6864	16
Morisset Peninsula	4	13160	20	2632	80	2105	16

7.2.5 Survey Unit – Myuna Colliery Surface Facilities Area – proposed clean water diversion works

The proposed surface water diversion works consists of constructing drainage channels to facilitate the management of clean water (Figure 7.2a & 7.2b). The areas proposed for the drainage channels were walked for the current heritage assessment. The area has been subjected to significant and large scale disturbance lying within the coal handling facilities area and access road of the Wangi Power Station from the 1940's and is currently within the surface facilities area of Myuna Colliery. Modified areas seen included dams, water channels, truck turning area, tracks, etc (Plate 23 & Plate 24). Away from these areas there was dense introduced and native vegetation cover.

No Aboriginal or European cultural heritage items were noted in the area proposed for the clean water diversion works during this survey.

7.3 Survey Results – Aboriginal Archaeology

The survey recorded new sites at Myuna Bay (midden); Buttaba Hills (culturally sensitive area); Morisset Peninsula (modified tree); and one site at Point Wolstoncroft (midden, artefacts, culturally sensitive sites and landform) (Figure 7-4). Two previously recorded sites Point Wolstoncroft 1 (AHIMS #45-7-0186) and Point Wolstoncroft 2 (AHIMS # 45-7-0187) were noted with additional material recorded for inclusion on the Point Wolstoncroft 2 AHIMS record.

The survey area was limited to those areas accessible by the public. While there were areas of good consistent visibility much of the survey area was covered in dense vegetation.

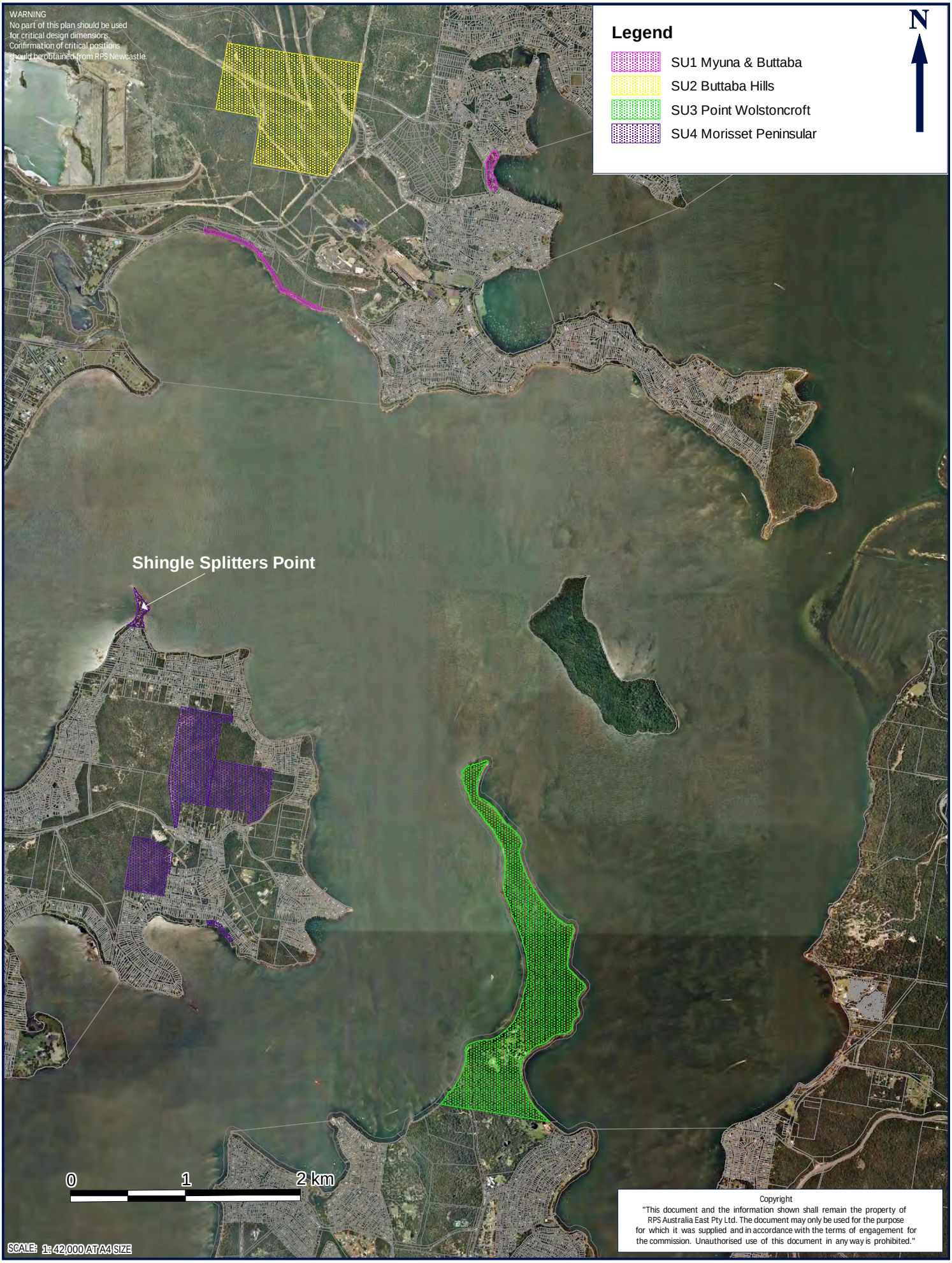
Table 7-2: Aboriginal cultural heritage sites noted and recorded

Survey Unit	Site Name	Eastings	Northings	Site type	Description
1	RPS MB 1	365025	6341071	Midden	*Anadara trapezia* on track.
2	RPS BH 1	*	*	Cultural site	Landform
3	Point Wolstoncroft 1 AHIMS # 45-7-0186	368402	6334343	Midden	Previously recorded. *Anadara trapezia* adjacent waterhole
3	RPS PW 1	*	*	Midden; artefacts; cultural site	Extensive *Anadara trapezia*, few *Ostrea angasi*; stone artefacts; other items and landform
3	Point Wolstoncroft 2 AHIMS # 45-7-0187	367475	6336289	artefact	Previously recorded site - to be amended to include 2 artefacts and revise midden extent
		367565	6336414	artefact	

Survey Unit	Site Name	Eastings	Northings	Site type	Description
4	RPS MP 1	364930	6336689	Modified tree	Modified tree
4	RPS MP 2	365342	6336208	Modified tree - potential	Modified tree - potential
	RPS MP 3	365058	6335017	Modified tree	Modified tree

***** see Addendum A & B

The sites cards recorded for inclusion on AHIMS are at Appendix 5.



TITLE: FIGURE 7-1 SURVEY UNITS

LOCATION: MYUNA

DATUM: N/A
PROJECTION: AMG ZONE 56 (AGD 84)

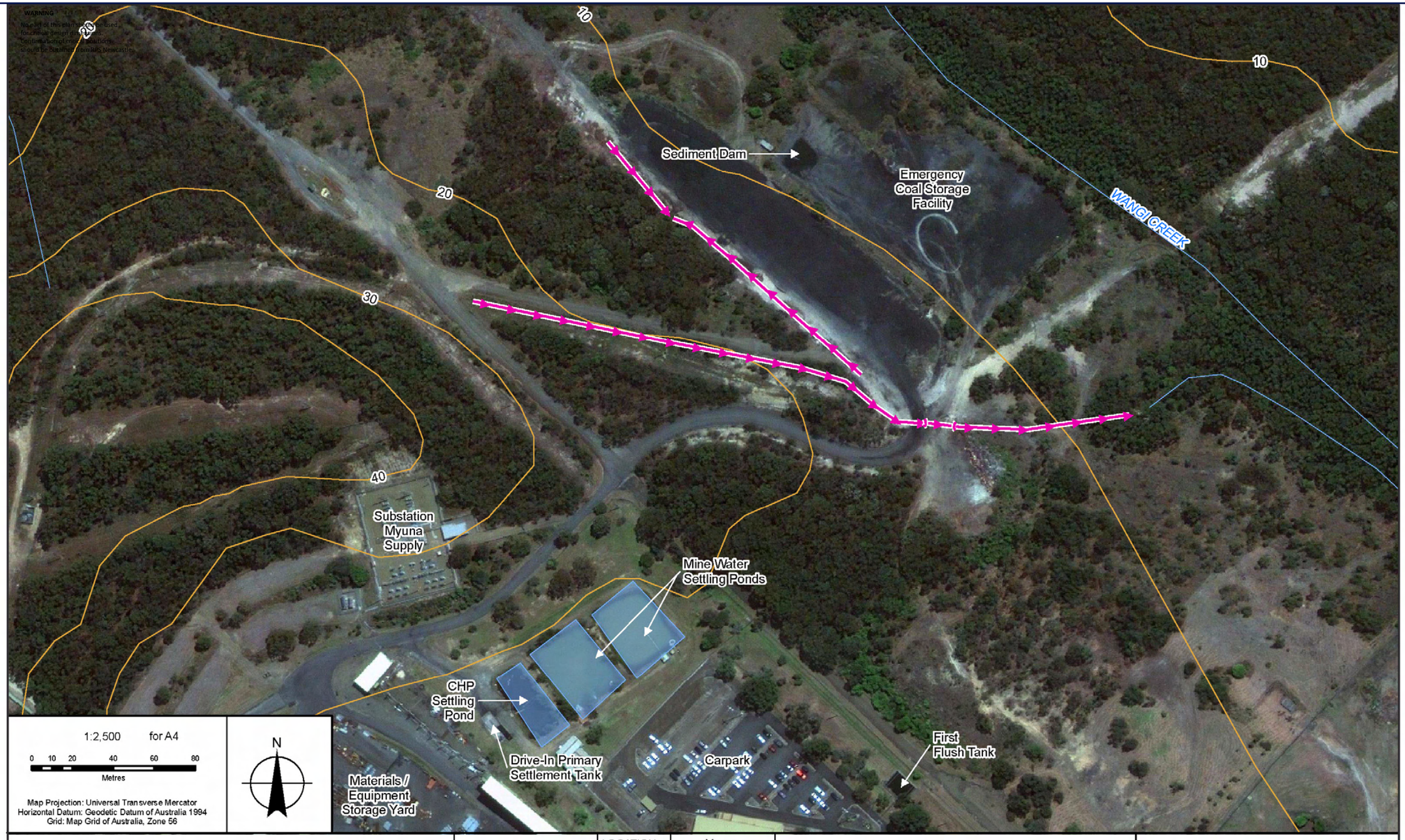
DATE: 22/02/2011
PURPOSE: ARCHAEOLOGY

LAYOUT REF: J:\JOBS\Centennial\All Jobs\PR103000 Myuna\10- Drafting
VERSION (PLAN BY): B A4 (NW-LN)

CLIENT: AECOM
JOB REF: 103000

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

RPS



TITLE: FIGURE 7-2 PROPOSED CLEAN WATER DIVERSION WORKS

LOCATION: MYUNA

DATUM: DATUM
PROJECTION: NON-EARTH (FEET)

DATE: 5/07/2010
PURPOSE: REPORT FIGURE

J:\JOBS\Centennial\All Jobs\103000 Myuna\10- Drafting\
LAYOUT REF: Arch\Figure 7-2 Proposed clean water diversion works
VERSION (PLAN BY): A-A3 (N.W.)

CLIENT: CENTENNIAL COAL
JOB REF: 103000

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

LEGEND

- Watercourse
- 10m Contours
- Proposed Clean Water Diversions

LOCATION	Myuna
SEAM	Great Northern, Fassifern & Wallarah Seam
DRAWN	F.M
CHECKED	
APPROVED	
SCALE	refer to scalebar

Myuna Colliery

Location of Proposed Works Coal Handling Plant Dam

Centennial Myuna

DATE 07-06-2010

Figure 5.1

TITLE: FIGURE 7-3 PROPOSED CLEAN WATER DIVERSION WORKS

LOCATION: MYUNA

DATUM: DATUM
PROJECTION: NON-EARTH (FEET)

DATE: 5/07/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: 103000 FIGURE 7-2.1 COAL HANDLING PLANT A-A3
VERSION (PLAN BY): A-A3 (N.W.)

CLIENT: CENTENNIAL COAL
JOB REF: PR 103000

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TITLE: FIGURE 7-4 ABORIGINAL CULTURAL HERITAGE SITES RECORDED DURING SURVEY

LOCATION: MYUNA

DATUM: DATUM
PROJECTION: AMG ZONE 56 (AGD 84)

DATE: 5/07/2010
PURPOSE: ARCHAEOLOGY

LAYOUT REF: J:\JOBS\Centennial\All Jobs\PR103000 Myuna\10- Drafting\Fig 7-3 ACH Sites recorded
VERSION (PLAN BY): NW (LN)

CLIENT: AECOM
JOB REF: 103000

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
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RPS

7.4 Survey Results – European Historic items

The Norfolk Pines, Shingle Splitters Point (#BC-01) listed in the Lake Macquarie Heritage Study were inspected. Without professing knowledge as an arborist, the pines appeared to be in reasonable condition.

The remnants of the rail bed and crushed stone ballast of the now decommissioned Wangi Power Station railway line were seen during the Buttaba Hills area survey (Survey Unit 2). Some items associated with that railway: rail bed; cuttings; culverts; rail lines; bolts; and timber sleepers were noted. It is important to understand that the NSW Heritage Branch considers items as listed above to be 'works' and not a 'relic' within the meaning of the Act (NSW Heritage Act, 1977). The definition of 'relic' in Section 4 (1) of the Act is documented as follows;

Relic means any deposit, artefact, object or material evidence that:
(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and;
(b) is of State or local heritage significance.

The density of vegetation covering the majority of the Project Application Area raises the possibility that some potential heritage items may be present but undetected. The proposed mine extension work has a potential for subsidence of <20mm therefore it is considered unlikely that there would be an impact on unidentified items.

8 Significance Assessment

In order to develop appropriate heritage management outcomes, it is necessary for the significance of Aboriginal sites or areas of archaeological sensitivity to be assessed. Aboriginal heritage can be significant for cultural and/or scientific reasons. Aboriginal people are the best placed to assess cultural significance and are therefore consulted in the Aboriginal heritage management process. Scientific significance is assessed according to scientific criteria outlined in DECCW heritage guidelines.

8.1 Cultural Significance Criteria and Assessment

An assessment of cultural significance incorporates a range of values which may vary for different individual groups and may relate to both the natural and cultural characteristics of places or sites. Cultural significance and Aboriginal cultural views can only be determined by the Aboriginal community using their own knowledge of the sites and their own value system.

As the cultural significance is a criterion that only Aboriginal people can assess, a detailed appraisal of cultural significance for the Project Application Area has not been included as part of this study. However, response and comment on the Project Application Area was discussed with Aboriginal representatives during the survey. Further details are included in the Aboriginal consultation log.

8.2 Archaeological Significance Criteria

Archaeological significance, also referred to as scientific significance, is determined by assessing an Aboriginal heritage site or area according to archaeological criteria. The assessment of archaeological significance is used to develop appropriate heritage management and impact mitigation strategies. Criteria for archaeological significance has been developed in accordance with the principals of the Burra Charter (ICOMOS 1999) and the DECC Aboriginal Cultural Heritage Standards and Guidelines Kit (1997) (Table 8-1).

Table 8-1: Archaeological Significance

Criteria	Description
Rarity	This criterion examines the frequency of the identified site types with others previously recorded in the local or regional landscape
Representativeness	All sites are representative of a site type, however, some sites may be in better condition, or demonstrate more clearly a particular site type. Representativeness is based on the understanding of extant sites in the local or regional landscape and the purpose of this criteria is to ensure a representative sample of sites area conserved for future generations
Integrity	This refers to site intactness. A site with contextual integrity can provide information relating to chronology, social systems, tool technology, site formation processes, habitation, frequency of use as well as other occupation indicators. Moderate to high levels of disturbance will generally result in low integrity.
Connectedness	Relates to inter-site relationships, that is whether a site can be linked to an archaeological complex, or where sequence of activities can be discerned. For example, a quarry (stone extractions site), may be linked to an adjacent heat treatment pit and knapping floor, these site thus could be linked as part of a stone tool production sequence.
Complexity	Refers to the contents of the site, such as, the variety and nature of features and/or of artefacts present. For example, rock art sites with many motifs may be ranked highly in terms of complexity, or artefact scatters with a wide variety of raw materials and/or or tool types may be more complex than surrounding sites.
Research Potential	This criteria is used to identify whether a site has the potential to contribute new information which to the interpretation of Aboriginal occupation in the area.

8.3 Assessment of Archaeological Significance

The archaeological significance criteria are usually assessed on two scales: local and regional; in exceptional circumstances however, state significance may also be identified. Archaeological significance criteria is assessed in three levels to which scores are assigned; low (score=1), moderate (score=2) and high (score=3).

A combination of these scores then provides a concept of the overall significance assessment of the site:

- Low significance 6-10
- Moderate significance 11-14
- High significance 15-18

The assessment provided in Table 8.2 uses the above criteria to determine a level of significance of the Aboriginal cultural heritage sites recorded during this survey.

Table 8-2: Assessed Levels of Significance for Aboriginal Sites

Site	Significance scale	Rarity	Representativeness	Integrity	Connectedness	Complexity	Research Potential	**Overall Significance**
RPS Myuna Bay 1	Local	1	2	1	2	1	1	**Low**
	Regional	1	1	1	1	1	1	**Low**
RPS BH1	Cultural site, (for significance statement, see Addendum A)							
Point Wolstoncroft 1 AHIMS#45-7-0186 *	Local	3	3	3	3	3	3	**High**
	Regional	3	3	3	3	3	3	**High**
RPSPW1	Cultural site, (for significance statement, see Addendum B)							
Point Wolstoncroft 2 AHIMS #45-7-0187	As per site card							
RPS MP 1	Local	2	2	2	1	1	1	**Low**
	Regional	1	1	1	1	1	1	**Low**
RPS MP 2	Local	2	2	2	1	1	1	**Low**
	Regional	1	1	1	1	1	1	
RPS MP 3	Local	2	2	2	1	1	1	**Low**
	Regional	1	1	1	1	1	1	

* (reassessed in accordance with additional information from the survey)

Table 8-2 shows that the majority of sites have been assessed to have low to moderate significance at the Local and Regional level. RPS MP 2 at this stage is assessed as low pending further verification and assessment. The exception is RPS Pt Wolstoncroft 1 which is assessed as being of High Significance at both the Local and Regional level.

9 European Historic Significance Assessment

The project Application Area has no heritage items inside its boundaries listed on either the NSW State Heritage Register, or the Lake Macquarie LEP.

The rail line associated with the Wangi Power Station Complex crosses land within the Project Application Area. However, on advice from the NSW Heritage Office, the rail line is considered a 'work' not a 'relic' (Karen Stankwoski, Heritage Officer, 20 January 2010). Thus the rail line is not considered to have the same level of significance (state significance) as items within the Wangi Power Station Complex.

No listed heritage items are at risk of impact from the proposed Project.

The Norfolk Pines, Shingle Splitters Point (#BC-01) have been proposed as heritage items in the *Lake Macquarie Heritage Study* (1993), but are not listed on the NSW State Heritage Register, nor the Lake Macquarie LEP; these pines are still present at Balcolyn and were observed during the survey. This item has been assessed to have moderate local significance *Lake Macquarie Heritage Study* (1993), but is not at risk of impact by the proposed Project.

10 Discussion

The basis under which this archaeological assessment has been conducted is that the potential impact will be limited to <20mm under all land and seagrass beds (Zone A). The survey targeted Zone A and the area of the lake within 20m of the high water mark, no survey was conducted on the lake bed (Zone B).

The survey recorded a number of sites (midden, scarred tree, artefacts) that are common site types across the wider Lake Macquarie area. No grinding grooves were recorded however, there is potential for these sites to occur on sandstone surfaces particularly near water courses.

Of the 77 Aboriginal sites recorded within the central Lake Macquarie area, the majority are Aboriginal middens. These middens are a commonly occurring example of resource gathering by the Awabakal people of Lake Macquarie and are the most likely type of site to be identified in this area. Culturally modified trees and ceremonial sites are less common.

The survey identified two areas considered to be ceremonial and therefore were deemed culturally significant by the ATOAC and ADTOAC on the basis of traditional knowledge as Awabakal descendents. The landform site recorded in the Buttaba Hills while not displaying any Aboriginal archaeological material was considered to be culturally sensitive. The midden previously recorded as Point Wolstoncroft 2 (AHIMS# 45-7-0187) is extensive with shell extending over an area of approximately one kilometre south from the tip of the Point, this site has also been identified as having ceremonial importance by ATOAC and ADTOAC and has an association with Pulba Island which is a known Aboriginal ceremonial site. Occurring adjacent to that area is a new site recorded as RPS PW1, while this site does contain midden shell it is a complex site incorporating a number of culturally significant features. It is an important site with its conservation highly recommended.

The culturally modified trees recorded at Morisset Peninsula according to the AHIMS list have not previously been recorded on the Peninsula.

Overall, the sites demonstrate that a range of resource gathering and ceremonial strategies of the Awabakal people were undertaken in the central western section of Lake Macquarie.

The Wangi Power Station rail line was the only European heritage observed and is not protected as a 'relic' under the *NSW Heritage Act 1977*. The proposed heritage item (BC-01) Norfolk pines, Shingle Splitters Point, Balcolyn identified in *City of Lake Macquarie Heritage Study* (1993), were observed in the Project Area, but have not been officially listed in the Lake Macquarie LEP. Due to the negligible level of land subsidence proposed for the Project (less than 20 millimetres under all land areas and foreshores), it is unlikely that there will be an impact on the remnants of the Wangi Power Station rail

line, the Norfolk pines, or any unidentified European heritage items within the Project Application Area.

The former Wangi Power Station, located adjacent to the Surface Facilities Area, and Threlkeld's original coal mine are listed on the NSW State Heritage Register; however, are located outside the Project Application Area and will not be impacted by the proposed Project.

Due to the negligible level of land subsidence, it is unlikely that the proposed Project will impact on European heritage.

11 Management and Mitigation

The Subsidence Assessment (Seedsman Geotechnics, 2010) indicates that mining can be designed to meet the subsidence (<20mm) proposed in Zone A. It is therefore considered there is minimal potential for impact from the proposed Project on sensitive Aboriginal cultural places or objects or on European cultural heritage items.

11.1 Aboriginal Cultural Heritage

Due to the negligible level of land subsidence likely as a result of the proposed Project, there is considered to be minimal to no potential for impact on middens, artefacts and modified trees within the Project Application Area.

Sensitive Aboriginal cultural heritage sites recorded during this survey include sandstone outcrops and rock overhangs (Addendum A & B). While the Subsidence Assessment (Seedsman Geotechnics, 2010) states that there will be no noticeable surface impacts, consideration should be given to a program of monitoring if mining is to occur within the immediate vicinity of the sites registered within Addendum A and Addendum B.

11.2 European Cultural Heritage

A negligible level of land subsidence is associated with the proposed Project. The rail line associated with the Wangi Power Station Complex is within the Project Area; however, the rail line is considered a 'work' and therefore does not require mitigation afforded to 'relics' under the *NSW Heritage Act 1977.* There are no other heritage items listed on either the NSW State Heritage Register, nor the Lake Macquarie LEP. The proposed Project will not impact on European Heritage Items.

The Norfolk Pines, Shingle Splitters Point (#BC-01) have been proposed as heritage items in the *Lake Macquarie Heritage Study* (1993), but are not listed on the NSW State Heritage Register, nor the Lake Macquarie LEP. Due to the negligible level of subsidence, this item is not at risk of impact by the proposed Project.

12 Mitigation Measures

The mitigation measures that are formulated from this archaeological assessment are based upon the legislation designed to address the impact of development on sites of cultural significance. It is recommended that works may proceed with regard to the following:

Mitigation Measure 1
If first and secondary extraction is to occur under the culturally sensitive sites recorded in Addendum A and Addendum B, an archaeological monitoring programme will be implemented for the potentially impacted sites.

Mitigation Measure 2
If there is evidence of mine-induced damage to sandstone outcrops and rock overhangs as described in Addendum A & Addendum B , then all mining works in the area should cease, the area cordoned off and contact made with DECCW Enviroline 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed.

Mitigation Measure 3
If during the course of mining work, significant European heritage material is identified and is likely to be impacted on by the proposed Project, the particular mining work should cease. A significance assessment by a suitably qualified archaeologist adhering to the NSW Heritage Branch significance criteria should be carried out and the NSW Heritage Branch should be notified if significant historical items are identified. Works should only recommence when an appropriate and approved management strategy is instigated.

Mitigation Measure 4
Myuna Colliery will develop an Aboriginal Cultural Heritage Management Plan (ACHMP) for the for the identified Aboriginal heritage items within the Project Area, as well as, contingency strategies for any additional heritage issues which may arise. The ACHMP would comprise:

- An assessment of the cultural significance of the Aboriginal heritage sites within the Project Area;
- Identification of roles and responsibilities (Centennial, Aboriginal stakeholders, heritage consultant); and
- Strategies for:
- Management of identified Aboriginal heritage sites;
- Review of the management of Aboriginal Heritage sites, should subsidence levels at existing monitoring points exceed 20 mm on land areas; and
- Management of additional sites, if identified.

The Myuna Colliery ACHMP will be developed in consultation with the relevant Aboriginal stakeholders to ensure that Aboriginal cultural values are adequately addressed.

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14 Plates

Plate 1 SU1 - Myuna Bay foreshore

Plate 2 SU1 - RPS Myuna Bay 1

Plate 3 SU1 – Buttaba foreshore park

Plate 4 SU 2 - Buttaba Hills

Plate 5 SU2 - Wangi Power Station rail line

Plate 6 SU2 – Stormwater Culvert under old Wangi Power Station rail line

Plate 7 SU 2 - Bush in vicinity of Wangi Creek

Plate 8 SU 2 - Looking south from ridgeline crest

Plate 9 SU3 - Point Wolstoncroft waterhole

Plate 10 SU3 - Point Wolstoncroft 1 AHIMS # 45-7-0186

Plate 11 SU3 - Lake foreshore in vicinity of Point Wolstoncroft 1 AHIMS # 45-7-0186

Plate 12 SU3 - Point Wolstoncroft western shoreline

Plate 13 SU3 - Point Wolstoncroft western shoreline showing midden material eroding from top of bank.

Plate 14 SU3 - AHIMS # 45-7-0187 Point Wolstoncroft 2 - artefact to be added to site record

Plate 15 SU4 - AHIMS # 45-7-0187 Point Wolstoncroft 2 - artefact to be added to site record

Plate 16 SU4 – Existing Morisset Peninsula eroding track

Plate 17 SU4 – RPS Morisset Peninsula 1

Plate 18: SU4 – Morisset Peninsula potentially modified tree recorded as RPS MP 2 – detail.

Plate 19: SU4 – Morisset Peninsula potentially modified tree recorded as RPS MP 2– note series of indentations along high side of tree trunk

Plate 20: SU4 – Morisset Peninsula – modified tree recorded as RPS MP 3

Plate 21 SU4 Morisset Peninsula – Norfolk pines, Shingle Splitters Point. Looking south

Plate 22 SU4 Morisset Peninsula – Norfolk pines, Shingle Splitters Point. Looking west

Plate 23 SU Myuna Colliery Working Facilities – proposed clean water diversion location

Plate 24 SU Myuna Colliery Working Facilities – proposed clean water diversion location

Appendix 1

Legislative Requirements

SUMMARY OF STATUTORY CONTROLS

The following overview of the legal framework is provided solely for information purposes for the client, it should not be interpreted as legal advice. RPS will not be liable for any actions taken by any person, body or group as a result of this general overview, and recommend that specific legal advice be obtained from a qualified legal practitioner prior to any action being taken as a result of the summary below.

COMMONWEALTH

Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (ATSIHP Act), Amendment 2006

The purpose of this Act is to preserve and protect all heritage places of particular significance to Aboriginal and Torres Strait Islander people. This Act applies to all sites and objects across Australia and in Australian waters (s4).

It would appear that the intention of this Act is to provide national baseline protection for Aboriginal places and objects where State legislation is absent. It is not to exclude or limit State laws (s7(1)). Should State legislation cover a matter already covered in the Commonwealth legislation, and a person contravenes that matter, that person may be prosecuted under either Act, but not both (s7(3)).

The Act provides for the preservation and protection of all Aboriginal objects and places from injury and/or desecration. A place is construed to be injured or desecrated if it is not treated consistently with the manner of Aboriginal tradition or is or likely to be adversely affected (s3).

The Australian Heritage Council Act 2003 together with **The Environment Protection and Biodiversity Conservation Act 1999** (Amended) includes a National Heritage List of places of National heritage significance, maintains a Commonwealth Heritage List of heritage places owned or managed by the Commonwealth and ongoing management of the Register of the National Estate.

STATE

It is incumbent on any land manager to adhere to state legislative requirements that protect Aboriginal Cultural heritage. The relevant legislation in NSW includes but is not limited to:

National Parks & Wildlife Act 1974 (NPW Act), Amended 2001.

The NPW Act provides statutory protection for all Aboriginal heritage, places and objects (not being a handicraft made for sale), with penalties levied for breaches of the Act. This legislation is overseen by the Department of Environment, Climate Change and Water (DECCW), and specifically the Director-General of DECCW. Part 6 of this Act is the relevant part concerned Aboriginal objects and places, with the Section 86 and Section 90 being the most pertinent:

Section 91: Under Section 91 of the Act it stipulates that a person who is aware of unregistered Aboriginal sites must report these to the DECCW, regardless of the land status (Freehold, leasehold, Crown land).

Section 90: "A person who, without first obtaining the consent of the Director-General, knowingly destroys, defaces or damages, or knowingly causes or permits the destruction or defacement of or damage to, an Aboriginal object or Aboriginal place is guilty of an offence against this Act." Under s.5 of the Act "object" means any deposit, object or material evidence (not being a handicraft made for sale) relating to indigenous habitation of the area. This applies to habitation both prior to and concurrent with the occupation of that area by persons of non Aboriginal extraction, and includes Aboriginal remains.

Section 87: Under Section 87 of the Act, permits may be issued which allow, allow the permit holder to conduct investigations of areas considered to be potential sites for the purpose of research, and also for conservation work associated with known sites.

Under Section 90 of the Act permits for impact to Aboriginal sites may be issued, these may include the collection of artefacts, as well as, subsurface salvaging of Aboriginal sites prior to ground disturbance works associated with construction. Any disturbance, damage or destruction of Aboriginal sites, known or unknown, without an approved permit is considered to contravene the NPW Act (1974) and the DECCW will pursue the person/company responsible.

Penalties under these two sections are currently 50 penalty units, or 6 months in gaol, or both for an individual and 200 penalty units for a corporation. The DECCW record all S.87 and S.90 permits issued in order to manage Aboriginal sites and ensure representative samples of sites are left in situ for future generations. In order to achieve this, the DECCW need to be made aware of all Aboriginal sites located in NSW.

Section 86: This section of the Act states that "A person, other than the Director-General or a person authorised by the Director-General in that behalf, who:

- disturbs or excavates any land, or causes any land to be disturbed or excavated, for the purpose of discovering an Aboriginal object;
- disturbs or moves on any land an Aboriginal object that is the property of the Crown, other than an Aboriginal object that is in the custody or under the control of the Australian Museum Trust;
- takes possession of an Aboriginal object that is in a national park, historic site, state conservation area, regional park, nature reserve, karst conservation reserve or Aboriginal area;
- removes an Aboriginal object from a national park, historic site, state conservation area, regional park, nature reserve, karst conservation reserve or Aboriginal area; or
- erects or maintains, in a national park, historic site, state conservation area, regional park, nature reserve, karst conservation reserve or Aboriginal area, a building or structure for the safe custody, storage or exhibition of any Aboriginal object,

except in accordance with the terms and conditions of an unrevoked permit issued to the person under section 87, being terms and conditions having force and effect at the time the act or thing to which the permit relates is done, is guilty of an offence against this Act."

Section 84: Aboriginal places of traditional significance (that may or may not contain archaeological material) are given protection under Section 84 of the NPW Act. To be an Aboriginal place for the purposes of this Act, this is a place that, in the opinion of the Minister, is or was of special significance with respect to Aboriginal culture.

Aboriginal Heritage Impact Permits (AHIP)
DECCW encourages consultation with relevant Aboriginal stakeholders for all Aboriginal Heritage assessments. However, if an Aboriginal Heritage Impact Permit (AHIP) is required for an Aboriginal site, then specific DECCW guidelines are triggered for Aboriginal consultation.

In 2010, the *Aboriginal Cultural Heritage (ACH) Consultation Requirements for Proponents* were issued by DECCW (12th of April, 2010). These consultation requirements replace the previously issued *Interim Community Consultation Requirements* (ICCR) for Applicants (DEC 2004). These guidelines apply to all AHIP applications prepared after April 12, 2010; for projects commenced prior to April 12, 2010 transitionary arrangements have been stipulated in a supporting document, Questions and Answers 2: Transitional Arrangements.

The ACH Consultation Requirements 2010, include a four stage Aboriginal consultation process and stipulates specific timeframes for each stage. Stage 1 requires that Aboriginal people who hold cultural information are identified, notified and invited to register an expression of interest in the assessment. Stage 1 includes the identification of Aboriginal people who may have an interest in the project area and hold information relevant to determining the cultural significance of Aboriginal objects or places. This identification process should draw on reasonable sources of information including: the relevant DECCW EPRG regional office, the relevant Local Aboriginal Land Council(s), the registrar, Aboriginal Land Rights Act 1983, the Native Title Tribunal, Native Title Services Corporation Limited, the relevant local council(s), and the relevant catchment management authority. The identification process should also include an advertisement placed in a local newspaper circulating in the general location of the project area. Aboriginal organisations and/or individuals identified should be notified of the project and invited to register an expression of interest (EoI) for Aboriginal consultation. Once a list of Aboriginal stakeholders have been compiled from the EoIs, they need to be consulted in accordance with ACH Consultation Requirements Stages 2, 3 and 4.

For projects commenced before the 12th of April, 2010, Section 1 (Q1) of the transitional arrangements indicates that if Aboriginal consultation was commenced prior to the 12th of April 2010 (including advertising and notification of stakeholders) then consultation is to be continued under the previous ICCR guidelines. .

*Interim Community Consultation Requirements (ICCR) for Applicant*s (DEC 2004) required a three stage process of which timeframes were stipulated for specific components. Stage 1 required the notification and registration of interests. Notification included an advertisement in a local print media, as well as, as contacting the Local Aboriginal Land Council(s), the registrar of Aboriginal Owners, Native Title Services, local council(s) and the Department of Environment and Conservation. Stage 1 also required the invitation for expressions of interest (EoI) to be sent to interested Aboriginal parties and an Aboriginal stakeholder list compiled. Stage 2 required the preparation of an assessment design to be sent to the Aboriginal stakeholders for comment and review. Stage 3 required that the assessment report be provided to registered Aboriginal stakeholders for review and comment.

ENVIRONMENTAL PLANNING & ASSESSMENT ACT 1979 (EP&A ACT)

This Act regulates a system of environmental planning and assessment for New South Wales. Land use planning requires that environmental impacts are considered, including the impact on cultural heritage and specifically Aboriginal heritage. Within the EP&A Acts, Parts III, IV, and V relate to Aboriginal heritage.

Part III regulates the preparation of planning policies and plans. Part IV governs the manner in which consent authorities determine development applications and outlines those that require an environmental impact statement. Part V regulates government agencies that act as determining authorities for activities conducted by that agency or by authority from the agency. The National Parks & Wildlife Service is a Part V authority under the EP&A Act.

In brief, the NPW Act provides protection for Aboriginal objects or places, while the EP&A Act ensures that Aboriginal cultural heritage is properly assessed in land use planning and development.

Part 3A of the EPA relates to major projects, and if applicable, obviates the need to conform to other specific legislation. In particular, s75U of the EPA Act explicitly removes the need to apply for s87 or s90 permits under the NPW Act. This means that although Aboriginal cultural heritage is considered during the planning process, a permit is not required to disturb or destroy an Aboriginal object or place. However, the Director-General of Planning must nonetheless consult with other government agencies, including DECCW and National Parks & Wildlife, prior to any decision being made.

Aboriginal consultation under part 3A is required under the *draft 2005 Part 3A EP&A Act Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*. This document stipulates that the ICCR process should be adhered to.

THE HERITAGE ACT 1977

This Act protects the natural and cultural history of NSW with emphasis on non-indigenous cultural heritage through protection provisions and the establishment of a Heritage Council. Although Aboriginal heritage sites and objects are primarily protected

by the National Parks & Wildlife Act 1974 (NPW Act), Amended 2001, if an Aboriginal site, object or place is of great significance, it may be protected by a heritage order issued by the Minister subject to advice by the Heritage Council.

Other legislation of relevance to Aboriginal cultural heritage in NSW includes the NSW Local Government Act (1993). Local planning instruments also contain provisions relating to indigenous heritage and development conditions of consent.

LAKE MACQUARIE LOCAL ENVIRONMENTAL PLAN

There is are no non-indigenous heritage items listed in the Lake Macquarie LEP.

CITY OF LAKE MACQUARIE HERITAGE STUDY

NAME/IDENTITY: NORFOLK PINES, SHINGLE SPLITTER'S POINT, BALCOLYN ITEM No. BC - 01

PREVIOUS/OTHER NAMES OR USES:

ADDRESS: Shingle Splitters Point
Balcolyn 2264

S.H.I.P. REF. No.

DATE INSPECTED: Oct. 1992

BY: Doring

PARISH: Morisset COUNTY: Northumberland

PRESENT OWNER(S) (Name & Address):

REAL PROPERTY DESCRIPTION:

SITE AREA:
CURRENT ZONING:

CATEGORY: area

SUBCATEGORY: trees - vegetation group

MAP 1:25000 No. 9231-4-N
NAME: SWANSEA
GRID: 645 377

HISTORICAL THEMES:
S.H.I.P.:

LOCAL:

Ref. Nos. for RELATED ITEMS

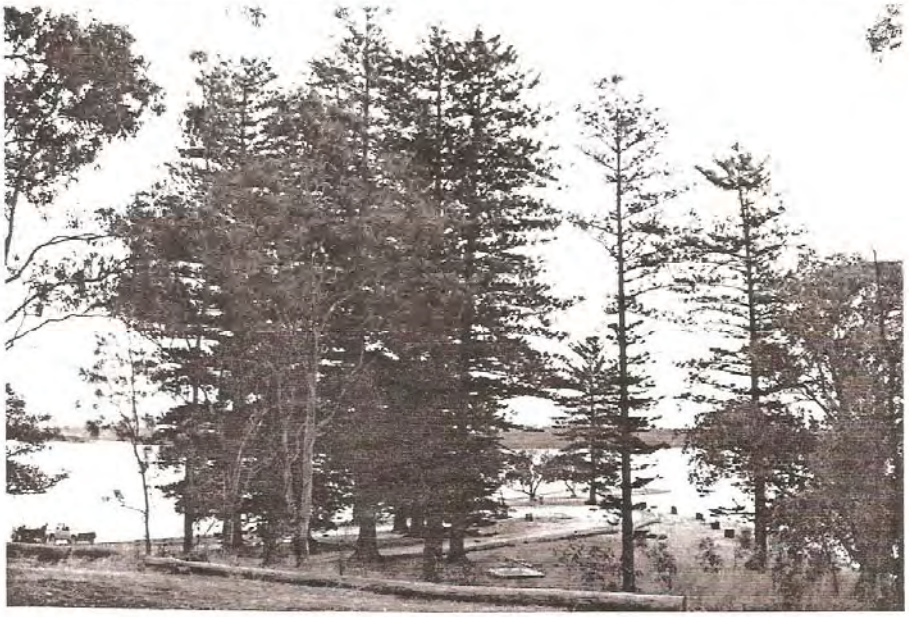
HISTORICAL PERIOD - BUILT: n/a USED: n/a

BUILDER: believed planted by Alfred Sara DATE BUILT: planted c1920

ARCHITECT/DESIGNER: n/a

PHOTOGRAPH &/OR SKETCH PLAN (and caption):
Island Pines growing on the Point

Some of the group of Norfolk
(Doring Neg.409.14)



ITEM No. BC - 01

Suters - Doring - Turner Study (1992-93): AREAS

CITY OF LAKE MACQUARIE HERITAGE STUDY

NAME/IDENTITY **NORFOLK PINES, SHINGLE SPLITTER'S POINT, BALCOLYN** ITEM No. **BC - 01**

KNOWN HERITAGE LISTINGS:

PHYSICAL CHARACTERISTICS

Townscape or Landscape Features: Shingle Splitters Point is a long tongue of land projecting north into the Lake. It is not far across the water from the mouth of Dora Creek. Its principal feature is a large number of Norfolk Island Pine trees. The trees form a notable landmark at the southern end of the Lake.

Other Details of Physical Appearance:

DESCRIPTION:

MODIFICATIONS:

PRESENT USE:

HISTORICAL NOTES: The trees are said to have been planted in about 1920 by Alfred Sara, who lived alone on the Point in a slab house. There may be traces of the slab house still in existence. Shingle Splitters Point got its name because of the many casuarina trees (she-oaks) growing there, which provided a living for timber cutters making roof shingles from them.

REFERENCES: Nilsen, L.(ed),"Lake Macquarie: Past & Present", pub. LMCC 1985.

EVALUATION CRITERIA:

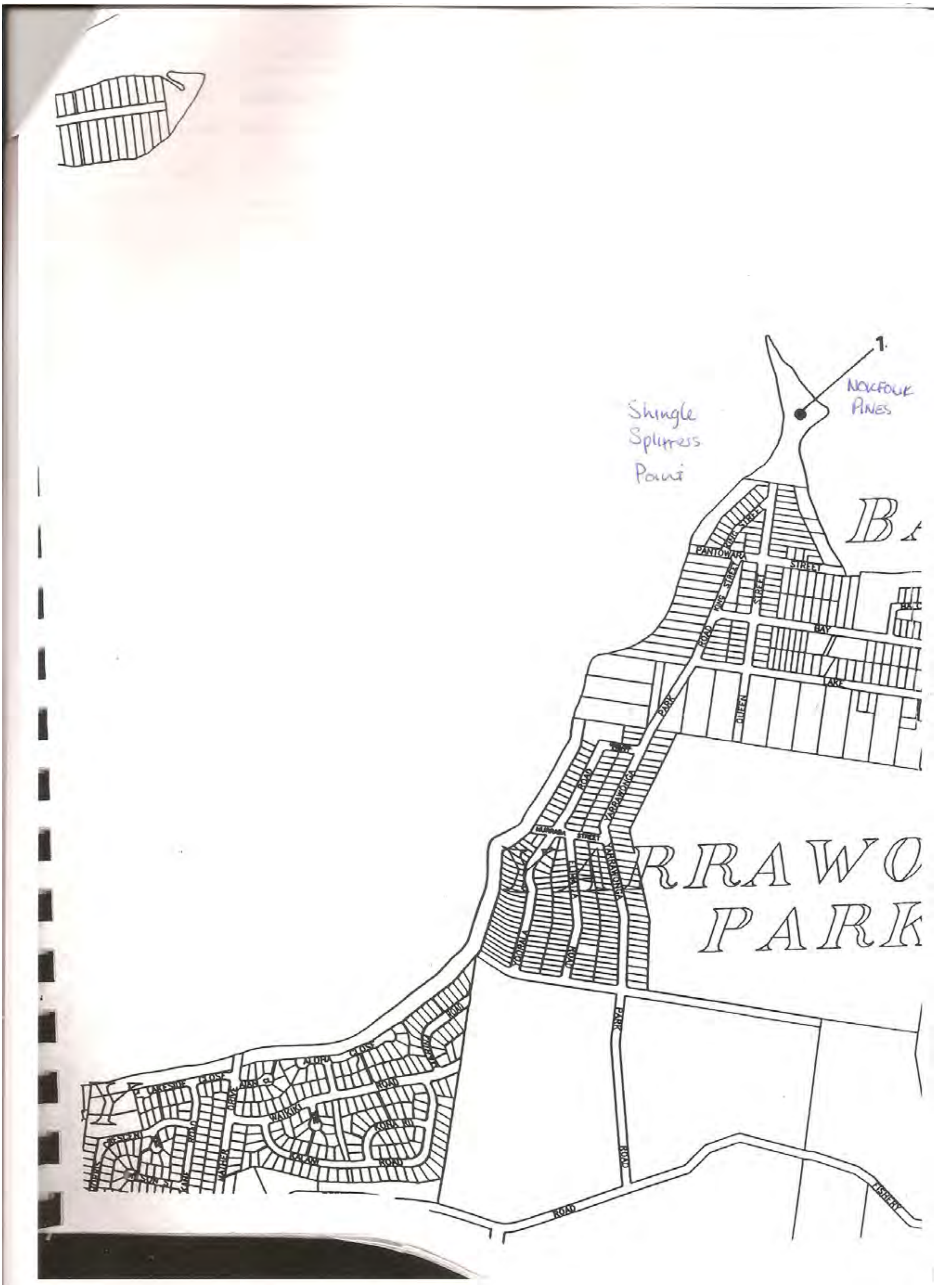
HISTORIC	Rare ( )	Associative ( )	Representative ( )
AESTHETIC	Rare ( )	Associative ( )	Representative ( )
SOCIAL	Rare ( )	Associative ( )	Representative ( )
SCIENTIFIC	Rare ( )	Associative ( )	Representative ( )
OTHER	Rare ( )	Associative ( )	Representative ( )

STATEMENT OF SIGNIFICANCE: The Norfolk Island Pines provide a landmark from many points around the south end of the Lake. They effectively commemorate the early settlers of Lake Macquarie.

Local Significance - moderate

ITEM No. BC - 01

Suters - Doring - Turner Study (1992-93): AREAS


1.
Norfolk Pines
Shingle Splitters Point
PANTOWARA
STREET
BAY
LAKE
QUEEN
PARK
ROAD
YARRAWONGA
PARK
LAKESIDE
CLOSE
ALORA
CLOSE
WAIKIKI
KONA
FISHERY
ROAD

Appendix 2

Aboriginal Consultation Log

Stage 1: Notification of project proposal and registration of interest

Organisation	Contact	Date	Comment
Local Newspaper advert		5 June 2010	Advert inserted in Newcastle Herald and Lakes Mail
DECCW	Diane Crosdale	16 Mar 2010	List of Stakeholders Recd.
LALC - Bahtabah	Michael Green	16 Mar 2010	Fax recd. Registering interest. No further info given on other groups
LALC - Darkinjung		16 Mar 2010	No response to date
LALC – Koompahtoo		16 Mar 2010	No response to date
Registrar Aboriginal owners	CourtneyField	16 Mar 2010	No registered owners
Native Title Services	Peter Schulz	16 mar 2010	Advised not at liberty to provide the info requested.
National Native Title tribunal	Kashana Cohen-McMeekin	16 Mar 2010	No registered Native title claimants.
Council - Wyong		16 Mar 2010	Telephone call to KT AECOM advising no information held
Council – Lake Macquarie		18 Mar 2010	Letter referred fro attention
Awabakal DTOAC	Shane Frost		Interest registered
Awabakal TOAC	Kerrie Brauer		Interest registered
Arwarbukarl Culture Resource Association	Darren McKenny	10 May 2010	No response
Cacatua Cultural Consultants	Donna and George Sampson	10 May 2010	No response
NSW Aboriginal Land Council	Steve Merritt – Director Eastern Zone	10 May 2010	No response
Awabakal LALC	Cheryl Kitchener	10 May 2010	Letter returned address unknown
Awabakal Newcastle Aboriginal Co-op	Kevin McKenney	10 May 2010	No response
Awabakal Newcastle Aboriginal Co-op	Kevin McKenney	10 May 2010	No response
Hunter Catchment Management Authority		10 May 2010	No knowledge of potential stakeholders
Forward registered parties to DECCW and LALC	DECCW; Darkinjung LALC; Bahtabah LALC; NSWALC for Koompahtoo LALC	3 June 2010	Letter forwarded with details of those registered.

Stage 1: Registered Aboriginal stakeholder organisations

Organisation	Contact	Date	Comment
Awabakal DTOAC	Shane Frost	13 May 2010	Interest registered
Awabakal TOAC	Kerrie Brauer	19 May 2010	Interest registered
LALC - Bahtabah	Michael Green	13 May 2010	Fax recd. Registering interest. No further info given on other groups
NSWALC for Koompahtoo LALC	Mal Davis	11 June 2010	Email from KT (AECOM) with info request from Mal Davis.

Stage 2: Presentation of information about the proposed project

Organisation	Contact	Date	Comment
Awabakal DTOAC	Shane Frost	2 June 2010	Methodology emailed and mailed
Awabakal TOAC	Kerrie Brauer	2 June 2010	Methodology emailed and mailed
LALC - Bahtabah	Michael Green	2 June 2010	Methodology emailed and mailed
NSWALC for Koompahtoo LALC	Mal Davis	15 June 2010	Methodology emailed. Unable to provide information or
Awabakal DTOAC	Shane Frost	9 June 2010	Invite to attend survey of Project Area sent
Awabakal TOAC	Kerrie Brauer	9 June 2010	Invite to attend survey of Project Area sent
West Lakes Aboriginal Community (c/o-Awabakal Local Aboriginal Land Council)	Rob Samson	9 June 2010	Invite to attend survey of Project Area sent
Bahtabah Local Aboriginal Land Council	Michael Green	9 June 2010	Invite to attend survey of Project Area sent

Stage 3: Gathering information about cultural significance

Action	Date
Presentation of information to registered Aboriginal parties	31 May 2010
Seek cultural information from registered Aboriginal parties - phone calls	Week of 7 June 2010
Protocol for sourcing and holding cultural information	Discussed with Shane Frost (ADTOAC) and Kerrie Brauer (ATOAC) 22 & 24 June 2010. Agreed information to be provided to Client, DECCW & DoP but contained in separate addendum to report. All parties

	to be advised that access to information is restricted with prior permission given by ADTOAC & ATOAC.
Seek views on potential management options	24 June 2010
Field survey of Project Application Area	22 & 24 June 2010

Group	Date and method	Comment received
Shane Frost (SF) ADTOAC	a) 26 May 2010 phone b) 9 June 2010 phone c) 16 June 2010 & 20 June 2010 - Letters d) Conversation 22 & 24 June 2010	a) Point Wolstoncroft / Wangi Peninsula and Pulbah Island special places; damage to eroding cliff op middens; rock shelves; b) Re-affirmed Point Wolstoncroft as special place; concern over rock shelves in drainage lines Buttaba Hills; wanted SF and KB to do joint survey. c) comments on methodology
Michael Green Bahtabah LALC	10 June 2010 phone	No money back to community from mining; loss of land and culture; I confirmed Bahtabah LALC land area not to be impacted on and therefore no survey to occur in their area.
Kerrie Brauer	a) Letter – 20 June 2010 b) Conversation 22 & 24 June 2010	Comments of methodology

Organisation	Contact	Date	Comment
Awabakal DTOAC	Shane Frost	26 May, 22 June & 24 June 2010	Telephone conversation with SF regarding cultural knowledge of the Project Area. See file note.
Awabakal TOAC	Kerrie Brauer	22 June & 24 June 2010	Discussions during field work.
LALC - Bahtabah	Michael Green	10 June 2010	Telephone discussion
NSWALC for Koompahtoo LALC	Mal Davis	15 June 2010	Unable to provide information or representative for fieldwork.
Awabakal DTOAC	Shane Frost	22 and 24 June 2010	Shane Frost attended survey of Project Area
Awabakal TOAC	Kerrie Brauer	22 and 24 June 2010	Kerrie Brauer attended survey of Project Area

Stage 4 Review of draft cultural heritage assessment report

Organisation	Contact	Date	Comment
Awabakal DTOAC	Shane Frost	16 August 2010	Draft sent for comments
Awabakal TOAC	Kerrie Brauer	16 August 2010	Draft sent for comments
LALC - Bahtabah	Michael Green	16 August 2010	Draft sent for comments
Awabakal DTOAC	Shane Frost	16 September 2010	Comments received & Included in Appendix 6
Awabakal TOAC	Kerrie Brauer	13 September 2010	Comments received & Included in Appendix 6
LALC - Bahtabah	Michael Green	No response received	Study area is outside of Bahtabah LALC boundary
NSWALC for Koompahtoo LALC	Mal Davis	No response received	Koompahtoo LALC in liquidation

Additional Consultation

Organisation	Contact	Date	Comment
Awabakal DTOAC	Shane Frost	19 January 2011	Letters sent from Centennial inviting to attend re-survey of Morisset Peninsula for 11 February 2011
Awabakal TOAC	Kerrie Brauer	19 January 2011	Letters sent from Centennial inviting to attend re-survey of Morisset Peninsula for 11 February 2011
West Lakes Aboriginal Community (c/o-Awabakal Local Aboriginal Land Council)	Rob Samson	19 January 2011	Letters sent from Centennial inviting to attend re-survey of Morisset Peninsula for 11 February 2011
Bahtabah Local Aboriginal Land Council	Michael Green	19 January 2011	Letters sent from Centennial inviting to attend re-survey of Morisset Peninsula for 11 February 2011
Awabakal DTOAC	Shane Frost	11 February 2011	Shane Frost attended survey of the Morisset peninsula and indicated he was satisfied with the outcome of the survey

Appendix 3

AHIMS

site_id	site_name	zone	easting	northing	grid_re	permi	features	recorders	asrtypes	reports	
14-7-0149	Gwandalan	56	368000	6333300	AGD		AFT : -, ETM : -	Griffiths	Midden		
45-6-2516	Pipers Point Rocky Point;	56	363450	6339000	AGD		AFT : -, ETM : -	Bonhomme Crai	Midden		
45-7-0003	Vales Point;Lake Macquarie	56	363738	6331615	AGD	730	AFT : -, ETM : -	Wyong Shire Co	Midden		
45-7-0004	Eraring Power Stn;Lake Viev	56	364220	6339945	AGD		AFT : -, ETM : -	Wright	Midden		
45-7-0009	Galgabba Pulbah Island	56	371505	6336701	AGD		AFT : -, ETM : -	Dyall	Midden		
45-7-0018	Middle Camp; Midden	56	372464	6331522	AGD		AFT : -, SHL : -	Dyall	Midden		
45-7-0019	Middle Camp; Midden 2	56	372619	6331622	AGD		AFT : -, SHL : -	Dyall	Midden		
45-7-0020	Middle Camp;	56	372464	6331522	AGD		AFT : -, SHL : -	Stockton	Midden		
45-7-0022	The Mine;	56	373400	6333420	AGD	135	AFT : -, ETM : -	Hanckel	Midden		
45-7-0023	Pinney Beach;The Mine;	56	373126	6333166	AGD		AFT : -, ETM : -	ASRSYS	Midden		
45-7-0024	Ham's Beach;	56	373724	6335371	AGD		AFT : -, ETM : -	Dyall	Midden		
45-7-0025	Ham's Beach	56	373712	6335556	AGD		AFT : -, SHL : -	Unknown Author	Midden		
45-7-0026	Ham's Beach;Beach South c	56	373988	6335925	AGD		AFT : -	ASRSYS	Open Camp Site		
45-7-0027	Ham's Beach;	56	374230	6336630	AGD		AFT : -, ETM : -	Hanckel	Midden, Open Camp Site		
45-7-0028	Ham's Beach;	56	374280	6336730	AGD		AFT : -, ETM : -	Hanckel	Midden		
45-7-0029	Ham's Beach;	56	374230	6336630	AGD		AFT : -, ETM : -	Hanckel	Midden		
45-7-0031	Blacksmiths Mat's Point	56	374579	6338497	AGD		AFT : -, ETM : -	Unknown Author	Midden		
45-7-0032	Ham's Beach;	56	374650	6336920	AGD		AFT : -, ETM : -	Hanckel	Midden		
45-7-0033	Ham's Beach;	56	374680	6337000	AGD		AFT : -, ETM : -	Hanckel	Midden		
45-7-0034	Ham's Beach;Reid's Mistake	56	374700	6337000	AGD		AFT : -, ETM : -	Hanckel	Midden		
45-7-0035	Ham's Beach;Reid's Mistake	56	374650	6336920	AGD		AFT : -, ETM : -	Stockton	Midden		
45-7-0039	Lake Entrance;	56	374630	6337530	AGD		AFT : -, ETM : -	Hanckel	Midden		
45-7-0069	Lake View Pantaloon Bay	56	365580	6340520	AGD		AFT : -, ETM : -	Dyall	Midden		
45-7-0070	Eraring;Crooked Creek;	56	363454	6341759	AGD		AFT : -, ETM : -	Dyall	Midden		
45-7-0081	Galgabba Creek;Swansea;	56	371687	6336704	AGD		AFT : -, ETM : -	Unknown Author	Midden		
45-7-0083	Swansea South 2 Swansea	56	373239	6336825	AGD		AFT : -	Unknown Author	Open Camp Site		
45-7-0086	Pulbar Island	56	368947	6336560	AGD		AFT : -, ETM : -	Morris	Midden		
45-7-0087	Pulbar Island	56	368661	6337195	AGD		AFT : -, ETM : -	Unknown Author	Midden, Open Camp Site		
45-7-0088	Pulbah Island 2	56	368445	6337000	AGD	1615	ACD : -	Sullivan	Aborig Place, Nat. Mytholog (Ritual)		
45-7-0090	Dora Creek;	56	362950	6338410	AGD		AFT : -, ETM : -	ASRSYS	Midden		
45-7-0091	Wangi Wangi;	56	369500	6339600	AGD		AFT : -, ETM : -	Dyall	Midden	2194	
45-7-0124	Point Morisset 1;	56	370400	6334520	AGD	826	AFT : -	Brayshaw, Donl	Open Camp Sit	1423	
45-7-0131	Summerland Point;	56	366820	6332970	AGD		AFT : -, ETM : -	Brayshaw	Midden		
45-7-0138	Bonny Boy Gully;	56	366820	6332970	AGD		AFT : -, ETM : -	Brayshaw	Midden	1846	
45-7-0139	Boatshed Midden;	56	368520	6340090	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2194	

site_id	site_name	zone	easting	northing	grid_re	permi	features	recorders	asrtypes	reports	
45-7-0140	The Promenade;	56	366560	6339280	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2194	
45-7-0141	Pump Station 7;	56	366550	6339650	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2194	
45-7-0142	RSL Midden;	56	368200	6340090	AGD	303	AFT : -, ETM : -	Mary Dallas Cor	Midden	2194	
45-7-0143	Dobell Drive;	56	368400	6339620	AGD	305	AFT : -, ETM : -	Mary Dallas Cor	Midden	2194	
45-7-0144	Windemere Ck 1;	56	363000	6334600	AGD		AFT : -, ETM : -	Lloyd	Midden	2237	
45-7-0145	Fishing Point 1;Fishing Point	56	368670	6341400	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden		
45-7-0146	Fishing Point 2;Fishing Point	56	368450	6341710	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden		
45-7-0151	M4;Balcolyn Street;	56	364620	6337170	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0154	M7;Fishery Point;	56	366050	6334500	AGD	597	AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0157	M10 Casuarina Point Reserv	56	366300	6334990	AGD	597	AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0158	M11;Lakeview Road, Barder	56	363500	6334110	AGD	598	AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0159	M12;Bulgonia Road, Barden	56	363950	6334850	AGD	611	AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0163	M3;Crusader Camp, Yarraw	56	363900	6336850	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0164	M6;Silverwater;	56	366050	6336100	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0166	M8;Dandaraga Road, Sugar	56	365300	6334500	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0167	M9;Camp Brightwaters;	56	363500	6334880	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0171	M13;Balcolyn;	56	364620	6337170	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0172	M5;Beach Road, Boat Harbo	56	365500	6336580	AGD		AFT : -, ETM : -	Mary Dallas Cor	Midden	2685	
45-7-0176	Gwandalan;	56	367200	6333300	AGD		AFT : -, ETM : -	Griffiths	Midden	2465	
45-7-0177	Camp Kanangra;	56	369500	6331500	AGD		AFT : -, ETM : -	Lambert, Newto	Midden		
45-7-0179	Black Neds Point;	56	365150	6331450	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0180	Cams Wharf	56	370675	6333675	AGD	698, 7	AFT : -, ETM : -	Nelson	Midden	3022	
45-7-0183	Diamond Drill Pt. North;	56	368050	6333200	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0184	Gwandalan;	56	368500	6331800	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0185	Murrays 2;	56	370750	6335750	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0186	Pt Wolstonecraft 1;	56	368350	6334200	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0187	Pt Wolstonecraft 2;	56	367490	6336250	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0188	Pulbah Island 3	56	368250	6337850	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0189	Sandy Beach 1;	56	364950	6331450	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0191	Publah Island 3;	56	368250	6337850	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0201	Nord 1 (N1)	56	369600	6332600	AGD	698	AFT : -, ETM : -	Stuart	Midden	3022	
45-7-0202	Coal Point 1(Swansea)	56	370030	6343000	AGD	691, 7	AFT : -, ETM : -	Mary Dallas Cor	Midden	3029	
45-7-0205	Rocky point;	56	364500	6339500	AGD		AFT : -, ETM : -	Bonhomme Crai	Midden		
45-7-0206	Rocky Point;	56	364500	6339500	AGD		AFT : -, ETM : -	Bonhomme Crai	Midden		
45-7-0208	Pipers Point;	56	363200	6338550	AGD		AFT : -, ETM : -	Nelson	Midden		

site_id	site_name	zone	easting	northing	grid_re	permi	features	recorders	asrtypes	reports	
45-7-0210	Murrays 1;	56	370780	6336250	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0213	Wangi Wangi Point;	56	368450	6338750	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0214	Sunshine Park;	56	365900	6335650	AGD		AFT : -, ETM : -	Nelson	Midden		
45-7-0219	Pulbah Island 4	56	368500	6337000	AGD		AFT : -, ETM : -	Unknown Autho	Midden		
45-7-0220	IF1	56	373430	6333620	AGD		AFT : -	Navin, Officer	Isolated Find		
45-7-0221	Quarries Head Ridgeline 2	56	373400	6334050	AGD	2315	AFT : -	Navin, Officer	Open Camp Site		
45-7-0222	Quarries Head Ridgeline 1	56	372980	6338900	AGD	2315	AFT : -	Navin, Officer	Open Camp Site		
45-7-0223	Point Morisset 3	56	370840	6335260	AGD		TRE : -	Navin, Officer	Scarred Tree		
45-7-0224	Point Morisset 2 - Not an Ab	56	370550	6334540	AGD		TRE : -	Navin	Scarred Tree		
45-7-0227	St Johns 1	56	363680	6333520	AGD	1947	AFT : -	Besant	None		
45-7-0228	St Johns 2	56	363720	6333820	AGD	1947	AFT : -	Besant	None	101024	
45-7-0229	Pelican Point	56	373150	6340490	AGD		AFT : -	Evans	None	2455	
45-7-0231	GALBABBA POINT	56	371460	6337230	AGD		AFT : -, ETM : -	Green	None		
45-7-0233	Sunshine 2	56	365924	6335524	AGD		SHL : -	Umwelt (Australi	None		
45-7-0234	Sinshine Park , Sunshine	56	365895	6335284	AGD		PAD : 3	Umwelt (Australi	None		
45-7-0235	Winding creek 1	56	365997	6336449	AGD		AFT : 2		None		
45-7-0236	Fig Tree Point 1	56	365421	6337201	AGD		SHL : -	Umwelt (Australi	None		
45-7-0237	Jonny's Point 2	56	365997	6336449	AGD		SHL : -	Umwelt (Australi	None		
45-7-0238	Jonny's Point 1	56	365992	6336253	AGD		AFT : 1	Umwelt (Australi	None		
45-7-0244	St Johns 3	56	363560	6333600	AGD	2845,	AFT : 1	Besant	None	100896	
45-7-0248	CP1	56	373900	6336450	AGD	2796,	AFT : -	Besant, Insite H	None	100437	
45-7-0255	Trinity Point GG2 (Catherine	56	363618	6333664	GDA		GDG : -	Besant	None		
45-7-0256	Trinity Point Scarred Tree 2	56	363749	6333815	GDA		TRE : -	Besant	None		
45-7-0257	Trinity Point Ochre (Catherin	56	363958	6333791	GDA		OCQ : -	Besant	None		
45-7-0258	Trinity Point IF1 (Catherine H	56	363730	6333744	GDA		AFT : -	Besant	None		
45-7-0262	SJOG 7	56	364036	6333848	GDA		GDG : 6	Besant	None		
45-7-0263	SJOG 6	56	364026	6333875	GDA		SHL : -	Besant	None		
45-7-0264	Lake Macquarie State Conse	56	367788	6335542	GDA		AFT : -	Darkinjung LALC	None		
45-7-0266	Black Neds Bay midden 1	56	374000	6337000	GDA		ARG : -, AFT : -	Welsh	None		
45-7-0267	Black Neds Bay 2	56	374000	6337800	GDA		AFT : -, SHL : -	Welsh	None		
45-7-0279	CV-18-10	56	367003	6333279	GDA		SHL : 1	Oakes	None		
45-7-0280	CV-19-10	56	366988	6333151	GDA		SHL : 1	Oakes	None		
45-7-0281	CV-20-10	56	365588	6331434	GDA		SHL : 1	Oakes	None		

Appendix 4

Glossary of Site Types

GLOSSARY OF SITE TYPES

The following is a brief description of most Aboriginal site types.

Artefact Scatters
Artefact scatters are defined by the presence of two or more stone artefacts in close association (i.e. within fifty metres of each other). An artefact scatter may consist solely of surface material exposed by erosion, or may contain sub-surface deposit of varying depth. Associated features may include hearths or stone-lined fireplaces, and heat treatment pits.

Artefact scatters may represent:

- Camp sites: involving short or long-term habitation, manufacture and maintenance of stone or wooden tools, raw material management, tool storage and food preparation and consumption;
- Hunting or gathering activities;
- Activities spatially separated from camp sites (e.g. tool manufacture or maintenance); or
- Transient movement through the landscape.

The detection of artefact scatters depends upon conditions of surface visibility, including vegetation cover, ground disturbance and recent sediment deposition. Unfavourable conditions obscure artefact scatters and prevent their detection during surface surveys.

Bora Grounds
Bora grounds are a ceremonial site associated with initiations. They are usually comprise two circular depressions in the earth, and may be edged with stone. Bora grounds generally occur on soft sediments in river valleys, although they may also be located on high, rocky ground in association with stone arrangements.

Burials
Human remains were often placed in hollow trees, caves or sand deposits and may have been marked by carved or scarred trees. Burials have been identified eroding out of sand deposits or creek banks, or when disturbed by development. The probability of detecting burials during archaeological fieldwork is extremely low.

Culturally Modified Trees
Culturally modified trees include scarred and carved trees. Scarred trees are caused by the removal of bark for use in manufacturing canoes, containers, shields or shelters. Notches were also carved in trees to permit easier climbing. Scarred trees are only likely to be present on mature trees remaining from original vegetation. Carved trees, the easiest to identify, are caused by the removal of bark to create a working surface on which engravings are incised. Carved trees were used as markers for ceremonial and symbolic purposes, including burials. Although, carved trees were relatively common in NSW in the

early 20th century, vegetation removal has rendered this site type extremely rare. Modified trees, where bark was removed for often domestic use are less easily identified. Criteria for identifying modified trees include: the age of the tree; type of tree (the bark of many trees is not suitable, also introduced species would be unlikely subjects); axe marks (with the need to determine the type of axe - stone or steel – though Aborigines after settlement did use steel); shape of the scar (natural or humanly scarred); height of the scar above the ground (reasonable working height with consideration given to subsequent growth).

Fish Traps

Fish traps comprised arrangements of stone, branches and/or wickerwork placed in watercourses, estuaries and along coasts to trap or permit the easier capture of sea-life.

Grinding Grooves

Grinding grooves are elongated narrow depressions in soft rocks (particularly sedimentary), generally associated with watercourses, that are created by the shaping and sharpening of ground-edge implements. To produce a sharp edge the axe blank (or re-worked axe) was honed on a natural stone surface near a source of water. The water was required for lubricating the grinding process. Axe grinding grooves can be identified by features such as a narrow short groove, with greatest depth near the groove centre. The grooves also display a patina developed through friction between stone surfaces. Generally a series of grooves are found as a result of the repetitive process.

Isolated Finds

Isolated finds occur where only one artefact is visible in a survey area. These finds are not found in apparent association with other evidence for prehistoric activity or occupation. Isolated finds occur anywhere and may represent loss, deliberate discard or abandonment of an artefact, or may be the remains of a dispersed artefact scatter. An isolated find may flag the occurrence of other less visible artefacts in the vicinity or may indicate disturbance or relocation after the original discard.

Middens

Shell middens comprise deposits of shell remaining from consumption and are common in coastal regions and along watercourses. Middens vary in size, preservation and content, although they often contain artefacts made from stone, bone or shell, charcoal, and the remains of terrestrial or aquatic fauna that formed an additional component of Aboriginal diet. Middens can provide significant information on land-use patterns, diet, chronology of occupation and environmental conditions.

Mythological / Traditional Sites

Mythological and traditional sites of significance to Aboriginal people may occur in any location, although they are often associated with natural landscape features. They include sites associated with dreaming stories, massacre sites, traditional camp sites and contact sites. Consultation with the local Aboriginal community is essential for identifying these sites.

Rock Shelters may contain Art and / or Occupation Deposit

Rock shelters occur where geological formations suitable for habitation or use are present, such as rock overhangs, shelters or caves. Rock shelter sites generally contain artefacts, food remains and/or rock art and may include sites with areas of potential archaeological deposit, where evidence of rock-art or human occupation is expected but not visible.

Stone Arrangements

Stone arrangements include lines, circles, mounds, or other patterns of stone arranged by Aboriginal people. These may be associated with bora grounds, ceremonial sites, mythological or sacred sites. Stone arrangements are more likely to occur on hill tops and ridge crests that contain stone outcrops or surface stone, where impact from recent land use practices has been minimal.

Stone Quarries

A stone quarry is a place at which stone resource exploitation has occurred. Quarry sites are only located where the exposed stone material is suitable for use either for ceremonial purposes (e.g. ochre) or for artefact manufacture.

Appendix 5

AHIMS Site Cards

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville NSW 2220

Office Use Only

Site Number | | | - | | - | | | | |

Date received / / Date entered into system / / Date catalogued / /

Entered by (I.D.)

Information Access

☐ Gender/male ☐ Gender/female ☐ Location restriction ☐ General restriction ☐ No access

Office Use Only

For Further Information Contact:

☐ **Nominated Trustee**

Title	Surname	First Name	Initials

Organisation

Address

Phone number Fax

Client on system ☐

☐ **Knowledge Holder**

Title	Surname	First Name	Initials
Mr	Frost	Shane	

Organisation Awabakal Descendd Trad Own

Address po Box 86 Clarencetown

Phone number 0428320671 Fax

Client on system ☐

Aboriginal Heritage Unit or Cultural Heritage Division Contacts

Geographic Location

Site Name RPS MP1

Easting 364930 Northing 6336689 AGD/GDA AGD

Mapsheet SWANSEA

Zone 56 Location Method Differential GPS

Other Registration

Primary Recorder

Title	Surname	First Name	Initials
Mrs	Nelson	Laraine	

Organisation RPS Group

Address PO Box 428 Hamilton

Phone number 49404200 Fax

Date recorded 24/06/2010

Client on system ☐

NPWS Aboriginal Site Recording Form - Site Information

OPEN/CLOSE SITE

Site Context

Landform

- [ ] Mountainous
- [ ] Plain
- [x] Rolling hills
- [ ] Steep hills
- [ ] Undulating plain

Landform Unit

- [ ] Beach
- [ ] Coastal rock platform
- [ ] Dune
- [ ] Intertidal flat
- [ ] Lagoon
- [ ] Tidal Creek
- [ ] Tidal Flat
- [ ] Cliff
- [ ] Crest
- [ ] Flat
- [ ] Lower slope
- [ ] Mid slope
- [x] Upper slope
- [ ] Plain
- [ ] Ridge
- [ ] Tor
- [ ] Valley flat
- [ ] Levy
- [ ] Stream bank
- [ ] Stream channel
- [ ] Swamp
- [ ] Terrace
- [ ] Terrace flat

Slope

[ ] degrees

Vegetation

- [ ] Closed forest
- [ ] Grasslands
- [ ] Isolated clumps of trees
- [x] Open forest
- [ ] Open woodland
- [ ] Scrub
- [ ] Woodland
- [ ] Cleared
- [ ] Revegetated
- [ ] N/A

Land use

- [ ] Conservation
- [ ] Established urban
- [ ] Farming-intensive
- [ ] Farming-low intensity
- [ ] Forestry
- [ ] Industrial
- [ ] Mining
- [ ] Pastoral/grazing
- [ ] Recreation
- [ ] Semi-rural
- [ ] Service corridor
- [ ] Transport corridor
- [ ] Urban expansion
- [ ] Residential

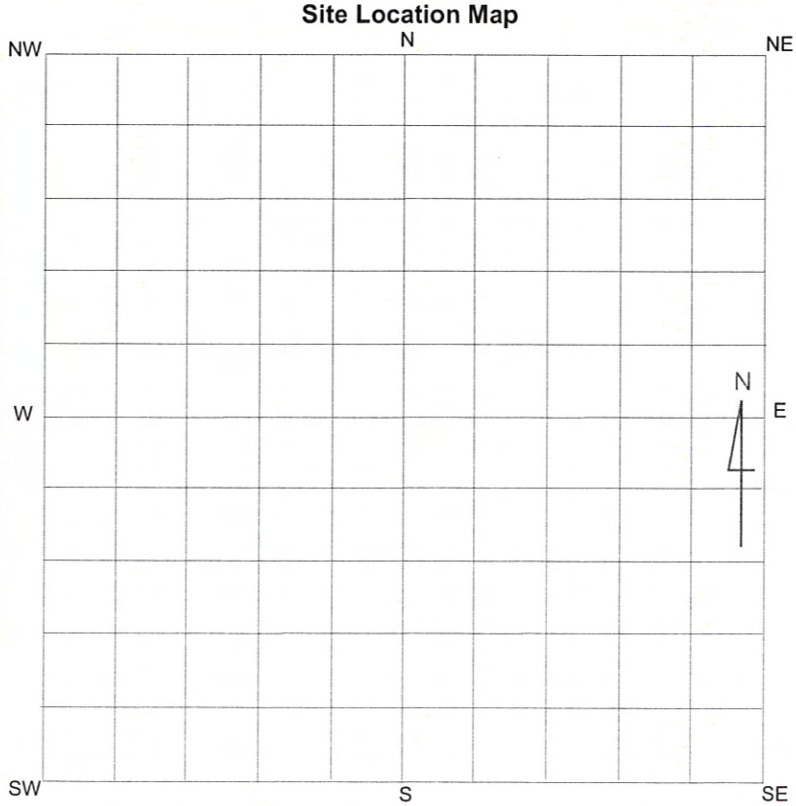
Water

Distance to permanent water source	750 metres
Distance to temporary water source	metres
Name of nearest permanent water source	
Name of nearest temporary water	

Directions for Relocation

Enter the fire trail from Helena St Balcolyn. Follow the track in southerly direction for about 200 m, the tree is on the eastern side about 3 metres from track.

Site Location Map



Current Land Tenure

- [ ] Public — National Park / other Government Dept.
- [ ] Private

Primary report **I.D.** [ ] (I.D. Office Use only)

NPWS Aboriginal Site Recording Form - Site Information

General Site Information

Closed Site

Shelter/Cave Formation

- ☐ Boulder
- ☐ Wind erosion
- ☐ Water erosion
- ☐ Rock collapse

Rock Surface Condition

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Condition of Ceiling

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Shelter Aspect

- ☐ North
- ☐ North East
- ☐ East
- ☐ South East
- ☐ South
- ☐ South West
- ☐ West
- ☐ North West

Open Site

Site Orientation

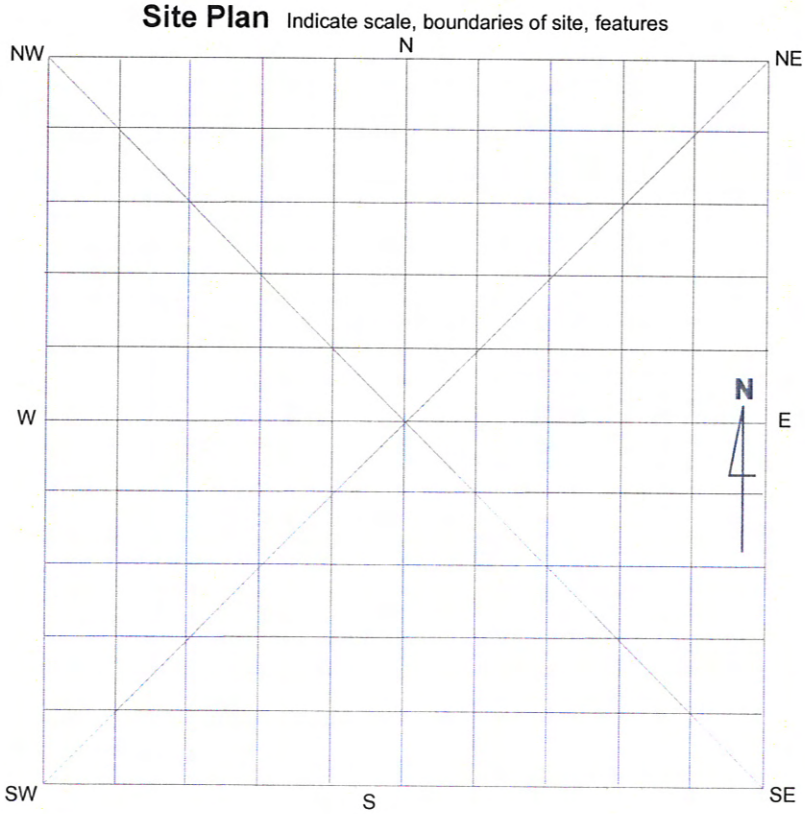
- ☐ N-S
- ☐ NE-SW
- ☐ E-W
- ☐ SE-NW
- ☑ N/A

Features

- ☐ 1. Aboriginal Ceremony & Dreaming
- ☐ 2. Aboriginal Resource & Gathering
- ☐ 3. Art
- ☐ 4. Artefact
- ☐ 5. Burial
- ☐ 6. Ceremonial Ring
- ☐ 7. Conflict
- ☐ 8. Earth Mound
- ☐ 9. Fish Trap
- ☐ 10. Grinding Groove
- ☐ 11. Habitation Structure
- ☐ 12. Hearth
- ☐ 13. Non Human Bone & Organic Material
- ☐ 14. Ochre quarry
- ☐ 15. Potential Archaeological Deposit
- ☐ 16. Stone Quarry
- ☐ 17. Shell
- ☐ 18. Stone Arrangement
- ☑ 19. Modified Tree
- ☐ 20. Water Hole

Site Plan

Indicate scale, boundaries of site, features



Site Dimensions

Closed Site Dimensions (m)

- ☐ Internal length
- ☐ Internal width
- ☐ Shelter height
- ☐ Shelter floor area

Open Site Dimensions (m)

- ☐ Total length of visible site
- ☐ Average width of visible site
- ☐ Estimated area of visible site
- ☐ Length of assessed site area

Aboriginal Community Interpretation and Management Recommendations

Preliminary Site Assessment

Site Cultural & Scientific Analysis and Preliminary Management Recommendations

This section should only be filled in by the Endorsees

Endorsed by: ☐ Knowledge Holder ☐ Nominated Trustee ☐ Native Title Holder ☐ Community Consensus

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Attachments (No.)

- ☐ A4 location map
- ☐ B/W photographs
- ☑ Colour photographs
- ☐ Slides
- ☐ Aerial photographs
- ☐ Site plans, drawings
- ☐ Recording tables
- ☐ Other
- ☐ Feature inserts-No. ☐

Comments

NPWS FEATURE RECORDING FORM - ARTEFACT

Site I.D. ☐ Site Name ☐

First recorded date ☐ **Importance** ☐

No. of instances ☐

Recorded by ☐

	Yes	No
Stone artefacts only	☐	
Artefacts collected	☐	
Permit issued	☐	

Percentage of Non-stone Artefacts to Percentage of Stone Artefacts

0-9% 10-19% 20-29% 30-39% 40-49% 50-59% 60-69% 70-79% 80-89% 90-100%

☐

Feature Context & Condition

Scatter No. ☐ Easting ☐☐☐☐☐☐ Northing ☐☐☐☐☐☐☐

Density (Artefact count per square metre) ☐

Dimensions ☐ Length (m) ☐ Width (m) ☐ Depth (m)

	Yes	No
In situ	☐	
Stratified	☐	

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

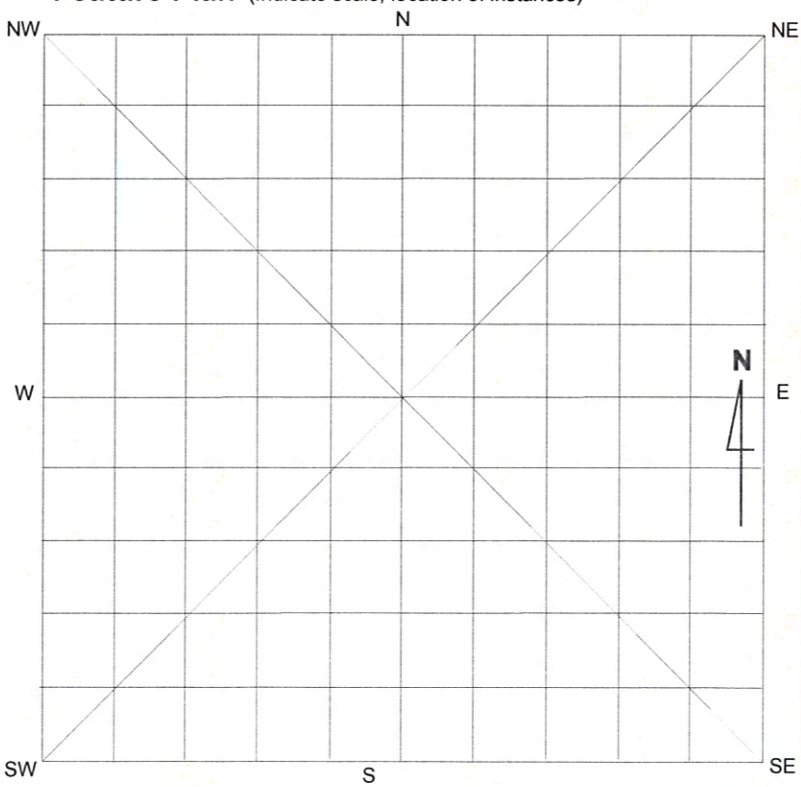
General Condition

- ☐ Weathered
- ☐ Vehicle damage
- ☐ Surface water wash
- ☐ Fire damage
- ☐ Erosion
- ☐ Stock damage
- ☐ Exposed archaeological material

Recommended Action

- ☐ Boardwalk
- ☐ Fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Fire hazard reduction
- ☐ Expert assessment
- ☐ Meeting with land manager
- ☐ Revegetation
- ☐ Signage
- ☐ Soil erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan (Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ☐ Land form
- ☐ Land form unit
- ☐ Slope
- ☐ Vegetation
- ☐ Land use

Water

Distance to permanent water source ☐ metres

Distance to temporary water source ☐ metres

Name of nearest permanent water source ☐

Name of nearest temporary water ☐

Stone Artefact

Instance No.	Recording Date	Artefact Material	Artefact Type	Platform Surface	Platform Type	Termination	Cross Section	Length (mm)	Width (mm)	Thickness (mm)

Other Artefact Type

Instance No.	Recording Date	Artefact Material	Artefact Type	Description	Length (mm)	Width (mm)	Thickness (mm)

Material

- Basalt
- Chert
- Fine grained siliceous
- Granite
- Quartz
- Quartzite
- Sandstone
- Silcrete
- Green glass
- Amber glass
- Amethyst glass
- Clear glass
- Ceramic
- Porcelain
- Tin can
- Wire
- Nail
- Button
- Shell
- Bone
- Wood
- Resin

Artefact Description

- Adze
- Anvil
- Axe
- Backed blade
- Blade
- Core
- Core tool
- Cyclon
- Distal fragment
- Eloura
- Flake
- Flake tool
- Flaked piece
- Hammerstone
- Manuport
- Milling slab
- Mortar
- Muller
- Nuclear tool
- Pirri
- Proximal fragment
- Tula
- Other diagnostic type
- Modified
- Unworked

Platform Surface

- Cortex
- Flake scar
- More than one flake scar
- Faceted
- Ground
- Indeterminate
- Bipolar

Termination

- Feather
- Hinge
- Step
- Outrepasse
- Bipolar

Platform Type

- Wide
- Focal
- Shattered
- Indeterminate
- Bipolar

Cross Section

- High/strong
- High/weak
- Low/weak
- Irregular

Comments:

NPWS FEATURE RECORDING FORM - MODIFIED TREE

Site I.D.

Site Name: RPS MP1

First recorded date

Importance: Cannot be presently determined

Aboriginal Information Recorded? No

No. of instances

Recorded by

Feature description

Easting: 3 6 4 9 3 0 Northing: 6 3 3 6 6 8 9

No. of scars: 1

No. of carved panels

Feature Condition

- [ ] Very good
- [ ] Good
- [x] Poor

Condition

- [x] Weathered
- [ ] Ringbarked
- [x] Fire damage
- [ ] Vehicle damage
- [x] Insects/termites
- [ ] Rot
- [ ] Limb fall
- [ ] Stock damage

Recommended Action

- [ ] Fencing
- [ ] Closure to public
- [ ] Continued inspection
- [ ] Expert assessment
- [ ] Fire hazard reduction
- [ ] Insect removal
- [ ] Meeting with land manager
- [ ] Rubbish removal
- [ ] Signage
- [ ] Tree health assessment
- [ ] Track closure/re-routing
- [ ] Additional recording

Feature environment

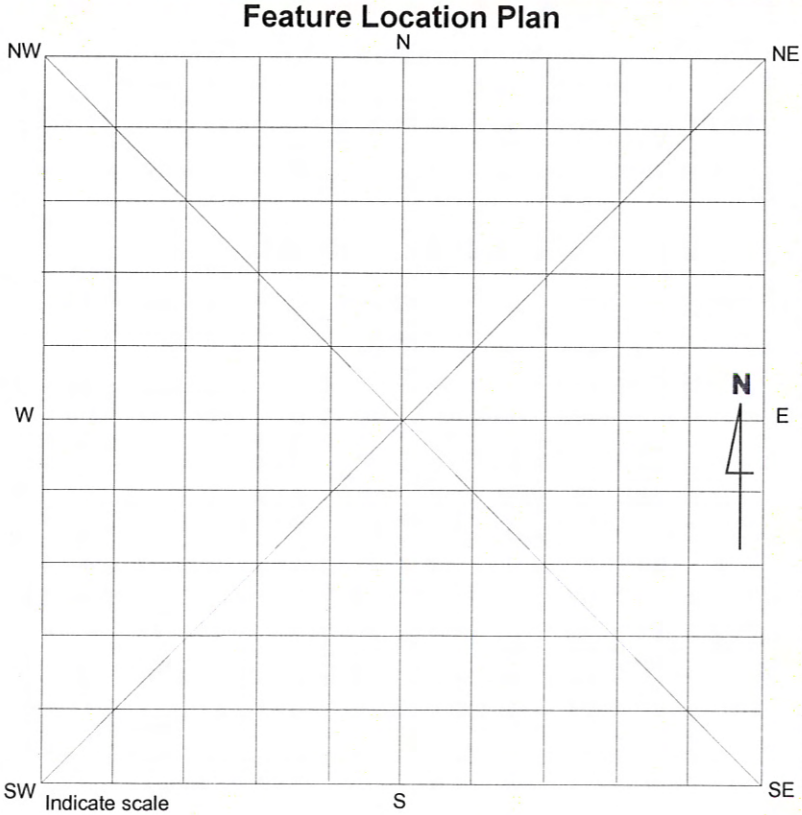
(Complete when *feature* environment differs to *site* environment, use attributes from cover card, page 2)

Hills	Land form
upper slope	Land form unit
5deg	Slope
open forest	Vegetation
crown land	Land use

Water

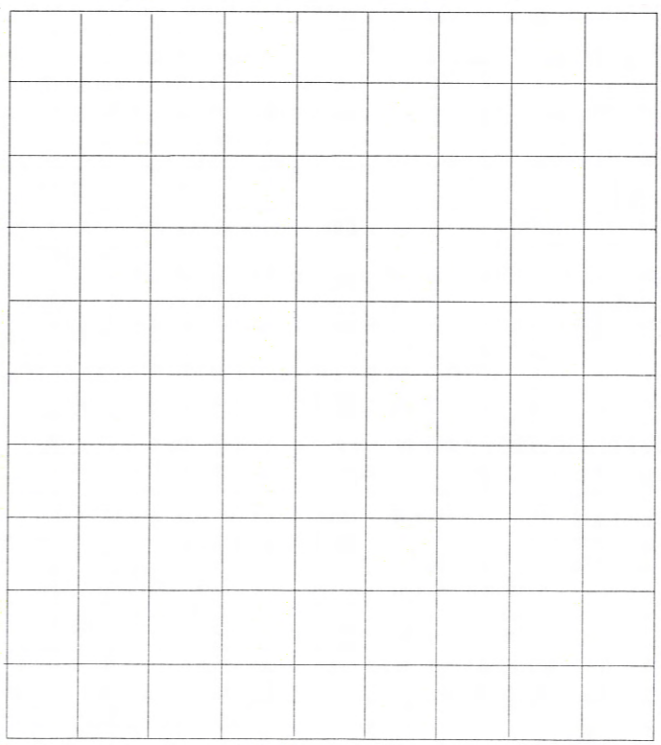
Distance to permanent water source	750 metres
Distance to temporary water source	metres
Name of nearest permanent water source	unamed creek
Name of nearest temporary water	

Feature Location Plan



Indicate scale

Scar/Carved Panel Drawing



Attach additional drawings

NPWS FEATURE RECORDING TABLE - MODIFIED TREE

Instance No.	Recording Date	Type	Species	Living Status	Tree Status	Regrowth	Length of Scar	Width of Scar	Depth	Height Above Ground	No. of Scars	Shape	No. of Carved Panels	Carving Type	Orientation	Axe Marks
1	24/06/201	Scarred	Eucalypt	Dying	Standing	No	320	190	35	1,300	1	Oval				Indeterm

Type of Tree	**Tree Species**	**Living Status**	**Tree Status**	**Regrowth**
Carved Tree	Eucalypt	Dead	Standing	Yes
Scarred Tree	Red Gum	Alive	Lying down	No
Carved/Scarred Tree	Angotha	Dying	Partially felled	
			Subject to salinity	
			Not *in situ*	

Scar Shape	**Carving Type**	**Axe Marks**	**Orientation**
Oval	Linear	Metal	North East
Rectangular	Geometric	Stone	East
Square	Pictorial	Indeterminate	South East
Round			South
Other			South West
			West
			North West
			North

Comments:
the tree is alive but in poor condition with damage from a lightening strike, bushfire and insects.

NPWS FEATURE RECORDING FORM - GROOVE

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Description

Type of Grinding Feature

- ☐ Broad
- ☐ Narrow/point
- ☐ Hollow
- ☐ Flat

Seed Species Present Recording date ____/____/____

Groove Function

Profile Shape

- ☐ 'U' shaped
- ☐ 'V' shaped
- ☐ Flat

Dimensions

Smallest	Largest	
Length (mm)	Length (mm)	Groove count
Width (mm)	Width (mm)	Cluster count
Depth (mm)	Depth (mm)	

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature ____ Length (m) ____ Width (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised

General Condition ctd

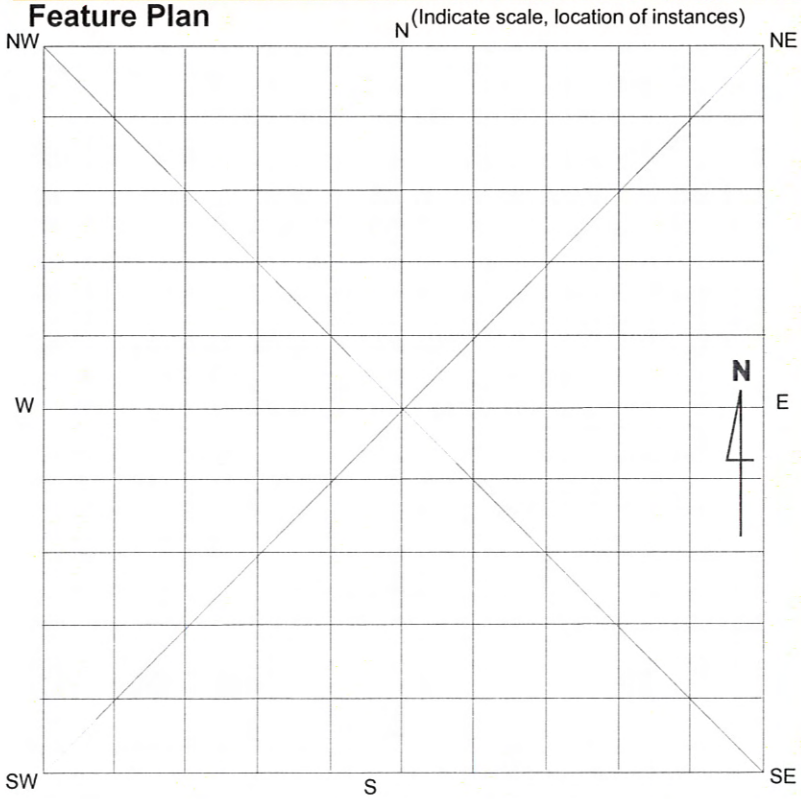
- ☐ Fire damage
- ☐ Surface water wash
- ☐ Graffiti
- ☐ Vehicle damage
- ☐ Erosion
- ☐ Stock damage

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING FORM - ART

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Pigment ☐ Engraved ☐ Super-impositioning ☐

Artwork Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti
- ☐ Fire damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock
- ☐ Unstable structure

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Dripline
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Insect/bird nest removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

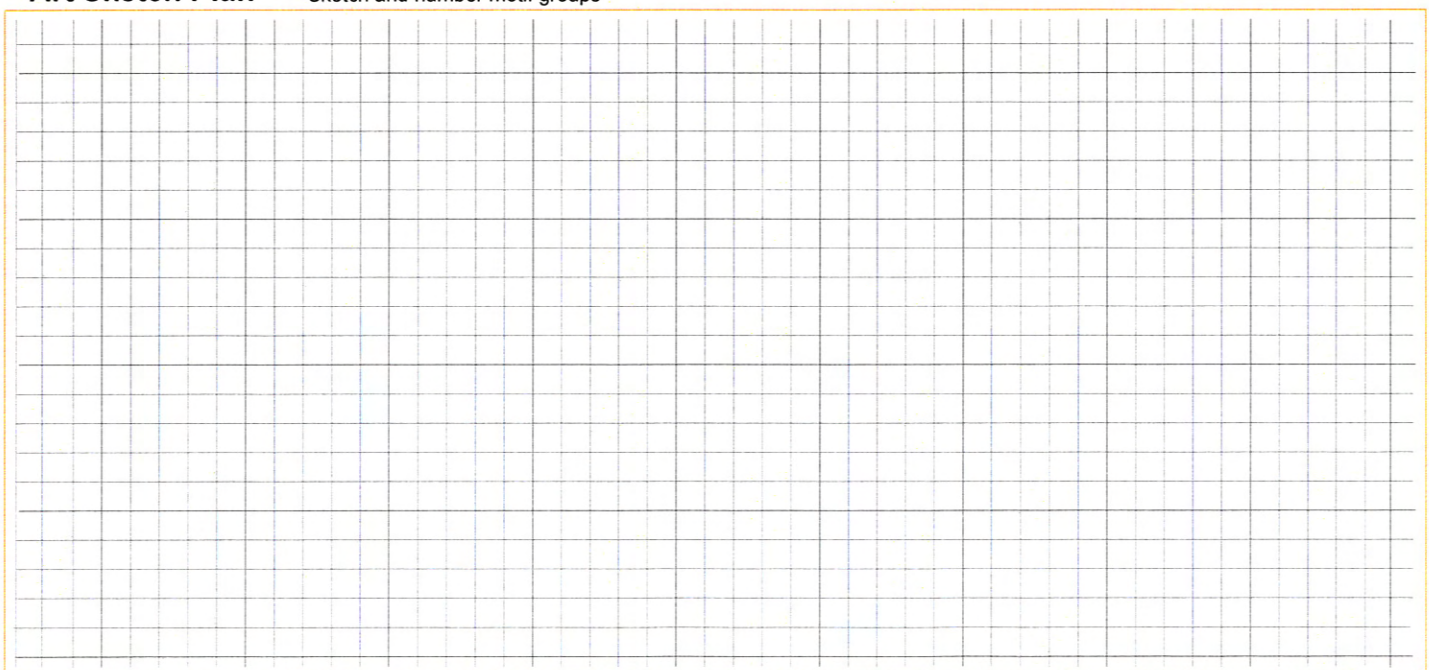
- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

- Distance to permanent water source ____ metres
- Distance to temporary water source ____ metres
- Name of nearest permanent water source ____
- Name of nearest temporary water ____

Art Sketch Plan

Sketch and number motif groups



NPWS FEATURE RECORDING TABLE - ART MOTIF

Instance	Recording Date	Motif	Application Technique	Form	Main Colour	Location	Condition

Motif

Anthropomorphic
Bird
Bird Track
Canoe
Circle
Contact material culture
Duck
Eel
Emu
Emu track
European figure
Female
Fish
Foot
Hand
Jellyfish
Kangaroo
Line
Lizard
Macropod
Macropod Track
Male
Marine-Other
Other
Pattern
Quadruped
Reptile
Rifle
Shield
Ship
Snake
Spear
Wallaby

Application Technique

Abraded
Drawn
Other
Painted
Pecked
Pigment & Engraved
Stencilled

Form

Fill
Line
Line+ Fill
Other
Pattern

Main Colour

Black
Mauve *
N/A
Orange *
Other
Red *
White *
Yellow *

Art Location

All over shelter surfaces
ceiling
Floor
Mostly near largest sheltered space
Mostly on out of the way surfaces
Other
Wall

Condition

Faded
Stained
Mineralisation Evident
V brant Colours
Unweathered
Weathered

Comments:

NPWS FEATURE RECORDING FORM - SHELL

Site I.D. ☐ Site Name ☐

First recorded date ☐/☐/☐ **Importance** ☐ **Aboriginal Information Recorded?** ☐

No. of instances ☐

Recorded by ☐

Feature Context & Condition

Easting ☐☐☐☐☐☐ Northing ☐☐☐☐☐☐☐

Dimensions of Whole Feature

☐ Length (m) ☐ Width (m) ☐ Depth (m)

Shell Distribution

☐ Surface scatter

☐ Stratified deposit

☐ Mounded

☐ Distance to high water mark (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti

General Condition ctd

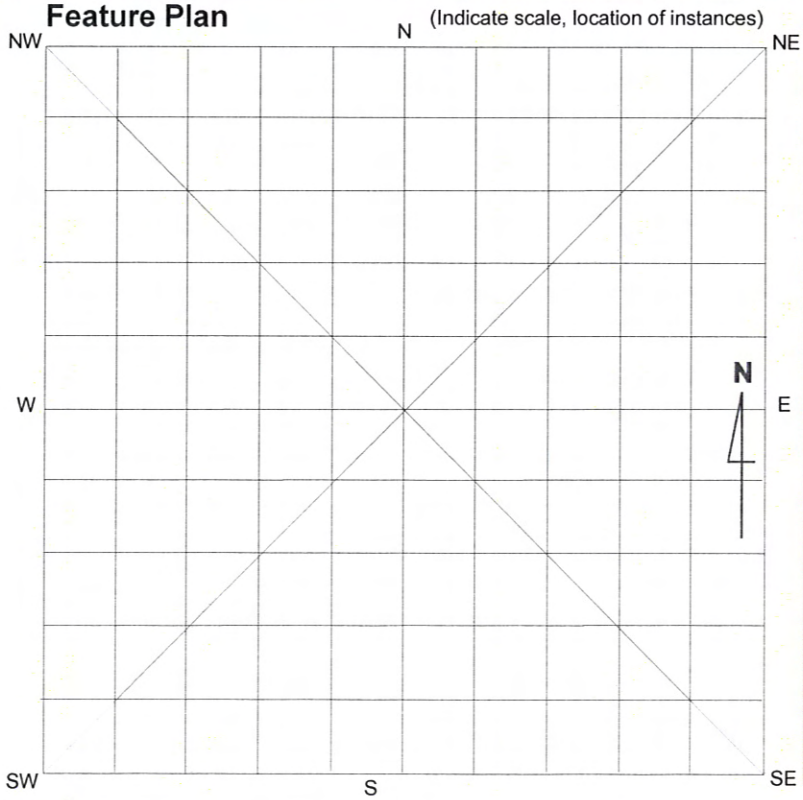
- ☐ Fire damage
- ☐ Vehicle damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock damage
- ☐ Unstable structure
- ☐ Exposed bone material
- ☐ Exposed archaeological material

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Insect/bird nest removal
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

☐ Land form

☐ Land form unit

☐ Slope

☐ Vegetation

☐ Land use

Water

Distance to permanent water source ☐ metres

Distance to temporary water source ☐ metres

Name of nearest permanent water source ☐

Name of nearest temporary water ☐

Instance No.	Recording Date	Shell Species	% of this species shell to % total of other shell

Species

Anadara	Nerita
Bimbala	Ocean Snail
Chiton	Periwinkle
Cowrie	Pippi
Dog Cockle	Ribbed Cockle
Duck Bill	Rock Oyster
Limpit	Thiad
Mud oyster	Triton
Mutton Fish	Turban (large)

Percentage of this Species Shell to Percentage Total of other Shell

0 – 9%
10 – 19%
20 – 29%
30 – 39%
40 – 49%
50 – 59%
60 – 69%
70 – 79%
80 – 89%
90 – 100%

Comments:

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville NSW 2220

Department of Environment & Climate Change NSW

Office Use Only

Site Number | | | - | | - | | | | |

Date received / / Date entered into system / / Date catalogued / /

Entered by (I.D.)

Information Access

☐ Gender/male ☐ Gender/female ☐ Location restriction ☐ General restriction ☐ No access

Office Use Only

For Further Information Contact:

☐ **Nominated Trustee**

Title	Surname	First Name	Initials

Organisation

Address

Phone number Fax

Client on system ☐

☐ **Knowledge Holder**

Title	Surname	First Name	Initials
Mr	Frost	Shane	

Organisation Awabakal Descendd Trad Own

Address po Box 86 Clarencetown

Phone number 0428320671 Fax

Client on system ☐

Aboriginal Heritage Unit or Cultural Heritage Division Contacts

Geographic Location

Site Name RPS MB1

Easting 365025 Northing 6341071 AGD/GDA GDA

Mapsheet sWANSEA

Zone 56 Location Method Differential GPS

Other Registration

Primary Recorder

Title	Surname	First Name	Initials
Mrs	Nelson	Laraine	

Organisation RPS Group

Address PO Box 428 Hamilton

Phone number 49404200 Fax

Date recorded 22/06/2010

Client on system ☐

NPWS Aboriginal Site Recording Form - Site Information

OPEN/CLOSE SITE: Open Site

Site Context

Landform

- [ ] Mountainous
- [ ] Plain
- [x] Rolling hills
- [ ] Steep hills
- [ ] Undulating plain

Slope

[ ] degrees

Landform Unit

- [ ] Beach
- [ ] Coastal rock platform
- [ ] Dune
- [ ] Intertidal flat
- [ ] Lagoon
- [ ] Tidal Creek
- [ ] Tidal Flat
- [ ] Cliff
- [ ] Crest
- [ ] Flat
- [x] Lower slope
- [ ] Mid slope
- [ ] Upper slope
- [ ] Plain
- [ ] Ridge
- [ ] Tor
- [ ] Valley flat
- [ ] Levy
- [ ] Stream bank
- [ ] Stream channel
- [ ] Swamp
- [x] Terrace
- [ ] Terrace flat

Vegetation

- [ ] Closed forest
- [ ] Grasslands
- [ ] Isolated clumps of trees
- [x] Open forest
- [ ] Open woodland
- [ ] Scrub
- [ ] Woodland
- [ ] Cleared
- [ ] Revegetated
- [ ] N/A

Land use

- [x] Conservation
- [ ] Established urban
- [ ] Farming-intensive
- [ ] Farming-low intensity
- [ ] Forestry
- [ ] Industrial
- [ ] Mining
- [ ] Pastoral/grazing
- [ ] Recreation
- [ ] Semi-rural
- [ ] Service corridor
- [ ] Transport corridor
- [ ] Urban expansion
- [ ] Residential

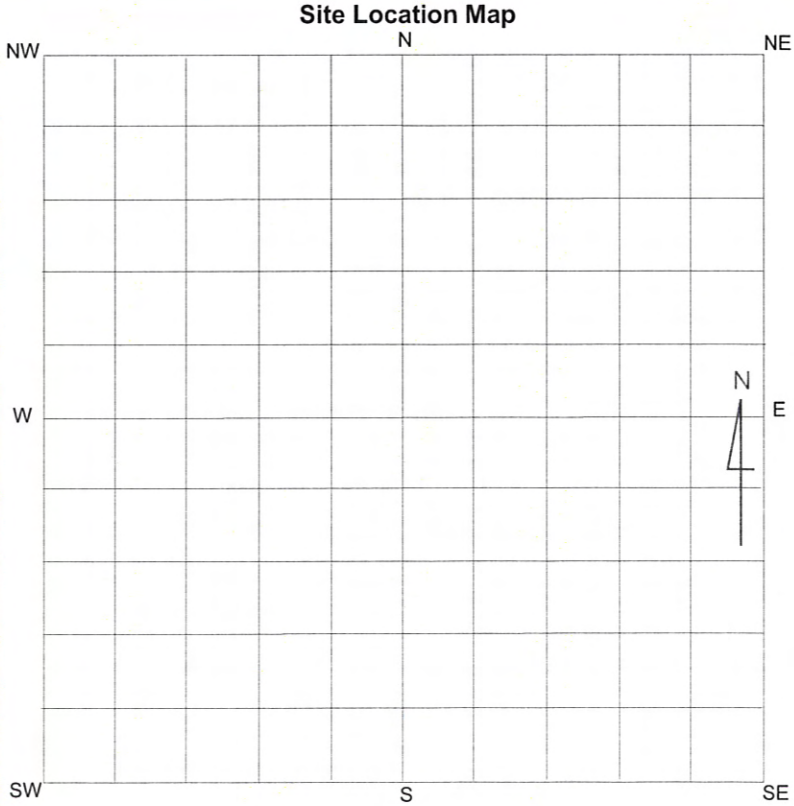
Water

Distance to permanent water source	? metres
Distance to temporary water source	? metres
Name of nearest permanent water source	
Name of nearest temporary water	

Directions for Relocation

Access from the northern end of the Myuna Bay foreshore park car park. Follow walking track for 100 metres north east the shell is visible in the track.

Site Location Map



Current Land Tenure

- [ ] Public — National Park / other Government Dept.
- [ ] Private

Primary report I.D. [ ] (I.D. Office Use only)

NPWS Aboriginal Site Recording Form - Site Information

General Site Information

Closed Site

Shelter/Cave Formation

- ☐ Boulder
- ☐ Wind erosion
- ☐ Water erosion
- ☐ Rock collapse

Rock Surface Condition

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Condition of Ceiling

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Shelter Aspect

- ☐ North
- ☐ North East
- ☐ East
- ☐ South East
- ☐ South
- ☐ South West
- ☐ West
- ☐ North West

Open Site

Site Orientation

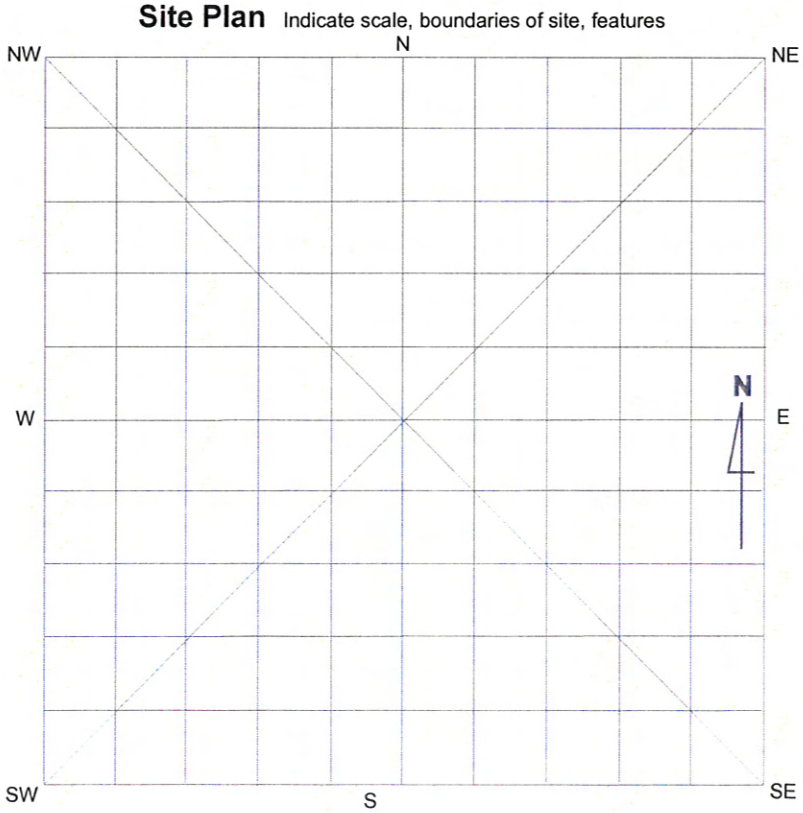
- ☐ N-S
- ☐ NE-SW
- ☐ E-W
- ☐ SE-NW
- ☑ N/A

Features

- ☐ 1. Aboriginal Ceremony & Dreaming
- ☐ 2. Aboriginal Resource & Gathering
- ☐ 3. Art
- ☐ 4. Artefact
- ☐ 5. Burial
- ☐ 6. Ceremonial Ring
- ☐ 7. Conflict
- ☐ 8. Earth Mound
- ☐ 9. Fish Trap
- ☐ 10. Grinding Groove
- ☐ 11. Habitation Structure
- ☐ 12. Hearth
- ☐ 13. Non Human Bone & Organic Material
- ☐ 14. Ochre quarry
- ☐ 15. Potential Archaeological Deposit
- ☐ 16. Stone Quarry
- ☑ 17. Shell
- ☐ 18. Stone Arrangement
- ☐ 19. Modified Tree
- ☐ 20. Water Hole

Site Plan

Indicate scale, boundaries of site, features



Site Dimensions

Closed Site Dimensions (m)

- ☐ Internal length
- ☐ Internal width
- ☐ Shelter height
- ☐ Shelter floor area

Open Site Dimensions (m)

- 20m Total length of visible site
- 1m Average width of visible site
- 20m Estimated area of visible site
- 100m Length of assessed site area

Aboriginal Community Interpretation and Management Recommendations

Preliminary Site Assessment

Site Cultural & Scientific Analysis and Preliminary Management Recommendations

This section should only be filled in by the Endorsees

Endorsed by: ☐ Knowledge Holder ☐ Nominated Trustee ☐ Native Title Holder ☐ Community Consensus

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Attachments (No.)

- ☐ A4 location map
- ☐ B/W photographs
- ☑ Colour photographs
- ☐ Slides
- ☐ Aerial photographs
- ☐ Site plans, drawings
- ☐ Recording tables
- ☐ Other
- ☐ Feature inserts-No. ☐

Comments

NPWS FEATURE RECORDING FORM - ARTEFACT

Site I.D. ☐ Site Name ☐

First recorded date ☐ **Importance** ☐

No. of instances ☐

Recorded by ☐

	Yes	No
Stone artefacts only	☐	
Artefacts collected	☐	
Permit issued	☐	

Percentage of Non-stone Artefacts to Percentage of Stone Artefacts

0-9% 10-19% 20-29% 30-39% 40-49% 50-59% 60-69% 70-79% 80-89% 90-100%

☐

Feature Context & Condition

Scatter No. ☐ Easting ☐☐☐☐☐☐ Northing ☐☐☐☐☐☐☐

Density (Artefact count per square metre) ☐

Dimensions ☐ Length (m) ☐ Width (m) ☐ Depth (m)

	Yes	No
In situ	☐	
Stratified	☐	

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

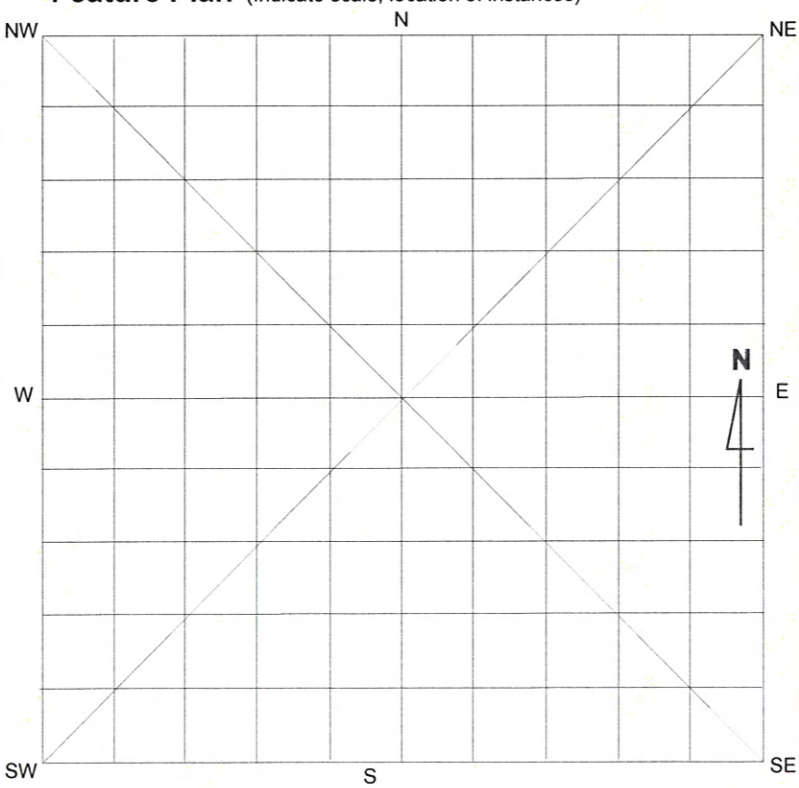
General Condition

- ☐ Weathered
- ☐ Vehicle damage
- ☐ Surface water wash
- ☐ Fire damage
- ☐ Erosion
- ☐ Stock damage
- ☐ Exposed archaeological material

Recommended Action

- ☐ Boardwalk
- ☐ Fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Fire hazard reduction
- ☐ Expert assessment
- ☐ Meeting with land manager
- ☐ Revegetation
- ☐ Signage
- ☐ Soil erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan (Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ☐ Land form
- ☐ Land form unit
- ☐ Slope
- ☐ Vegetation
- ☐ Land use

Water

Distance to permanent water source ☐ metres

Distance to temporary water source ☐ metres

Name of nearest permanent water source ☐

Name of nearest temporary water ☐

Stone Artefact

Instance No.	Recording Date	Artefact Material	Artefact Type	Platform Surface	Platform Type	Termination	Cross Section	Length (mm)	Width (mm)	Thickness (mm)

Other Artefact Type

Instance No.	Recording Date	Artefact Material	Artefact Type	Description	Length (mm)	Width (mm)	Thickness (mm)

Material

- Basalt
- Chert
- Fine grained siliceous
- Granite
- Quartz
- Quartzite
- Sandstone
- Silcrete
- Green glass
- Amber glass
- Amethyst glass
- Clear glass
- Ceramic
- Porcelain
- Tin can
- Wire
- Nail
- Button
- Shell
- Bone
- Wood
- Resin

Artefact Description

- Adze
- Anvil
- Axe
- Backed blade
- Blade
- Core
- Core tool
- Cyclon
- Distal fragment
- Eloura
- Flake
- Flake tool
- Flaked piece
- Hammerstone
- Manuport
- Milling slab
- Mortar
- Muller
- Nuclear tool
- Pirri
- Proximal fragment
- Tula
- Other diagnostic type
- Modified
- Unworked

Platform Surface

- Cortex
- Flake scar
- More than one flake scar
- Faceted
- Ground
- Indeterminate
- Bipolar

Termination

- Feather
- Hinge
- Step
- Outrepasse
- Bipolar

Platform Type

- Wide
- Focal
- Shattered
- Indeterminate
- Bipolar

Cross Section

- High/strong
- High/weak
- Low/weak
- Irregular

Comments:

NPWS FEATURE RECORDING FORM - MODIFIED TREE

Site I.D. ____ Site Name ____

First recorded date ____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature description

Easting ____ Northing ____

No. of scars ____

No. of carved panels ____

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

Condition

- ☐ Weathered
- ☐ Ringbarked
- ☐ Fire damage
- ☐ Vehicle damage
- ☐ Insects/termites
- ☐ Rot
- ☐ Limb fall
- ☐ Stock damage

Recommended Action

- ☐ Fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Fire hazard reduction
- ☐ Insect removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Tree health assessment
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature environment

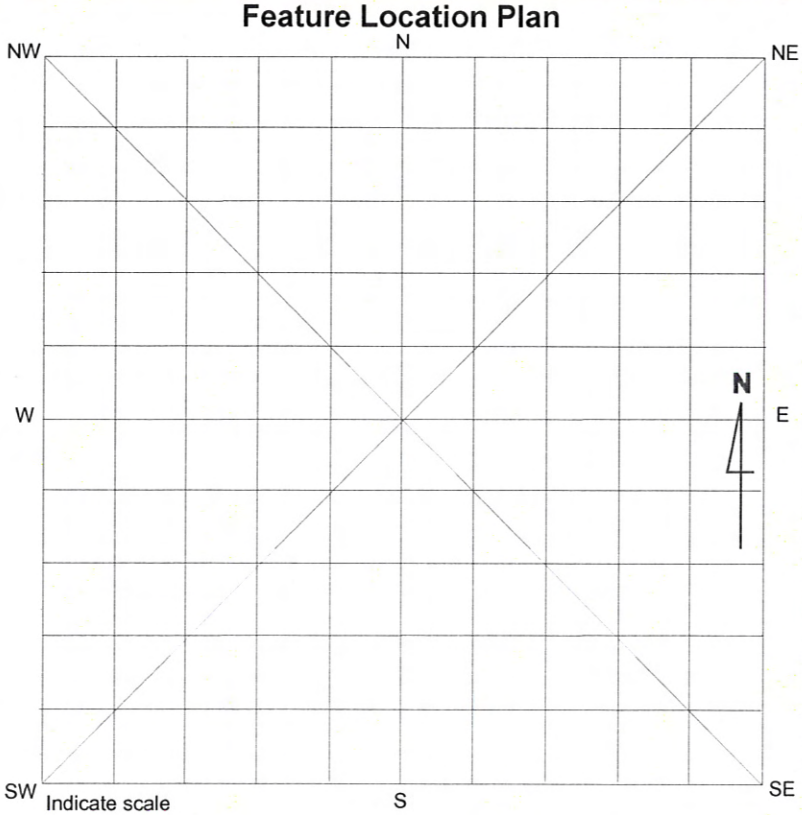
(Complete when *feature* environment differs to *site* environment, use attributes from cover card, page 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

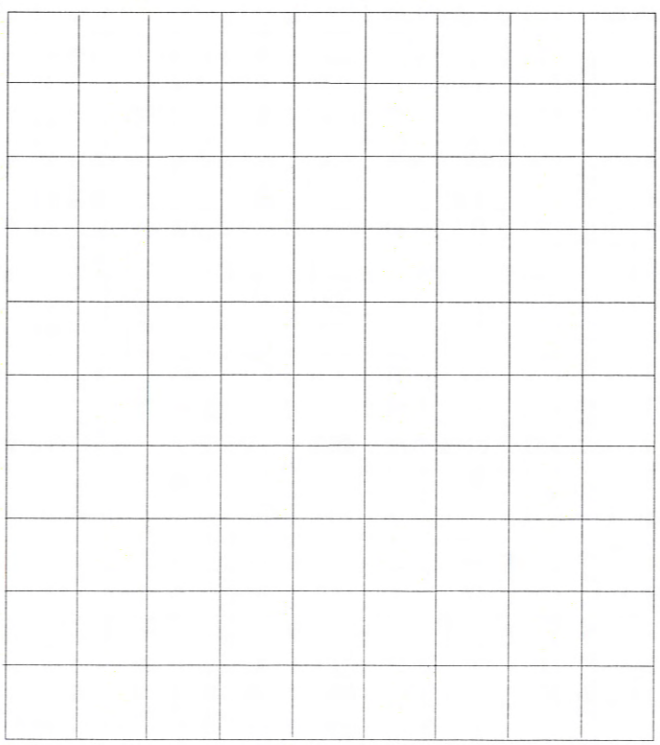
Water

- Distance to permanent water source ____ metres
- Distance to temporary water source ____ metres
- Name of nearest permanent water source ____
- Name of nearest temporary water ____

Feature Location Plan



Scar/Carved Panel Drawing



Attach additional drawings

NPWS FEATURE RECORDING TABLE - MODIFIED TREE

Instance No.	Recording Date	Type	Species	Living Status	Tree Status	Regrowth	Length of Scar	Width of Scar	Depth	Height Above Ground	No. of Scars	Shape	No. of Carved Panels	Carving Type	Orientation	Axe Marks

Type of Tree	**Tree Species**	**Living Status**	**Tree Status**	**Regrowth**
Carved Tree	Eucalypt	Dead	Standing	Yes
Scarred Tree	Red Gum	Alive	Lying down	No
Carved/Scarred Tree	Angotha	Dying	Partially felled	
			Subject to salinity	
			Not *in situ*	

Scar Shape	**Carving Type**	**Axe Marks**	**Orientation**
Oval	Linear	Metal	North East
Rectangular	Geometric	Stone	East
Square	Pictorial	Indeterminate	South East
Round			South
Other			South West
			West
			North West
			North

Comments:

NPWS FEATURE RECORDING FORM - GROOVE

Site I.D. ____ Site Name ____

First recorded date ____/____/____ Importance ____ Aboriginal Information Recorded? ____

No. of instances ____

Recorded by ____

Feature Description

Type of Grinding Feature

- ☐ Broad
- ☐ Narrow/point
- ☐ Hollow
- ☐ Flat

Seed Species Present Recording date ____/____/____

Groove Function

Profile Shape

- ☐ 'U' shaped
- ☐ 'V' shaped
- ☐ Flat

Dimensions

Smallest	Largest	
Length (mm)	Length (mm)	Groove count
Width (mm)	Width (mm)	Cluster count
Depth (mm)	Depth (mm)	

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature ____ Length (m) ____ Width (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised

General Condition ctd

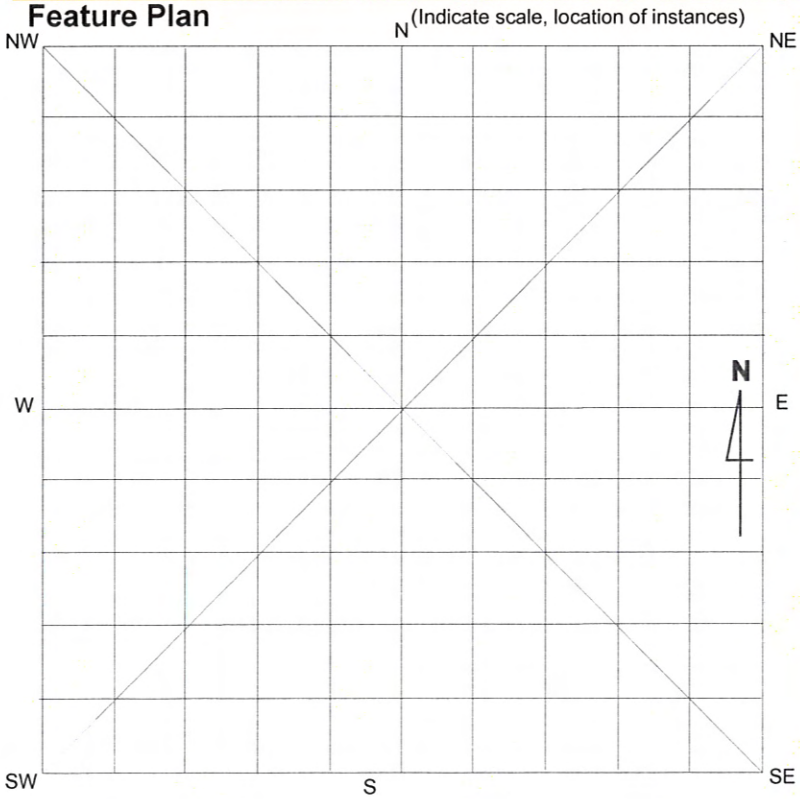
- ☐ Fire damage
- ☐ Surface water wash
- ☐ Graffiti
- ☐ Vehicle damage
- ☐ Erosion
- ☐ Stock damage

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING FORM - ART

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Pigment ☐ Engraved ☐ Super-impositioning ☐

Artwork Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti
- ☐ Fire damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock
- ☐ Unstable structure

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Dripline
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Insect/bird nest removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

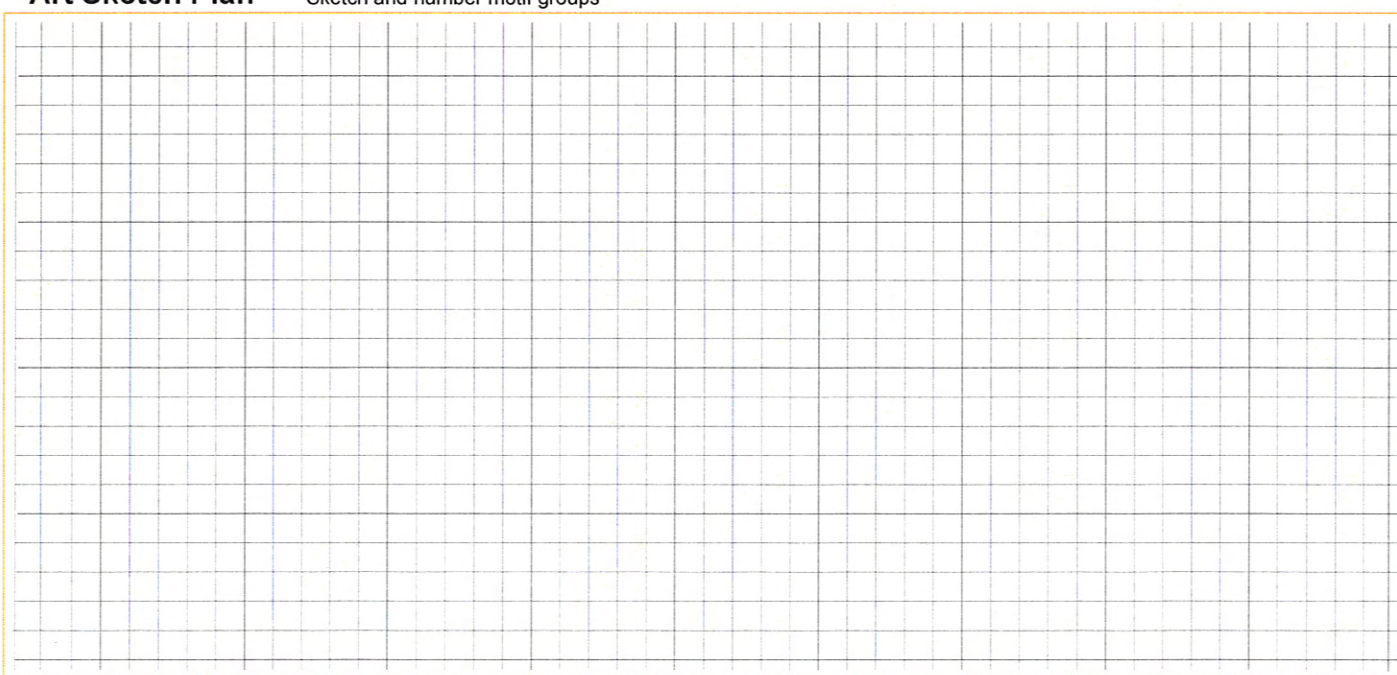
- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

- Distance to permanent water source ____ metres
- Distance to temporary water source ____ metres
- Name of nearest permanent water source ____
- Name of nearest temporary water ____

Art Sketch Plan

Sketch and number motif groups



Instance	Recording Date	Motif	Application Technique	Form	Main Colour	Location	Condition

Motif

Anthropomorphic
Bird
Bird Track
Canoe
Circle
Contact material culture
Duck
Eel
Emu
Emu track
European figure
Female
Fish
Foot
Hand
Jellyfish
Kangaroo
Line
Lizard
Macropod
Macropod Track
Male
Marine-Other
Other
Pattern
Quadruped
Reptile
Rifle
Shield
Ship
Snake
Spear
Wallaby

Application Technique

Abraded
Drawn
Other
Painted
Pecked
Pigment & Engraved
Stencilled

Form

Fill
Line
Line+ Fill
Other
Pattern

Main Colour

Black
Mauve *
N/A
Orange *
Other
Red *
White *
Yellow *

Art Location

All over shelter surfaces
ceiling
Floor
Mostly near largest sheltered space
Mostly on out of the way surfaces
Other
Wall

Condition

Faded
Stained
Mineralisation Evident
V brant Colours
Unweathered
Weathered

Comments:

NPWS FEATURE RECORDING FORM - SHELL

Site I.D. [ ] Site Name RPS MB 1

First recorded date 22/06/2010 **Importance** Cannot be presently determined **Aboriginal Information Recorded?** [ ]

No. of instances 1

Recorded by Laraine Nelson

Feature Context & Condition

Easting 3 6 5 0 2 5 Northing 6 3 4 1 0 7 1

Dimensions of Whole Feature

20 Length (m) 1 Width (m) [ ] Depth (m)

Shell Distribution

- [x] Surface scatter
- [ ] Stratified deposit
- [ ] Mounded

15 Distance to high water mark (m)

Feature Condition

- [ ] Very good
- [ ] Good
- [x] Poor

General Condition

- [x] Weathered
- [ ] Vandalised
- [x] Surface water wash
- [ ] Mineralisation
- [ ] Graffiti

General Condition ctd

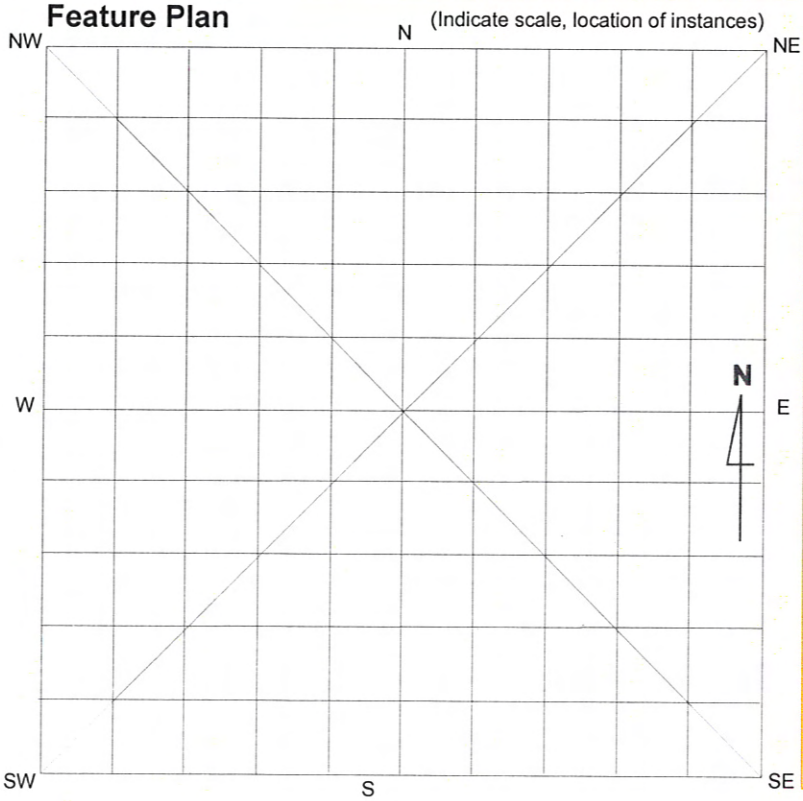
- [ ] Fire damage
- [ ] Vehicle damage
- [ ] Insects/termites
- [x] Erosion
- [ ] Stock damage
- [ ] Unstable structure
- [ ] Exposed bone material
- [x] Exposed archaeological material

Recommended Action

- [ ] Boardwalk
- [ ] Cage/barrier/fencing
- [ ] Closure to public
- [ ] Continued inspection
- [ ] Expert assessment
- [ ] Fire hazard removal
- [ ] Graffiti removal
- [ ] Meeting with land manager
- [ ] Insect/bird nest removal
- [ ] Revegetation
- [ ] Rubbish removal
- [ ] Signage
- [ ] Erosion control
- [ ] Track closure/re-routing
- [ ] Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

Hills Land form

terrace Land form unit

nil Slope

open forest Vegetation

crown land Land use

Water

Distance to permanent water source [ ] metres

Distance to temporary water source [ ] metres

Name of nearest permanent water source

unknown

Name of nearest temporary water

unknown

Instance No.	Recording Date	Shell Species	% of this species shell to % total of other shell
1	24/06/2010	Anandara	90-100%
	24/06/2010	Mud Oyster	0-9%

Species

Anadara	Nerita
Bimbala	Ocean Snail
Chiton	Periwinkle
Cowrie	Pippi
Dog Cockle	Ribbed Cockle
Duck Bill	Rock Oyster
Limpit	Thiad
Mud oyster	Triton
Mutton Fish	Turban (large)

Percentage of this Species Shell to Percentage Total of other Shell

0 – 9%
10 – 19%
20 – 29%
30 – 39%
40 – 49%
50 – 59%
60 – 69%
70 – 79%
80 – 89%
90 – 100%

Comments:

The shell is observed in a narrow walking track. . Vegetation may cover other midden material off the track. The shell occurs intermittently and in small clusters over the 20 metres. .

Appendix 6

Aboriginal Feedback and Community Responses

14 September 2010

RPS- Harpers O'Sullivan
Attn: Laraine Nelson
Senior Archaeologist
PO Box 428
Hamilton NSW 2303

Dear Laraine,

Re: Comments Regarding the Myuna Colliery Extension of Mining Cultural Heritage Assessment Draft Report

Please find below our comments regarding the Myuna Colliery Extension of Mining Cultural Heritage Assessment Draft Report and Site Survey Field Inspection Report.

We would like to thank RPS for the opportunity to comment and request that a copy of the Final Report is forwarded to the Awabakal Traditional Owners Aboriginal Corporation at your earliest convenience.

If you require any further information please do not hesitate in contacting me.

Yours sincerely,

K. Brauer

Kerrie Brauer
Director | Administration

Awabakal Traditional Owners Aboriginal Corporation
ABN: 90 203 408 390 | ICN: 4411
PO Box 253 Jesmond NSW 2299 Australia
T: 61 2 49 58 81 70 | E: info@awabakal.com.au | www.awabakal.com.au

Myuna Colliery Extension of Mining Draft Report

Comments Regarding Aboriginal Heritage Assessment Draft Report
Site Survey Field Inspection Report

For

RPS – Harpers Somers O'Sullivan
Attn: Laraine Nelson
Senior Archaeologist
PO Box 428
HAMILTON NSW 2303

By

Kerrie Brauer
Site Officer

Telephone: (02) 49588170
Mobile: 0412866357

September 2010

Table of Contents

Aboriginal Site Assessment

The Awabakal Traditional Owners Aboriginal Corporation Aboriginal site assessment 'walk on country' was conducted within the proposed project area on Tuesday 22nd and Thursday 24th June 2010. Kerrie Brauer attended the site inspection and a foot survey was conducted along the proposed Myuna Colliery Extension of Mining Project area.

The primary objective of the preliminary Aboriginal Heritage assessment is to ascertain the presence of any areas of cultural or archeological significance within the study area. The project area is defined to seeking approval under Part 3A of the Environmental Planning and Assessment Act 1979 for an extension of underground mining at Myuna Colliery.

We would like to affirm that the observation and information gathering process presented evidence of Shell Middens, artifacts, stone arrangement, rock shelters and a scared tree within the proposed project area. The investigative observation indicates that there is a high potential for Aboriginal cultural material to be concealed below the vegetated ground surface as a result of the general use of the area.

The site was inspected and assessed for artifacts and further evidence that would indicate cultural heritage values and an Aboriginal presence. However, it should not be assumed that Aboriginal cultural heritage values or additional artifacts do not exist within the proposed project area.

The project area contains culturally significant sites that include evidence of Awabakal occupation. The survey provided a holistic assessment both adverse and positive, and placed the proposed project in the context of other mining projects within close proximity. The current level of impact on the cultural heritage values associated with the site was evident by the walking tracks used by the community.

We believe that the structure and context of the landscape of the surrounding project area relates to distinctive factors that are associated to Aboriginal inhabitance. Therefore, we recommend that the Mitigation Strategy Measures needs to reflect all possible aspects considering the possibility of subsidence under the culturally sensitive sites. We highly recommend that we have the opportunity to inspect the culturally sensitive sites (shell middens, stone arrangements etc) after mining underneath these sites are completed.

As the proposed project contains culturally sensitive areas we recommend that an Aboriginal Management Committee be established to direct the sensitive Cultural Heritage aspects within the Proposed Project area for the life of the mine.

Cultural Historical Overview of the Awabakal People

The Awabakal Traditional Owners Aboriginal Corporation members are descendants of the Awabakal People and accordingly have a spiritual connection and a primary association with our cultural boundary. The Awabakal Descendants are recognised as the Traditional Owners within the Aboriginal and wider communities and adjoining Indigenous Nations. We are a registered Aboriginal Corporation under the Federal Governments Aboriginal Corporations Act and we are registered with the Department of Environment, Climate Change and Water (DECCW).

We, as the Descendants of the Awabakal People believe that it is important to protect the Cultural Heritage of our Ancestors. Life here prior to colonisation had an abundant existence, and resources such as seafood, wildlife and plants abounded.

The use of stone tools is undeniably associated with a certain relationship with the natural environment. The high level of history already documented from the region is an indication that this area was utilised by the Awabakal People prior to European Occupation.

Since the earliest days of colonial impact, our history has been a well-documented one, with the most reliable information relayed by our peoples first hand, and also supplemented by non-Indigenous observation and interpretation. This cultural environment is a holistic one that interconnects our spirituality with our land and sea country to our peoples past, present and future. Today, the descendants of the Awabakal People believe now more than ever, that it is essential to nurture new visions that are inspired by the cultural integrity of their ancestral family.

Though the Awabakal experience since colonisation has been marred with violence, disrespect and complexity, the acknowledgment of the Awabakal cultural base is still critical in understanding the purpose of the region's future. The principles of the Awabakal Tradition and Culture still exists today to keep intact the moral and spiritual fibre of this land and sea country, giving direction to all who live within the land of the Awabakal People.

Aboriginal people are connected through their own unique cultural tapestry that is complex, which entwines the people with the land, language, totems and kinship relationships to their sacred dreaming, culture and heritage.

Our ancestors taught us to love and take care of our own country, and not to desire the lands that belong to the people of other nations.

This region is full of meaningful cultural reminders that speak to the present day through the Awabakal Creation Stories, Language and Art. The principles of traditional culture are there to keep intact the moral and spiritual fibre of Aboriginal People to survive in the land of their Ancestors.

Aboriginal Cultural Significance

We would like to take this opportunity to clarify our position being the direct descendants of the Traditional Awabakal People of the Lake Macquarie and Newcastle Region. As Awabakal Descendants our cultural association with the cultural area (Awabakal region) is derived through the history of our ancestors Margaret and Ned of the Awabakal People, the original inhabitants of the land.

Margaret and Ned are a well documented Aboriginal couple of whom numerous newspaper articles and several books have recorded their lives within the Awabakal Nation. Margaret and Ned are remembered and celebrated in Lake Macquarie and have two Bays at Swansea respectfully named in their honour, Black Neds Bay and Margarets Bay. Margarets Bay was officially named by her descendants, and is adjacent to Parbury Park which in 1880 was part of a reserve set aside for the use of Margaret and her children.

The principle vision and aims of the Awabakal People is to protect the cultural heritage of our ancestors. Therefore, any artifacts and/or residual evidence of our people are held in high regard and are considered a cultural reminder that unites us with our country, our past and spirituality.

All land is culturally significant to Aboriginal people and therefore deserves the respect and sensitivity that connects us to our ancestral lands.

The districts surrounding the Myuna region is culturally significant to the Awabakal People who utilised and physically cared for the environment, and with the evidence already retrieved and documented from the region is a reasonable indication that this area was highly utilised by the Awabakal people prior to European settlement.

The region was utilised by the Awabakal People repeatedly for many purposes including ceremony, fishing, hunting and food gathering. This is evident by the vast amount of documentation recorded from the region. This evidence indicates a lifestyle of educational value of traditional occupation, and therefore demands the respect of the historical value that this particular and surrounding area provides.

This region is a reminder of the existence of our people, whose occupation is acknowledged and intrinsically connects us to the environment within the project area.

In our view, the Myuna region is a part of the land that facilitates and completes the landscape of the Awabakal boundary and echoes the ethos of our cultural heritage.

Our connection to our ancestral country is both physical and spiritual and the remnance of our cultural reminders are for the Awabakal people to interpret and pass on from generation to generation.

Draft Comments

With regard to the Myuna Colliery Extension of Mining Cultural Heritage Assessment Draft Report, we recognise the evaluation by RPS appears to be comprehensive.

We believe that the **Report** encompasses and provides a broad and informative overview regarding the many aspects associated with the Aboriginal Culture Heritage concerning the project area. We would like to highlight our appreciation of the informative process that the representative from RPS outlined during the survey assessment.

We believe that a statement of cultural significance from the Awabakal traditional descendants would add a critical understanding and perspective to the **Report**. We recommend that RPS makes an allowance for this type of statement to be included in this and future Cultural Heritage Assessments.

Our comments to the contents of the Myuna Colliery Cultural Heritage Assessment Draft Report are as follows:

Page 3, Executive Summary, We believe that the reference made to 'Aboriginal community representatives' in the **Report** should be changed to 'Registered Aboriginal Stakeholders', as the meaning of 'community' has a wider group connotation, whereas the meaning of 'Stakeholders' refers to independent parties and is more accurate and specific, and therefore we would like the **Report** to consistently refer to the 'Registered Aboriginal Stakeholders' instead of a generic 'Aboriginal community representatives'.

It is our interpretation that Aboriginal communities consist of Aboriginal people, many of whom have relocated into other Aboriginal Nations / Traditional Lands and need to demonstrate their respect of the culture and heritage of the region and the rights of the traditional descendants of the area, given that the Hunter and Lake Macquarie regions consist of many Aboriginal community members who have no cultural association with this land or heritage.

Page 3 Executive Summary, We are concerned that the Mitigation Measures within the **Report** does not provide and/or make any reference for the inclusion of any consultation involvement with the Registered Aboriginal Stakeholders.

Page 10, 1.1.2, We are concerned that the Aboriginal Cultural Sensitive areas have not been included within Zone A. We also believe that although this section states, and proposes that there will be no noticeable surface impact, there are no absolute guarantees that there will be negligible subsidence impact on the Aboriginal Cultural Sensitive areas. Therefore, we believe that site investigation of the culturally sensitive areas after mining extraction is completed is essential by the Registered Aboriginal Stakeholders and propose that this phase be included within the Mitigation Measures recommendations.

Page 11, 1.5, We have concerns that RPS may be operating outside DECCW Aboriginal Consultation Requirements in relation to timeframes for responding to the

proposed methodology and fieldwork. Our concerns were heightened by the timelines for responses for the methodology and for the dates of proposed fieldwork.

On the 1 June 2010 ATOAC received an email from RPS with an attached project outline and methodology, asking if we could possibly respond to the proposed Methodology by 28 June 2010. ATOAC responded to RPS by email on the 20 June 2010 with our comments regarding the methodology with a number of questions that needed to be answered for clarification so that we are able to make informed decisions regarding the proposed project.

We believe that we were not afforded adequate time to evaluate any further information required before the fieldwork had taken place, which was held within the methodology response timeframe, and consider the consultation process to be very rushed. With regard to the field survey, we had mentioned and considered that there was a limited amount of time allocated for such a large area to be surveyed.

We believe that the RPS process regarding Aboriginal consultation needs improving to provide an informative outline in the early stages of a proposed project. This can be achieved by meeting with the Registered Aboriginal Stakeholders to inform and discuss the proposed project to insure due diligence concerning the project methodology prior to fieldwork.

Page 22, 3.1, third paragraph, We believe that another descriptive word could have been used in this paragraph instead of the word… "exploit"…, as this word does invoke a different meaning. We suggest that the word… "utilise"…would be more appropriate to describe how our people made use of their resources.

We believe that other aspects could have been presented within the **Report** to highlight the connection, meaning and importance of what the land means to our people, the Awabakal.

Page 23, 3.2, We believe that the references made by Brayshaw may be misleading as it contradicts other reputable historical accounts and records, for example Threlkeld's historical account. We consider that these types of statements have the potential to misinform the reader which indicates a need to address, rather than obscure the cultural tribal boundary of this area. Therefore, we recommended that RPS provide a fair and balanced statement for a more correct evaluation of the Traditional Awabakal Cultural footprint mentioned in this **Report**.

We believe that a definition and meaning of Traditional Owners could be included to bring a greater understanding to the context. For example: Traditional Owners are descendants of the first peoples, who have a responsibility for caring for their particular ancestral country.

We also suggest that the reference to "Old Jacky's Tribe" (Threlkeld in Gunson 1974:241) be added to this section as it better describes our Awaba Clan Boundary in which Myuna Project sits within and would bring further clarification of the Awabakal perspective to the **Report**.

Page 33, 5.3, We believe that the reference made to the Lake Macquarie Aboriginal Heritage Management Strategy which RPS indicates is discussed under this section in 5.2 may be misleading, as the **Report** makes reference to this aspect but does not include the Lake Macquarie Aboriginal Heritage Management Strategy.

Page 39, 6.1, We believe that the Discussion of Potential Sites is misleading as the Table does not include the results from the fieldwork. We consider that this section within the **Report** needs further clarification by adding that additional sites were found within the proposed project area.

Page 53, 8.3, We recommend that RPS may need to consider the value of 'place' within this section of the **Report**. We also believe that a Heritage and Cultural weighting would add context to the mix, as this consideration is to insure the protection and conservation of Place & Objects which impact significantly on the spirituality, cultural, historic and general legacy needs of Aboriginal people to address inequalities in social and community well being.

Page 56, 10, third paragraph, may be a typo with regard to European cultural heritage within this paragraph.

Page 56, 10, fourth paragraph, We believe that the reference…"Aboriginal community participants"…needs to be changed to ATOAC & ADTOAC, as the Traditional Awabakal Descendants were the participants who determined these sites as being significant and culturally sensitive.

Page 57, 11.1, We agree in principle with the recommendation outlining the consideration of a program to inspect/monitor the recorded sensitive Aboriginal Cultural Heritage sites if the Mining Application is approved. We believe this aspect should be reflected within the Mitigation Management Strategies.

Page 58, 12, Mitigation Measures, We agree in principle with the Mitigation Measures recommendations, and would further recommend that we have the opportunity to inspect the highly culturally sensitive sites after mining underneath these areas are completed.

With regard to the Mitigation Measures we express a high level of alarm and distress regarding the probability of risk to our cultural heritage values through the proposed activity seeking permit approval by Myuna Colliery.

We believe that the Mitigation Measures are inadequate regarding the scenario of disturbance to our cultural heritage we state that we find this highly disturbing and that mining activity may be given greater weighting than conservation.

Empirical learning demonstrates that the impact of subsidence can have devastating effects on our cultural heritage landscape and features and our cultural heritage is coming under increasing and continuing pressure and risk because of the volume and level of mining activity. We believe that there is potential for subsurface subsidence within the proposed project.

Continued multiple adverse impacts place increasing environmental and cultural heritage values stress on our landscape and specifically to our features and objects which provide a rich evidence of our social function which extended beyond pre-contact into and continuing through post contact, tool ingenuity, ceremony and Dreamtime and commerce and trade, as well as architecture and housing and food and remedial knowledge and practices.

The Awabakal Traditional Owners Aboriginal Corporation (ATOAC) makes the following assessment conservation recommendations based on the DECCW recommended approach consistent with the NPW Act — Conservation involves identifying, assessing, protecting and maintaining the important cultural and heritage values of landscapes, resources, places, objects, customs and traditions so that we, and generations to come, can enjoy, learn from them, and appropriately manage these values.

Legislation ensures that Aboriginal heritage must be considered as part of land management. DECCW protects Aboriginal heritage through:

- Management planning
- Public education and awareness
- Physical protection works

The following weighted assessment considers the above three areas of Aboriginal Heritage conservation.

The following statements and recommendations are made within the context that:

- The NPWS recognises that Aboriginal culture is living and unique and recognises the right of Aboriginal people to protect, preserve and promote their culture.
- The NPWS recognises that Aboriginal people are the rightful cultural owners of Aboriginal cultural heritage information and Aboriginal sites and objects ('relics' under the National Parks & Wildlife Act, 1974). In the area of Aboriginal cultural heritage, the NPWS is committed to a joint and equitable management partnership with its own Aboriginal heritage staff and with Aboriginal communities.
- The NPWS commits to an active partnership with Aboriginal communities in advocating constructive changes to legal and institutional arrangements governing the control of Aboriginal heritage.

We are concerned that perspectives of Intergenerational equity are not taken into consideration considering that the **Report** does refer to the potential of subsidence which would impact on Awabakal Cultural Heritage sites within the continued underground mining area of Myuna Colliery. This consideration would clearly demonstrate a commitment to the protection of Aboriginal Cultural Heritage sites by Myuna Colliery if indeed Aboriginal sites are exposed during the life of the mining project.

We believe that the **Report** has not taken into consideration and/or addresses the issues pertaining to Intergenerational Equity for future generations of Awabakal

people in the event of possible damage or disturbance to Awabakal Aboriginal Cultural Heritage if potential surface impacts eventuate from subsurface subsidence.

We seek DECCW's serious consideration of the legacy of cumulative and continued proposed damage to our cultural heritage values and examine intergeneration equity standards in determining approvals or non-approvals. Any approval and conditions must use best practice standards and intergenerational equity weighting in consideration in determining the future conservation of our cultural landscape.

Empirical evidence demonstrates that the area has a history of poor cultural heritage recording and reporting and cumulative impact assessment integrated into a weighting for intergenerational legacy is of a poor standard.

Recommendations

- We recommend and support Centennial Myuna Pty Ltd in opening up a dialog with the Awabakal Traditional Descendants to explore and assess our primary attachment to our Land and Cultural Heritage given that this Myuna Colliery and other Centennial Projects are within the Awabakal Cultural footprint.

- That RPS makes an allowance for a statement of cultural significance from the Awabakal traditional descendants to be included in this and future Cultural Heritage Assessments.

- That we have the opportunity to inspect/monitor the Culturally Sensitive sites after mining underneath the area is completed if the Mining Application is approved.

- We seek Myuna Colliery to finance a cultural heritage survey and recording of the Rock Shelters to ensure conservation practices which would demonstrate and support intergenerational equity. This should be adequately resourced to achieve the intended conservation and intergenerational equity outcome.

  This recommendation is to be implemented using the best practice standards as set out by NPWS. As per guidelines, it is recommended that the Traditional Awabakal Descendants would on occasion obtain professional archaeological advice in the course of such assessments. It is important to appreciate that the distinction some archaeologists have made in the past between archaeological sites on the one hand and 'sacred' sites on the other may have little meaning for Aboriginal people.

  > "***Such 'archaeological' sites as middens, rock shelter deposits, scarred trees, stone quarries; burials and cemeteries etc are as likely to have spiritual and cultural value as are ceremonial sites (e.g. bora rings) or Dreaming sites. The 'spread' of the spiritual is greater in Aboriginal society than in non-Aboriginal Australian society (particularly the northern European fraction of Australian society)".***
  >
  > "***This underlines the importance for archaeologists of an understanding of archaeology as a discourse which assigns meaning to places and things. Aboriginal shell middens,***

in other words, are not archaeological in themselves; they are archaeological only insofar as archaeologists (or others) think of and refer to them in that way. Archaeology is thus a way of making sense of or giving order to things and places which exist in the world".
Refer to the Archaeological Standards Manual

- To undertake a technical Empirical study over the life of the mine to inform Industry practices and future archaeological recommendations to reduce the cumulative adverse impacts on our cultural heritage which is increasing in its values due to the rarity of the integrity of our features due to the compounding adverse impacts from multiple human and resource industry activities. These standards need to be applied, shared and utilised in current and future assessment and permit determinations. This should also inform alternative mining activity and techniques appropriate to reducing adverse impacts.

- That additional consideration and due diligence be added within the Mitigation Measures concerning site investigations of the Culturally Sensitive areas by the registered stakeholders, considering that the Mining Application is seeking a further 21 years of activity.

- That the Awabakal Traditional Owners/Descendants who have a cultural and hereditary association with the land of their ancestors have the exclusive right to adjudicate on the spirituality of any particular location or site.

- The need for an undertaking by the Myuna Colliery for ongoing consultation and protection of the areas within the proposed project and surrounding Awabakal sites by *all* who will be associated with the project

Summary

The principal vision and aim of the Awabakal people is to protect the cultural heritage of our ancestors. Therefore the residual evidence of our people is held in high degree and is regarded as a cultural reminder that unites us with our country and spirituality.

The Myuna region is well within the Awabakal boundary and is therefore regarded as culturally significant to the Awabakal Traditional Owners/Descendants.

Our people are concerned that Aboriginal Cultural Heritage is being overlooked, and believe that more consideration should be afforded to provide an essential element for the protection of these sites in order to demonstrate Intergenerational Equity.

The site assessment and observation indicates that there is a high potential for additional Aboriginal cultural material to be concealed below the vegetated ground surface as a result of the general use of the area. Therefore we recommend that ongoing inspections of the Culturally Sensitive areas and due diligence be added within the Mitigation Measures.

Although anthropologists may have the ability to identify past physical use of a location, they do not have the capability to adjudicate on the spirituality of any particular location or site. This is the exclusive right of the traditional owners who have a cultural and hereditary association with the land of their ancestors.

Of increasing concern is the apparent 'carte blanche' approvals rate for permits to destroy or damage areas identified as having high cultural heritage value by the Aboriginal community and that there is limited application of intergenerational equity for a measurable and tangible reporting regime.

Mitigation arrangements for irreversible adverse impact of an area and landscape features require serious conservation consideration. The potential impact has caused a great deal of distress to us as Awabakal Traditional Owners, as cultural heritage values are a living culture and reflect both the historic and contemporary Aboriginal values associated with our country.

We acknowledge RPS and the Myuna Colliery's commitment and support in addressing the many aspects related to the perspectives and diversity that is associated with Aboriginal Cultural Heritage.

We reserve the right and reluctance to share our cultural heritage with others in respect to aspects of the cultural significance that connects us to our country. It is believed by our people that those who shouldn't be privy to this cultural knowledge have no rights or entitlements to it.

ADDENDUM A

RESTRICTED ABORIGINAL CULTURAL HERITAGE SITE: INFORMATION RESTRICTED TO CENTENNIAL, DECCW AND DEPARTMENT OF PLANNING

ADDENDUM B

RESTRICTED ABORIGINAL CULTURAL HERITAGE SITE: INFORMATION RESTRICTED TO CENTENNIAL, DECCW AND DEPARTMENT OF PLANNING

Appendix N

Greenhouse Gas Assessment (AECOM Australia Pty Ltd, 2010c)

Myuna Colliery Extension of Mining

Greenhouse Gas Assessment

Greenhouse Gas Assessment

Myuna Colliery Extension of Mining

Prepared for

Centennial Myuna Pty Ltd

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Distribution

Copies	**Recipient**	**Copies**	**Recipient**
1	**Maryanne Crawford** **Group Environment Manager** **Centennial Coal** Via Email	1	AECOM File Copy

Contents

List of Tables

1.0 Introduction

AECOM was commissioned by Centennial Myuna Pty Ltd (CMPL) to prepare an Environmental Assessment (EA) for the Myuna Colliery Extension of Mining (proposed Project) located near Lake Macquarie, approximately 90 km north-east of Sydney. This study was undertaken as part of an Environmental Assessment to support an application for Project Approval under Part 3A of the Environmental Planning & Assessment Act 1979.

The Project will extend mining and coal handling at Myuna Colliery within the Project Application Area and proposes to:

- mine using bord and pillar methods in the Wallarah, Great Northern and Fassifern seams in CCL762 and ML1370, for a further 21 years;
- produce, handle and distribute to Eraring Power Station, up to 2 Mtpa using existing infrastructure;
- continue the use of ancillary infrastructure and services for a further 21 years;
- upgrade the water management system; and
- rehabilitate the surface facilities within 5 years of completion of mining.

Myuna Colliery's Surface Facilities Area is located in Wangi Wangi on the western side of Lake Macquarie, 25 km south-west of Newcastle. The Myuna Colliery Surface Facilities Area is surrounded by vegetated ridgelines and is adjacent to the now disused Wangi Power Station. All existing infrastructure within the Surface Facilities Area of Myuna Colliery will be utilised to service the proposed Project, with some minor modification. Myuna Colliery will continue to use the Eraring Energy owned Enclosed Overland Conveyor to transport coal to Eraring Power Station.

CMPL undertakes underground mining at Myuna Colliery:

- Within the Development Consent Mining Area; and
- Within Consolidated Coal Lease (CCL) 762 and Mining Lease (ML) 1370 but external to the Development Consent Mining Area, pursuant to the combined operation of Section 74(1) of the Mining Act 1992 (Mining Act) and clause 8K of the Environmental Planning and Assessment Regulation 2000.

The Project Application Area encompasses ML 1370, a portion of CCL 762 and the Surface Facilities Area. The Project Application Area comprises an area within the boundaries of CCL 762 and ML 1370, but external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area).

AECOM was commissioned to undertake an assessment of greenhouse gas (GHG) emissions from the proposed Project for inclusion in the EA.

1.1 Scope of Works

The purpose of this assessment was to estimate the change in annual GHG emissions associated with the proposed Project. A quantitative assessment of the potential scope 1, 2 and 3 GHG emissions from the project were made in relation to the following sources:

- Emissions from combustion of fuel by on-site vehicles used to transport men and materials associated with operations and to handle and manage the mine's small ROM coal stockpile (Scope 1);
- Emissions from the use of Liquefied Petroleum Gas (LPG), sulphur hexafluoride (SF6), and oils and greases (Scope 1);
- Fugitive emissions from the extraction of coal (Scope 1);
- Fugitive emissions from post mining activities (stockpiled coal) (Scope 1);
- Electricity use (Scope 2 and 3);
- Indirect emissions from the combustion of the coal produced at Myuna Colliery by Eraring Power Station (Scope 3).

Scope 1 and Scope 2 emissions were estimated using data provided by CMPL and emission factors and methods specified in the National Greenhouse and Energy Reporting System (NGERS) (to which CMPL is a mandatory respondent). Indirect emissions (Scope 3) associated with the operation of the facility, namely those associated with use of the product coal by Eraring Power Station, were estimated using National Greenhouse Account (NGA) Factors (DCC; June, 2009), as NGERS has no Scope 3 requirement.

Emissions were assessed for two scenarios:

- Existing production (2008/09 data); and
- Proposed maximum production (2.0 Mtpa).

Results were compared to historical Australian emission levels.

2.0 Project Description

The Project will extend mining at Myuna Colliery within the Project Application Area, comprising an area external to the Development Consent Mining Area (with the exception of the inclusion of the Surface Facilities Area) but within the boundaries of CCL 762 and ML 1370.

The Project's mining operations will continue to be carried out using bord and pillar methods in the Wallarah, Great Northern and Fassifern coal seams, generally consistent with the manner in which CMPL undertakes current mining operations at Myuna Colliery. Further, all existing infrastructure and services at the Surface Facilities Area will be utilised to service the Project.

2.1 Mining Area

The Project Application Area encompasses the three coal seams (Wallarah, Great Northern and Fassifern) previously mined at Myuna Colliery and, as such, includes some existing workings and areas requiring new workings to be developed. Access to new areas will be from the existing workings.

2.2 Mining Methods

The Project's mining operations will continue to be carried out using bord and pillar methods in the Wallarah, Great Northern and Fassifern coal seams, generally consistent with the manner in which CMPL undertakes current mining operations at Myuna Colliery. The mining layout to be implemented within the three seams in any given area of the Project Application Area will be determined during detailed mine planning and development of a geotechnically -engineered mine design. The mine design will address the various mine constraints, including (at least) the High Water Level Subsidence Control Zone; the 40 metres of solid rock head and the coal pillar factor of safety. For areas where secondary extraction is proposed to be undertaken, CMPL will seek approval from Industry and Investment NSW.

2.3 ROM Coal Production Limits

Myuna Colliery is currently authorised to produce up to 1.3 Mtpa within the Development Consent Mining Area. The Project seeks approval for ROM Coal production up to 2.0 Mtpa, which is within the operational capacities of the existing approved CHP.

2.4 Coal Transport

No changes are proposed to the current coal transport methods. Coal produced by Myuna Colliery will continue to be supplied directly to Eraring Power Station by the Eraring Energy owned Enclosed Overland Conveyor. The small ROM coal stockpile area will continue to be used when Eraring Energy is unable to accept deliveries due to scheduled maintenance or conveyor breakdown. During these outages, a front-end loader recovers coal from the stockpile and loads it onto trucks that dump the coal into a reclaim hopper for transportation to Eraring Power Station by the Enclosed Overland Conveyor as required.

2.5 Coal Handling

No changes are proposed to the current coal handling, preparation, or stockpiling procedures of the existing operations. A negligible amount of waste rock from the CHP will continue to be transported on the Surface Facilities Area and stored back underground.

2.6 Mine Access and Surface Facilities

Existing mining areas (including existing underground workings for ventilation) will continue to be utilised for the Project including (but not limited to) mine access, emergency management and underground services and infrastructure. As such, no changes are proposed to the current mine access, infrastructure or facilities. Minor changes to the licensed discharge point configuration and temporary coal stockpile area (involving minor water management works) will be required to improve water management at the Surface Facilities Area. Vehicles operated on site use diesel fuel, while the coal handling plant, conveyor and other plant are electrically powered.

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3.0 Greenhouse Gases

GHGs are gases found in the atmosphere that absorb outgoing heat that is reflected from the sun. The absorption of the heat energy warms the air, enabling life to survive, and is known as the Greenhouse Effect. The primary greenhouse gas is carbon dioxide (CO_2).

Human activities, such as the combustion of carbon-based fuels, increase the amount of GHGs in the atmosphere. This leads to greater absorption of heat and increases in atmospheric temperature, known as the Enhanced Greenhouse Effect.

The NSW Government has committed to a long term GHG reduction target of 60% reduction in GHG emissions by 2050 and a return to year 2000 GHG emission levels in NSW by 2025. There are, however, no legislative limits for emissions of CO_2, methane (CH_4) or nitrous oxide (N_2O).

Due to the complex interdependencies of environmental and atmospheric systems, quantification of the likely environmental effects associated with a particular amount of GHG release into the atmosphere cannot be made. In general terms, increasing GHG levels in the atmosphere result in increased average global temperatures. These temperature increases can result in changes in ocean levels (due to melting of glaciers and polar ice caps) and water temperatures and greater humidity. Changes in weather patterns are also associated with increased atmospheric temperatures, resulting in effects such as increased droughts in some areas and increased flooding in others.

3.1 Global Warming Potential

Different GHGs have different heat absorbing capacities. In order to achieve a basic unit of measurement, each GHG is compared to the absorptive capacity of CO_2, and measurements and estimates of GHG levels are reported in terms of CO_2 equivalent emissions (CO_2-e). Global warming potentials (GWPs) are used to compare the abilities of GHGs to trap heat in the atmosphere. A GWP is based on the radiative efficiency of a gas (i.e. its heat-absorbing ability), relative to that of CO_2, and its decay rate (i.e. atmospheric lifetime), also relative to CO_2. The GWP provides a means to convert emissions of GHGs into CO_2-e units. The global warming potentials of the primary greenhouse gases are shown in **Table 1**.

Table 1: Greenhouse Warming Potentials - Select Greenhouse Gases

Greenhouse Gas	Global Warming Potential*
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
Sulphur hexafluoride (SF_6)	23,900
*GWP factors specified for calculating emissions under Kyoto accounting provisions Source: NGA Factors, June 2009	

3.2 National Response to Climate Change

3.2.1 Kyoto Protocol

The Kyoto Protocol is an international agreement created under the United Nations Framework Convention on Climate Change in Kyoto, Japan in 1997. The Kyoto Protocol aims to reduce the collective GHG emissions of developed countries by at least 5 % below 1990 levels during the period 2008 to 2012, which is known as the first commitment period.

Australia ratified the Kyoto Protocol in December, 2007, with the action taking effect in March 2008. Australia has committed to ensuring its GHG emissions over 2008 to 2012 are no more than 8 per cent above 1990 levels.

3.2.2 National Greenhouse Gas Inventory

Australia's National Greenhouse Gas Inventories are designed to provide estimates of Australia's net GHG emissions and track Australia's progress towards its Kyoto target. Australia has updated and published annual national GHG inventories for each year from 1990 to 2008 inclusive. The inventories are prepared according to international guidelines. Details of the most recent inventory (2008) are shown in **Table 2**.

Table 2: Australian National Greenhouse Gas Emissions, 2008

Sector	Mt CO_2-e
Agriculture, forestry, fishing	120.1
Mining	57.8
Coal Mining	***32.1***
Manufacturing	72.7
Electricity, gas, water	210.8
Construction	1.8
Commercial services	17.6
Transport & storage	41.0
Residential	54.3
Total of all economic (ANZSIC) sectors	576.2
Source: Australian Greenhouse Emissions Information System, Department of Climate Change and Energy Efficiency. (Wed Jun 30 09:44:41 2010)	

In 2008, Australia's net GHG emissions were 576.2 Mt CO_2-e. Of the total Australian emissions, 32.1 Mt CO_2-e (5.5 %) were emitted by the coal mining industry. The change in emissions from coal mining in Australia between 1990 and 2008 are shown in **Figure 1**. Emission levels steadily increased between 2002 and 2007.

Figure 1: Greenhouse Gas Emissions from Coal Mining - Australia, 1990 - 2007

Source: http://ageis.climatechange.gov.au/ANZSIC.aspx; accessed 30 June 2010

3.2.3 Greenhouse Gas Reporting

The National Greenhouse and Energy Reporting Act 2007 (the NGER Act) was passed in September 2007. The NGER Act establishes a mandatory reporting system for corporate GHG emissions and energy production and consumption in Australia. The first reporting period under the Act commenced on 1 July 2008.

The NGER Act requires controlling corporations to register and report if they emit GHGs, produce energy, or consume energy at or above specified quantities per financial year (1 July to 30 June). The reporting timeline is shown in **Figure 2**. Corporations emitting the greatest amount of GHG or consuming the most energy were initially targeted for the first phase, while corporations with lower emission and energy consumption levels are now being incorporated. The final threshold is 50 kilotonnes of CO_2 equivalent or 200 terajoules of energy.

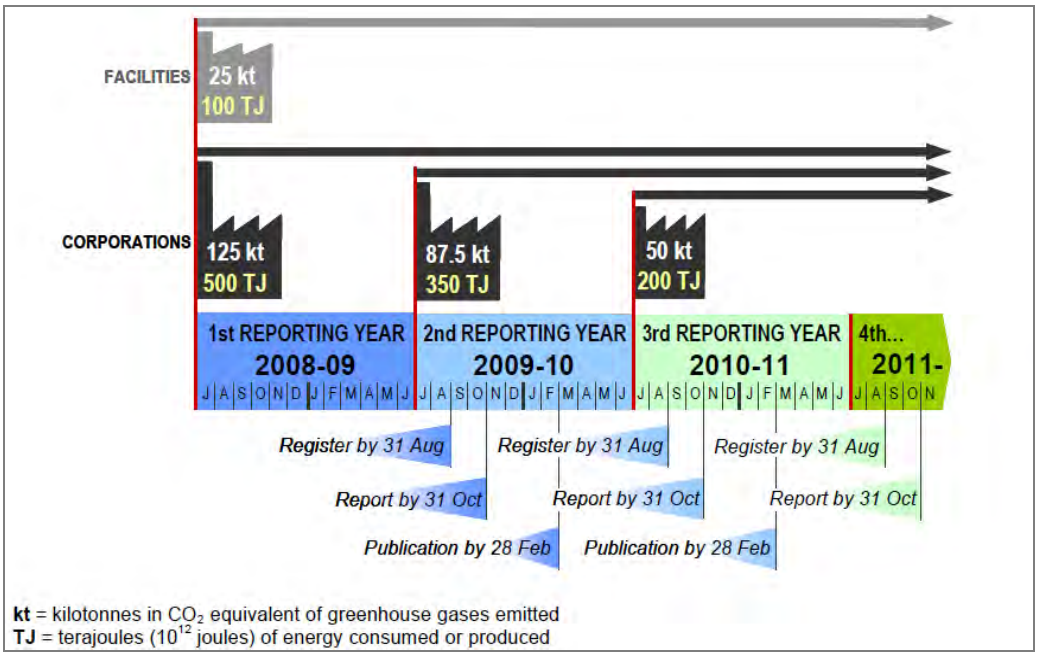

Figure 2: NGER Reporting Timeline

Corporations, such as CMPL, that meet the NGER thresholds must report on:

- GHG emissions;
- Energy production; and
- Energy consumption.

The NGER (Measurement) Determination 2008 outlines calculation methods and criteria for GHG emissions, energy production and consumption. The Determination provides for four methods of calculation:

- Method 1 (default method) is derived from the National Greenhouse Accounts methods, and is based on national average estimates;
- Method 2 is a facility-specific method that uses industry practices for sampling and Australian or equivalent standards for analysis;
- Method 3, which is the same as Method 2 but is based on Australian or equivalent standards for both sampling and analysis; and
- Method 4, which relates to direct measurement of emissions by continuous or periodic emissions monitoring.

4.0 Emissions Estimates

4.1 Methodology

Estimation of the GHG emissions associated with the existing approved operations and proposed Project was undertaken using the emission factors and methods outlined in the National Greenhouse and Energy Reporting (Measurement) Determination 2008 and complementary to the National Greenhouse Accounts (NGA) Factors (June, 2009). The NGA Factors provide three types of assessment categories:

- **Scope 1**, which covers direct emissions from sources within the boundary of an organisation, such as fuel combustion and manufacturing processes;
- **Scope 2**, which covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation; and
- **Scope 3**, which includes all other indirect emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation; that is, emissions associated with the production of fuels and emissions from the generation of purchased electricity (external emissions).

Annual emissions from the following sources were assessed, based on information provided by CMPL:

- Emissions from combustion of fuel by on-site vehicles used to transport staff and materials associated with operations and to handle and manage the mine's small ROM coal stockpile (Scope 1);
- Emissions from the use of Liquefied Petroleum Gas (LPG), sulphur hexafluoride (SF_6), and oils and greases (Scope 1);
- Fugitive emissions from the extraction of coal (Scope 1);
- Fugitive emissions from post mining activities (stockpiled coal) (Scope 1);
- Electricity use (Scope 2 and 3);
- Indirect emissions from the combustion of the coal produced at Myuna Colliery by Eraring Power Station (Scope 3).

CMPL provided historical electricity and diesel use for the period 2006/07 – 2008/09 and expected electricity and diesel use for the Colliery operating at 2 Mtpa. The historical and predicted data were used in the calculations as described in the following sections.

CMPL monitors fugitive emissions associated with the extraction of coal at the ventilation shaft on a monthly basis as required by the NGER Act 2007. The mine operates in the Fassifern, Great Northern and Wallarah seams, and the monitoring data indicates that the gas concentration in the ventilation flow is related to gassy Fassifern seam workings and is not associated with production levels. As such, the fugitive emissions measured between July 2008 and June 2009 were taken to be indicative of both existing and potential future emissions associated with coal production (refer to **Section 4.2.5**).

4.2 Emission Estimates

4.2.1 Combustion of Liquid Fuel (Scope 1)

Fuel Combustion

The combustion of diesel fuel in vehicles is a source of GHGs. For this assessment, diesel-powered mobile vehicles used on site were included in the assessment. Emission factors for transport-related emissions are shown in **Table 3**.

Table 3: Emission Factors – Diesel Oil Combustion (Transport)

Transport equipment type	Energy content factor	Emission Factor (kg CO_2-e/GJ)		
	(GJ/kL)	CO_2	CH_4	N_2O
General transport	38.6	69.2	0.2	0.5
Source: Schedule 1 Part 4 Item 54, NGERS Measurement Determination 2008				

Diesel usage at Myuna Colliery is related to the coal production levels, the requirement to transport men in and out of the mine, and to the supply of support materials to the working faces. Historical and predicted diesel use and their associated production levels are shown in **Table 4**. CMPL has applied a key performance indicator (KPI) of 0.000247 kL/ t ROM for future fuel use based on historical production levels and diesel fuel use. This KPI was used to predict fuel use at the proposed maximum production level of 2 Mtpa as shown below.

Table 4: Historical and Predicted Diesel Use

Period	Year	Production (t ROM)	Diesel Use (L)
Historical	2006/07	1,078,020	233,862
	2007/08	1,169,093	272,550
	2008/09	1,132,974	271,579
Predicted	2009/10	1,154,141	286,822
	2011/12	1,592,000	393,000
	2012/13	1,850,000	457,000
	2013/14	1,850,000	457,000
Maximum Production Predicted		2,000,000	494,000

Emissions associated with the combustion of fuel on-site at Myuna Colliery are shown in **Table 5** (existing) and **Table 6** (proposed). Comparison of the data indicates an additional 600 tCO_2-e would be emitted under the proposed production rate of 2 Mtpa.

Table 5: Scope 1 Emissions – Existing Fuel Combustion (Transport)

Activity Data	Amount (kL)	Energy Content Factor	Energy Content	Emission Factors	Gases	NGERS Method	Scope 1 Emissions (t CO_2-e)
Diesel oil	271.6	38.6	10,483.0	69.2	CO_2	Method 1	725
				0.2	CH_4		2.1
				0.5	NO_2		5.2
Total							**733**

Table 6: Scope 1 Emissions – Proposed Fuel Combustion (Transport)

Activity Data	Amount (kL)	Energy Content Factor	Energy Content	Emission Factors	Gases	NGERS Method	Scope 1 Emissions (t CO_2-e)
Diesel oil	494.0	38.6	19,068.4	69.2	CO_2	Method 1	1,320
				0.2	CH_4		3.8
				0.5	NO_2		9.5
Total							**1,333**

4.2.2 Fugitive Emissions from the use of Liquefied Petroleum Gas (LPG) (Scope 1)

CPML uses a small quantity of LPG on site. This usage is not expected to change as a result of the proposed increase in production. GHG emissions associated with LPG use at the site are summarised in **Table 7**; these represent existing and predicted emissions.

Table 7: Scope 1 Emissions - LPG

Activity Data	Amount (kL)	Energy Content Factor	Energy Content	Emission Factors	Gases	NGERS Method	Scope 1 Emissions (t CO_2-e)
LPG	0.63	25.3	15.939	51.2	CO_2	Method 1	1
				0.1	CH_4		0
				0.03	NO_2		0
Total							1

4.2.3 Fugitive Emissions from Sulphur Hexafluoride (Scope 1)

The mine electrical distribution system uses switchgear insulated by sulphur hexafluoride (SF_6). The quantity of gas within switchgear at the mine is not expected to increase with the planned increase in production. GHG emissions associated with SF_6 use at the site are summarised in **Table 8**; these represent existing and predicted emissions.

Table 8: Scope 1 Emissions – SF6

Activity Data	Amount (t)	Emission Factor	NGERS Method	Scope 1 Emissions (t CO_2-e)
SF_6	0.012	0.005	Method 1	0
Total				**0**

4.2.4 Emissions from Energy Consumed by other than Combustion (Oils and Greases) (Scope 1)

In 2008/09, the mine consumed 360 kL of oils/ greases in the course of operating and maintaining production and ancillary plant and equipment. During this period, the mine had a total production level of 1.13 Mt. GHG emissions associated with this use of materials were equivalent to 390.5 3 tCO_2-e as shown in **Table 9**.

Table 9: Scope 1 Emissions – Oil/Grease (2008/09 - Existing)

Activity Data	Amount (kL)	Energy Content Factor	Emission Factors	Gases	NGERS Method	Scope 1 Emissions (t CO_2-e)
Petroleum based oils(other than petroleum based oil as fuel)	354.852	38.6	27.9	CO_2	Method 1	384.13
			0	CH_4		0
			0	NO_2		0
Petroleum based greases	5.909	38.6	27.9	CO_2	Method 1	6.4
			0	CH_4		0
			0	NO_2		0
Total						**390.53**

The use of oil/grease at the site is expected to increase proportionally with the proposed increase in production. Predicted emissions associated with the use of oil/grease at the proposed maximum production level of 2 Mtpa are shown in **Table 10**.

Table 10: Scope 1 Emissions – Oil/Grease (Proposed)

Activity Data	Amount (kL)	Energy Content Factor	Emission Factors	Gases	NGERS Method	Scope 1 Emissions (t CO_2-e)
Petroleum based oils(other than petroleum based oil as fuel)	626.408	38.6	27.9	CO_2	Method 1	678.10
			0	CH_4		0
			0	NO_2		0
Petroleum based greases	10.431	38.6	27.9	CO_2	Method 1	11.29
			0	CH_4		0
			0	NO_2		0
Total						**689.39**

4.2.5 Fugitive Emissions from the Extraction of Coal

Fugitive emissions associated with extraction of coal comprise Methane (CH_4) and Carbon Dioxide (CO_2) released at the coalface during production activities and also ongoing from the coal pillars left after mining

CMPL currently produces coal from 3 seams the Wallarah, Great Northern and Fassifern with each seam having different characteristics with respect to the gases contained and subsequently released. The potential for emissions from each seam is related to the seam characteristics, quantity and rate of production activity along with ventilation required for production areas and old mine workings.

With this in mind and considering the planned increase in production will in the near future see all production activity concentrated in the Fassifern seam as below:

- October 2010 - 1 production unit in Wallarah seam, 2 production units in Fassifern seam.
- November 2010 - 1 production unit in Wallarah seam, 3 production units in Fassifern seam –,
- May 2012 - 4 production units in Fassifern seam

And as can be seen from **Table 11** the Fassifern Seam has the greatest contribution to GHG emissions at the mine.

Table 11: Gas contribution current operating pattern (1 production unit in each of 3 seams)

		CH_4		CO_2	
Seam	**Ventilation Flow (M^3/sec)**	**Gas %**	**Gas Flow (L/sec)**	**Gas %**	**Gas Flow (L/sec)**
Wallarah(1 pdx unit)	80	0.05	40	0.4	32
Great Northern(1 pdx unit)	30	0.09	27	0.5	15
Old Fassifern(no pdx)	45	0.1	45	0.2	9
Fassifern(1 pdx unit)	130	0.55	715	0.3	39
Total	**285**		**827**		**95**
Gas make and balance as at August 2010; data provided by CMPL.					

CMPL measures emissions of CH_4 and CO_2 from the Myuna ventilation shaft on a monthly basis using Method 4 as required by NGERS. Inspection of the data measured between July 2008 and June 2009, presented in **Table 12** are indicative of the current operation having 1 production unit operating in each of the 3 seams at the mine.

Table 12: Scope 1 Fugitive Emissions from Coal Extraction (2008/09 – Existing)

Activity Type	Amount	Unit	Gas	NGERS Method	Scope 1 Emissions* (t CO_2-e)
Run of mine coal extracted from gassy underground mine	1,132,974	Tonnes of coal	CO_2	Method 4	9,212
			CH_4	Method 4	414,566
Total					**423,778**
*Estimated using measurements and methods as specified in NGERS; data for 2008/09 provided by CMPL.					

Total estimated fugitive emissions (NGERS Method 4) from extraction of coal as measured at the mine ventilation shaft in the 2008/09 financial year were 423,778 t CO_2-e[1]. From May 2012 CMPL plan to have implemented operational changes to produce coal from 4 units in the Fassifern seam the resulting fugitive emissions from extraction of coal have been estimated using seam characteristics, historical gas make and balance data and presented in **Table 13**.

Table 13: Proposed Scope 1 Fugitive Emissions from Coal Extraction (4 production units in Fassifern seam)

Activity Type	Amount	Unit	Gas	NGERS Method	Scope 1 Emissions* (t CO_2-e)
Run of mine coal extracted from gassy underground mine	2,000,000	Tonnes of coal	CO_2	Method 4	7,388
			CH_4	Method 4	569,213
Total					**576,593**
*Estimated as specified in NGERS methods using historical data and modelling; data provided by CMPL.					

Total estimated fugitive emissions (NGERS Method 4) for the proposed increased production from operations wholly within the Fassifern seam from extraction of coal amount to 576,593 t CO_2-e[2]. being an estimated increase of 152,815 t CO_2-e[3].

4.2.6 Fugitive Emissions from Post-Mining Activities (Stockpiled Coal)

Fugitive emissions from the stockpiled coal were estimated as shown in **Table 14**. In accordance with the method required by the NGERS (Measurement) Determination, default values for gassy coal mines were used in these calculations. All ROM coal was assumed to be product coal. Fugitive emissions from the coal mined at Myuna Colliery would equate to approximately 28,000 t CO_2-e per year at the proposed production level of 2 Mtpa.

[1] Reported in Myuna Colliery NGERS Report, 2008/09

[2] Reported in Myuna Colliery NGERS Report, 2008/09

[3] Reported in Myuna Colliery NGERS Report, 2008/09

Table 14: Fugitive Emissions - Coal

Scenario	Amount (t)	Emission Factor – methane (t CO_2-e/t raw coal)*	Fugitive emissions (t CO_2-e)
Existing	1,132,974	0.014	15,862
Proposed	2,000,000		28,000
Difference	867,026,	-	12,138
* NGERS Measurement Determination, Chapter 3, Part 3.2 section 3.17 – gassy underground coal mine. A gassy mine is defined as an underground mine that has at least 0.1 % methane in the mine's return ventilation [National Greenhouse and Energy Reporting (Measurement) Technical Guidelines 2009]			

Total fugitive emissions associated with the coal mining process would be 423,778 t CO_2-e (extraction of coal) plus 28,000 t CO_2-e (post mining stockpile) or 451,778 t CO_2-e in total. This represents an increase of approximately 12,138 t CO_2-e per year at the proposed 2 Mtpa production level.

4.2.7 Emissions from Electricity Use (Scopes 2 and 3)

Coal mining, coal haulage, coal clearance and coal handling plant and equipment at the site, including roof bolters, continuous miners, shuttle cars, conveyors and crushing and screening plant, are electrically-powered. Electricity consumption for 2008/09 was 26.33 MWh; of this, approximately 50% was used in the production process (i.e. is subject to increase under the proposed production rate increase), and the other 50% represented base load (ventilation, compressed air, office/bathhouse and workshop facilities), which is unlikely to change. CMPL estimated electricity consumption for 2011/12 to 2013/14 based on increasing the production-related electricity use in line with the expected production increases; the maximum estimated consumption rate of 37 MWh was used in this assessment as indicative of electricity use for the proposed 2 Mtpa production rate. Results are shown in **Table 15.** The proposed increase in production would result in an additional 0.01 Mt CO_2-e per year compared to existing levels.

Table 15: GHG Emissions from Electricity Use

Emissions Type	Emission Factor (kg CO_2-e/kWh)*	GHG Emissions (t CO_2-e)		
		Existing	Proposed	Difference
Scope 2	0.89*	23,433.2	32,955	9,521.8
Scope 3	0.18**	4739.3	5,281.6	542.3
Full Fuel Cycle (total)	**1.07**	**28,172.5**	**38,236.6**	**10,064**
** NGERS (Measurement) Determination 2008, Schedule 1, Part 6, Item 77* ***Table 39, NGA Factors, June 2009*				

4.2.8 External Emissions (Scope 3)

External emissions are those associated with the operations of a facility but are not under the control of the facility. The external emission sources investigated in this assessment were derived from the hypothetical combustion of the maximum permitted ROM coal produced by Myuna Colliery per annum. The emission factors for calculating emissions from the combustion of black coal are shown in **Table 16**.

Table 16: Emission Factors - Combustion of Coal

Fuel type	Energy content factor (GJ/t)	Emission Factor (kg CO_2-e/GJ)		
		CO_2	CH_4	N_2O
Black coal (other than that used to produce coke)	27	88.2	0.03	0.2
Source: Table 1 of NGA Factors, June 2009				

The above emission factors were used to calculate the emissions associated with the combustion of the coal produced by the Myuna Colliery; results are outlined in **Table 17**.

Table 17: External Emissions - Combustion of Myuna Colliery Coal

Greenhouse Gas	Estimated GHG Emissions (t CO_2-e)		
	Existing	Proposed	Difference
CO_2	2,698,064	4,762,800	2,064,736
CH_4	918	1,620	702
N_2O	6,118	10,800	4,682
Total	**2,705,100**	**4,775,220**	**2,070,120**

As shown, the proposed increase in coal production at the mine has the potential to lead to the release of an additional 2 Mt CO_2-e per year (external to the site).

4.3 Emissions Summary

Emissions estimates from all sources described above are summarised in **Table 18**.

Table 18: Annual Greenhouse Gas Emissions Summary

Scope	Activity	Estimated Emissions (t CO_2-e)		
		Existing	Proposed	Difference
1	On-site transport (diesel oil)	733	1,333	600
	LPG	1	1	0
	SF_6	0	0	0
	Oil and grease	391	689	298
	Extraction of coal	423,778	576,593	152,815
	Stockpiled coal	15,862	28,000	12,138
2	Electricity use	23,433	32,955	9,521
	Total (mine operations only)	**464,198**	**639,571**	**175,373**
3	*Electricity*	*4,739*	*5,282*	*542*
	Combustion of mined coal	*2,705,100*	*4,775,220*	*2,070,120*
	Total	***3,174,037***	***5,420,073***	***2,2464,036***

The existing mine operations generated an estimated 0.46Mt CO_2-e for 2008/09. Emissions would increase to approximately 0.64 Mt CO_2-e at the proposed maximum production rate of 2.0 Mtpa. Fugitive emissions associated with the extraction of coal are the greatest source of emissions associated with on-site activities.

When indirect emissions, including Scope 3 electricity emissions and emissions associated with the combustion of the produced coal, are taken into account, the emissions increase to 3.2 Mtpa and 5.4 Mtpa respectively. As indicated, combustion of the coal generates the most GHG emissions of all activities related to the site's operations.

The total additional emissions associated with the proposed Project represent an approximate increase of 38 % over existing site emissions (i.e. excluding Scope 3 emissions), due to the gaseous nature of future mining within the Fassifern seam. At the proposed production level of 2 Mtpa, Myuna Colliery's on-site emissions represent approximately 2 % of mining emissions in Australia and 0.1 % of total Australian emissions (based on 2008 data from the Australian Greenhouse Emissions Information System, Department of Climate Change and Energy Efficiency, 2010). As such, the proposed increase in production would not substantially increase the total Australian emissions or impede emission reduction actions.

4.4 Emission Reduction Opportunities

As shown in **Table 18**, the greatest emission sources associated with the proposed Project are those associated with the combustion of the coal (Scope 3), the management of which is not controlled by CMPL, followed by fugitive emissions from the mine (Scope 1), which are primarily associated with emissions from ventilation of the underground workings.

The most likely method of directly reducing Scope 2 GHG emissions from the site will be through the ongoing implementation of the site's Energy Saving Action Plan (ESAP). Investigations into opportunities for improvements in energy efficiency are assessed annually in CMPL's ESAP reporting, with emission reduction strategies developed that are cost effective and feasible. The ESAP will continue to identify where potential savings in fuel and electricity could be made, together with the subsequent implementation of energy efficiency strategies where practical. Potential mitigation measures that will be considered include:

- The use of low emission fuels where possible;
- Energy savings initiatives in the key focus areas of:
  - Power factor correction;
  - Metering and monitoring;
  - Compressed air;
  - Coal handling plant; and
- Keeping equipment in good operating order to maintain efficiency. Machinery, plant and equipment will be serviced and kept in good working order and service records will be kept.

CMPL has committed to mitigation and offset of Scope 1 emissions, specifically by:

- Undertaking research into reducing the emissions generated by ventilation air methane (VAM). This includes government funding to investigate VAM technology at Mandalong Mine, and if proven successful and cost effective, then this technology will provide opportunities for application at other mines.
- Committing to offset 10% of its Scope 1 and Scope 2 emissions per annum. This commitment will coincide with the reporting and auditing obligations outlined under the NGER Act, whereby the tonnes of CO2-e offset each year will go through a rigorous verification process. These offsets will be located in Australia, will be accredited to a recognised scheme or standard (or in the process of achieving accreditation), will be independently verified, and will be undertaken in accordance with any relevant Australian Government policies and standards at that time. These offsets will be put in place where opportunities to avoid or mitigate emissions are not available, or until a National emissions trading scheme is imposed on the Colliery.

Such actions are in keeping with Centennial's commitment to GHG reduction strategies.

5.0 Conclusion

CMPL proposes to continue operations at the Myuna Colliery at an increased production rate of 2 Mtpa. Operations at the site generate GHG emissions associated with:

- Emissions from combustion of fuel by on-site vehicles used to transport men and materials associated with operations and to handle and manage the mine's small ROM coal stockpile (Scope 1);
- Emissions from the use of Liquefied Petroleum Gas (LPG), sulphur hexafluoride (SF6), and oils and greases (Scope 1);
- Fugitive emissions from the extraction of coal (Scope 1);
- Fugitive emissions from post mining activities (stockpiled coal) (Scope 1);
- Electricity use (Scope 2 and 3); and
- Indirect emissions from the combustion of the coal produced at Myuna Colliery (Scope 3).

CMPL provided historical electricity and diesel use for the period 2006/07 – 2008/09 and expected electricity and diesel use for the Colliery operating at 2 Mtpa for 2011/12 – 2013/14. The historical data and predictions were used in the calculations as described in the following sections.

CMPL monitors fugitive emissions associated with the extraction of coal at the ventilation shaft on a monthly basis as required by the NGER Act 2007. The mine operates in the Fassifern, Great Northern and Wallarah seams, and the monitoring data indicate that the gas concentration in the ventilation flow is related to gassy Fassifern seam workings and is not associated with production levels. As such, the fugitive emissions measured between July 2008 and June 2009 were used in the calculations of current and potential future fugitive emissions.

The proposed Project would increase the potential GHG emissions from the operation Myuna Colliery from the current average emissions by approximately 0.01 Mt CO_2-e per year. External emissions associated with the combustion of the coal to generate electricity at a power station represent the greatest proportion of emissions associated with the site's activities (on-site and external).

GHG emission levels of the on-site activities represent approximately 0.1 % of total Australian emissions and 2 % of mining emissions in Australia (based on 2008 data from Australian Greenhouse Emissions Information System, Department of Climate Change and Energy Efficiency). The percentage increase in emissions (38 %) over existing levels is due to the gaseous nature of future mining in the Fassifern seam, though this increase is not considered likely to significantly affect total NSW or Australian emissions or impede emission reduction actions. CMPL is committed to undertaking research into reducing and/or offsetting a portion of its Scope 1 and Scope 2 emissions to addressing the effects of its operations on the Enhanced Greenhouse Effect.

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Appendix O

Economic Assessment (Gillespie Economics, 2010)

Myuna Colliery
Extension of Mining

Economic Assessment

Prepared for

AECOM PTY LTD

By

Gillespie Economics
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OCTOBER 2010

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Centennial Myuna Pty Ltd (CMPL) seeks a Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to extend underground mining and associated activities at Myuna Colliery within the Project Application Area for a further 21 years (the proposed Project).

The Project requires the preparation of an Environmental Assessment (EA) in accordance with the requirements of the EP&A Act. An economic assessment is required as part of the EA.

From an economic perspective there are two important aspects of the Project that have been considered:

- The economic efficiency of the Project (i.e. consideration of economic costs and benefits) which can be evaluated using benefit cost analysis; and
- The economic impacts of the Project (i.e. the economic stimulus that the Project would provide to the regional or State economy) which can be evaluated using regional economic impact assessment.

A benefit cost analysis identified a range of potential economic costs and benefits of the Project. Values were placed on production and external costs and benefits. The net production benefits of the Project were estimated at $343M. The external costs from the Project relate to greenhouse gas generation, valued at $166M. External benefits associated with employment provided by the Project were estimated at $100M.

Overall the Project is estimated to have net benefits of $278M and hence is desirable and justified from an economic efficiency perspective.

A regional economic impact analysis, using input-output analysis, estimated that in total, the Project will contribute the following to the regional economy:

- $159M in annual direct and indirect regional output or business turnover;
- $71M in annual direct and indirect regional value added;
- $53M in annual household income; and
- 451 direct and indirect jobs.

At the State level the Project will make the following contribution to the economy:

- $222M in annual direct and indirect output or business turnover;
- $104M in annual direct and indirect value added;
- $71M in annual direct and indirect household income; and
- 732 direct and indirect jobs.

This stimulus would be felt across a range of sectors in the economy including the coal mining sector, structural metal products manufacturing sector, agricultural and mining machinery manufacturing sector, electricity sector, wholesale trade sector, retail trade sector, health sector, other business services sector, and the hotels, cafes and restaurants sector.

A 21-year approval is being sought for the Project. On cessation of mining the economic stimulus provided by the Project will cease. The significance of these Project cessation impacts will depend on:

- The degree to which any displaced workers and their families remain within the region;

- The economic structure and trends in the regional economy at the time.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Nevertheless, given the uncertainties about the circumstances within which Project cessation will occur, it is important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the Project brings to the region, to strengthen and broaden the region's economic base.

1 INTRODUCTION

Centennial Myuna Pty Ltd (CMPL), a 100% subsidiary of Centennial Coal Company Ltd (CCCL), operates the Myuna Coal Mine. Myuna Colliery's Surface Facilities Area is on the western side of Lake Macquarie, approximately 25 kilometres south-west of Newcastle.

CMPL seeks a Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to extend underground mining and associated activities within the Project Application Area for a further 21 years (the proposed Project).

An Environmental Assessment (EA) for the Project is required in accordance with the provisions of the EP&A Act. The NSW Department of Planning (DoP) Director-General's Requirements for the Project indicate that an economic assessment is needed as part of the EA. The Director-General's Requirements identify the need for:

- *"A detailed assessment of the costs and benefits of the Project as a whole, and whether it would result in a net benefit to the community.*

- *A conclusion justifying the Project on.....economic grounds,..."*

From an economic perspective there are two important aspects of the Project that can be considered:

- The economic efficiency of the Project (i.e. consideration of economic costs and benefits); and
- The economic impacts of the Project (i.e. the economic stimulus that the Project will provide to the regional or State economy).

Planning NSW (James and Gillespie, 2002) *Guideline for Economic Effects and Evaluation in EIA* identifies economic efficiency as the key consideration of economic analysis. Benefit Cost Analysis (BCA) is the method used to consider the economic efficiency of proposals. The draft guideline identifies BCA as essential to undertaking a proper economic evaluation of proposed developments that are likely to have significant environmental impacts.

The above draft guideline indicates that economic impact assessment may provide additional information as an adjunct to the economic efficiency analysis. Economic stimulus to the regional and State economy can be estimated using input-output modelling.

This study relates to the preparation of each of the following types of analyses:

- A BCA of the Project; and
- An economic impact assessment of the Project.

2 BENEFIT COST ANALYSIS

2.1 INTRODUCTION

For the Project to be economically desirable from a community perspective, it must be economically efficient. Technically, a development is economically efficient and desirable on economic grounds if the benefits to society exceed the costs (James and Gillespie, 2002). For mining developments, the main economic benefit is the producer surplus generated by the mine and the employment benefits it provides, while the main economic costs relate to environmental and cultural costs. The technique that is used to weigh up these benefits and costs is BCA.

BCA involves the following key steps:

- identification of the base case or "without" Project case;
- identification of the "with" Project scenario;
- physical quantification and valuation of the projects incremental benefits and costs;
- consolidation of values using discounting to account for the different timing of costs and benefits;
- application of decision criteria;
- sensitivity testing; and
- consideration of non-quantified benefits and costs, where applicable.

The sub-sections below provide a BCA of the Project based on financial, technical and environmental advice provided by CMPL and its specialist consultants.

2.2 IDENTIFICATION OF THE BASE CASE AND PROJECT

Identification of the "base case" or "without" Project scenario is required in order to facilitate the identification and measurement of the incremental economic benefits and costs of the Project.

Under the base case, mining under the existing 1977 development consent and within the development consent boundary would be able to operate viably for approximately another 5 years, though at a decreasing production rate. For the purpose of the analysis, the following base case production profile is assumed:

Table 2.1
Production Under the Base Case

Year of Future Production	Annual Coal Production (Mtpa)
Yr 1 - 2011	1.3
Yr 2 - 2012	1.3
Yr 3 - 2013	1.3
Yr 4 - 2014	0.8
Yr 5 - 2015	0.4

In contrast, the Project will extend mining and coal handling at Myuna Colliery within the Project Application Area and proposes to:

- mine using bord and pillar methods in the Wallarah, Great Northern and Fassifern seams in CCL762 and ML1370, for a further 21 years;
- produce, handle and distribute to Eraring Power Station, up to 2Mtpa using existing infrastructure;
- continue the use of ancillary infrastructure and services for a further 21 years;
- upgrade the water management system; and
- rehabilitate the surface facilities within 5 years of completion of mining.

CMPL's alternatives for the mining of coal are essentially limited to different scales, designs, technologies, processes, impact mitigation measures etc. However, these alternatives could be considered to be variants of the proposed Project rather than distinct alternatives. Consequently, this BCA focuses on the Project compared to the identified base case.

2.3 IDENTIFICATION OF BENEFITS AND COSTS

Relative to the base case or "without" scenario, the Project may have the potential incremental economic benefits and costs shown in Table 2.2.

Table 2.2
Incremental Economic Benefits and Costs of the Project

Category	Costs	Benefits
Production	Opportunity cost of existing land owned by CMPL Opportunity cost of capital Capital costs associated with continued coal production Operating costs, including administration, mining, processing and rehabilitation (ex royalties) Decommissioning costs of the Project	Avoided decommissioning costs under the base case Economic value of coal Residual value of capital and land at the cessation of the Project
Potential Externalities	Air quality impacts Greenhouse gas impacts Acoustic impacts Aquatic ecology impacts Terrestrial ecology impacts Aboriginal and Non-Aboriginal heritage impacts Groundwater impacts Traffic and transport impacts Visual impacts Surface water impacts and sediment/erosion control	Economic and social benefits of employment provided by the Project

It should be noted that the potential external costs, listed in Table 2.1, are only economic costs to the extent that they affect individual and community well-being through direct use of resources by individuals or non-use. If the potential impacts are mitigated to the extent where community wellbeing is insignificantly affected, then no external economic costs arise.

2.4 QUANTIFICATION/VALUATION OF BENEFITS AND COSTS

In accordance with NSW *Treasury Guidelines for Economic Appraisal* (NSW Treasury, 2007), where competitive market prices are available, they have generally been used as an indicator of economic values.

2.4.1 *Production Costs and Benefits*

Production Costs

Opportunity Cost of Land

There is an opportunity cost associated with continuing to use land already owned by CMPL for the Project mine infrastructure instead of its next best use. An indication of the opportunity cost of the

land can be gained from its market value, estimated at $2.6 Million (M). This opportunity cost occurs in year 5 when under the base case the existing mining operation would likely cease.

Opportunity Cost of Capital

Where continued mining would utilise plant and machinery already owned by CMPL, there is an opportunity cost associated with utilising this plant rather than selling it or using it elsewhere. An indication of its opportunity cost can be gained from its estimated market value. The market value estimated by CMPL is in the order $49M. This opportunity cost occurs in year 5 when under the base case the existing mining operation would likely cease.

Capital Cost of the Project

Incremental capital costs over the life of the Project are estimated at $150M including major mining equipment, mobile mining equipment, site infrastructure maintenance, sustaining capital and contingency costs. These costs are included in the economic analysis in the years that they are expected to occur.

Annual Operating Costs of the Project

The operating costs of the Project include those associated with labour, stores and supplies, repairs and maintenance, general expenses and overheads. Average annual incremental operating costs of the mine are estimated at $67M.

While royalties are a cost to CMPL they are part of the overall producer surplus benefit of the mining that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Project. Nevertheless, it should be noted that the Project will generate total incremental royalties in the order of $109M (undiscounted).

Decommissioning Costs

At the cessation of the Project the surface infrastructure is assumed to be decommissioned at an estimated cost of $4M.

Production Benefits

Avoided Decommissioning Costs

Under the base case the site would be decommissioned in 2015. With the Project these costs are avoided (but incurred at the end of the Project life). Avoiding this decommissioning cost in 2015 is a benefit of the Project.

Economic Value of Coal

Production is assumed to occur at up to 2 Mtpa for a period of 21 years.

There are two main economic benefits of the Project related coal product. The first relates to the direct value of the coal recovered from Myuna Colliery. An indication of this value is the market value of the coal as indicated by the contract price with Eraring Power Station.

The second economic benefit relates to the fact that without the Project, higher value export coal from other Centennial Mines in Lake Macquarie would be required to supply Eraring Power Station. The Project enables this higher value coal to be diverted to its highest value use – export, rather than lower value domestic thermal use. The value of this additional benefit is equal to the premium obtained by

exporting coal instead of supplying it to Eraring Power Station adjusted for additional washing and delivery costs (to Newcastle Port) compared to delivery to Eraring Power Station.[1]

There is obviously considerable uncertainty around future coal prices and hence assumed coal values have been subjected to sensitivity testing (see Section 2.6).

Residual Value at End of the Evaluation Period

At the end of the Project, the rehabilitated surface infrastructure site and purchased capital equipment may have some residual value that could be realised by sale. This is assumed to be $2.6M and $49M, respectively.

2.4.2 ***External Costs and Benefits***

Acoustics – the Myuna Colliery Surface Facilities Area is located within a topographic depression approximately 500 metres north west of the nearest potentially affected receiver located at Summerhill Drive, Wangi Wangi, and approximately 600 metres west of residences in Donnelly Rd, Arcadia Vale. Maximum noise levels on Summerhill Drive and Sunset Close, Wangi Wangi, are predicted to be below LAmax 30 dBA. The highest LAmax noise level at any residential area is predicted to occur as a result of forklift pass-by events in the materials yard under the influence of a temperature inversion. External noise levels up to LAmax 43 dBA may occur at residences on Donnelly Road under these circumstances. Hence, predicted noise levels meet the most stringent recommended sleep disturbance noise goal of 49 dBA at Donnelly Road receivers under adverse weather conditions. Based on the negligible impacts predicted, there are not expected to be any external acoustic costs of the Project.

Limited underground blasting may be required for the proposed Project. Vibration from underground blasting is predicted to be negligible and below levels of human perception at the nearest residential locations. The main potential vibration generating activities at the Surface Facilities Area will include the operation of mobile equipment such as the loader and trucks. Given the separation distance between mining operations and the nearest potentially affected residential locations, vibration levels from these activities is predicted to be negligible and below levels for human perception at the nearest residential receivers. Based on the negligible impacts predicted, blasting is not expected to result in an external cost of the Project.

Air quality – sensitive air quality receptors surrounding the Surface Facilities Area include the residential areas of Wangi Wangi and Arcadia Vale. All modelling predictions indicate that the concentrations of particulate matter and dust deposition attributable to the proposed Project would be within the current NSW DECCW air quality goals at all surrounding receivers near to the Surface Facilities Area. Based on the negligible impacts predicted, there are not expected to be any external air quality costs of the Project.

Greenhouse gases – the Project is predicted to generate in the order of 644,853 tonnes of greenhouse gas emissions (CO_2-e) associated with mining and transport of product coal via conveyor

[1] An alternative but equivalent approach to the consideration of the economic value of the coal is to recognise that while the Myuna Colliery supplies coal to Eraring Power Station at a negotiated financial price, the appropriate estimate of the economic value for thermal coal from the Myuna Colliery is the world price for this coal (Sinden and Thampapillai 1995). The current FOB world price for thermal coal is around $100/t. However, this relates to washed coal delivered to Port. The operating costs referred to earlier do not include allocations for washing and delivery to port as this is not required by Eraring Power Station. Consequently the economic value is the world prices for thermal coal adjusted for additional washing and delivery costs (to Newcastle Port) compared to delivery to Eraring Power Station.

to Eraring Power Station[2]. To place an economic value on carbon dioxide equivalent (CO_2-e) emissions, a shadow price of carbon is required that reflects its social costs. The social cost of carbon is the present value of additional economic damages now and in the future caused by an additional tonne of carbon emissions. There is great uncertainty around the social cost of carbon with a wide range of estimated damage costs reported in the literature. An alternative method to trying to estimate the damage costs of carbon dioxide is to examine the price of carbon credits. Again, however, there is a wide range of permit prices. For this analysis, a shadow price of carbon of AUS$30/t CO_2-e was used, with sensitivity testing from AUS$8/t CO_2-e to AUS$40/t CO_2-e (refer to Appendix 1).

Aquatic Ecology – part of the Project Application Area is located below Lake Macquarie, which is inhabited by estuarine plants and animals living on or within the lake bed, in the water column and within the intertidal zone along the foreshore. Seagrass habitat is extensive throughout shallow near-shore sections of the Project Application Area, however, given that predicted subsidence levels where seagrass beds occur would be negligible (< 20 millimetres), the Project is not considered to have any substantial impact on seagrass habitat. Direct or indirect impacts to fish and threatened species that utilise seagrass habitat are not therefore expected. Saltmarsh and mangrove habitat are not known to occur within or in proximity of the Project Application Area and would not be affected by the Project. Part of the Lake Macquarie State Conservation Area (Point Wolstoncroft), does occur within the Project Application Area. Pulbah Island Nature Reserve also occurs near the boundary of the Project Application Area. However, no impact to the conservation values of this these areas (in terms of aquatic ecology) as a result of the Project is expected. Based on the negligible impacts predicted, there are not expected to be any external aquatic ecology costs of the Project.

Terrestrial Ecology – the Project Application Area includes areas of native vegetation, State Forest, State Conservation Areas and partially disturbed vegetation, among the developed residential and industrial areas of Eraring and Morisset Peninsula. However, due to the negligible subsidence (i.e. less than 20 millimetres) proposed on the land-based areas of the Project Application Area the proposed Project is unlikely to significantly impact on any species, population or ecological community listed under the *Threatened Species Conservation Act 1995*, *Environment Protection and Biodiversity Conservation Act 1999* or State Environmental Planning Policy No. 44 – Koala Habitat Protection. No threatened species, endangered populations or threatened ecological communities were identified during a survey of the area of the proposed minor drainage works at the Surface Facilities Area. Based on the negligible impacts predicted, there are not expected to be any external terrestrial ecology costs of the Project.

Aboriginal and non-Aboriginal heritage – impacts on highly significant Aboriginal heritage sites have been shown to affect the well-being of the broader community (Gillespie Economic 2008). The fieldwork undertaken for the Aboriginal cultural heritage impact assessment led to the recording of four new Aboriginal cultural heritage sites within the Project Application Area. However, due to the negligible subsidence (i.e. less than 20 millimetres) proposed on the land-based areas of the Project Application Area, it is considered that the proposed Project is unlikely to have significant impacts on items or works of Aboriginal or European heritage significance. No listed or new items or works of European Heritage significance have been previously recorded within the Project Application Area. Based on the negligible impacts predicted, there are not expected to be any external Aboriginal and non-Aboriginal heritage costs of the Project.

Groundwater – the Project will result in additional groundwater seepage into the workings requiring an increase in the amount of water delivered back to the surface and underground storage. However, the Project is not likely to result in significant impacts to the local groundwater regime, as the groundwater make will continue to be discharged back into Lake Macquarie. Similarly, the saline water which will continue to enter the mine and be discharged back into a saline environment following settlement is not predicted to alter the salinity balance of Lake Macquarie. Areas subject to subsidence of less than

[2] It should be noted that greenhouse gas generation associated with usage of the product coal is considered to be outside of the scope of the BCA of the Project.

20 millimetres (Morisset Peninsular and Point Wolstoncroft) may experience minimal disturbance to the rock overlying the coal seam and so negligible disturbance to shallow alluvial groundwaters is predicted. Based on the negligible impacts predicted, there are not expected to be any external Groundwater costs of the Project

Traffic and transport – the proposed Project will not significantly alter the existing traffic and transport network for deliveries and staff movements to and from the Surface Facilities Area. No coal is proposed to be transported by road. Traffic impacts of the Project are therefore expected to be negligible. Based on the negligible impacts predicted, there are not expected to be any external transport costs of the Project.

Visual impacts – Myuna Colliery Surface Facilities Area is primarily surrounded by an elevated, vegetated buffer, largely screening it from residential receptors. Due to the topographical positioning and surrounding landforms, Myuna Colliery is generally not visible to the local community, thereby having little effect on the visual amenity of the local area. As no new infrastructure is proposed for the Project there is not expected to be any external visual costs of the Project.

Surface water impacts – the Project will continue to undertake treatment and discharge of ground and surface waters in accordance with an Environmental Protection Licence (EPL). The Project will effect an increase in discharges though the EPL's two licensed discharge points due to the increase in the extent of mining. These increases will be accommodated in the approved discharge limits and will adhere to the water quality criteria of the EPL. The increased discharges requires by the Project will not require any variation to existing EPL conditions. Surface water will continue to be managed in accordance with the Water Management System to control and separate clean and dirty water with discharges designed to meet DECCW requirements. This will be aided by the proposed clean water diversions at the Myuna Colliery Surface Facilities Area. No negative surface water impacts are anticipated, thus it is not expected to result in an external cost of the Project.

Social and economic value of employment – the Project would require approximately 210 direct jobs for a period of 21 years. Historically, employment benefits of projects have tended to be omitted from benefit cost analysis on the implicit assumption that labour resources used in a project would otherwise be employed elsewhere. Where this is not the case and labour resources would otherwise be unemployed for some period of time, Streeting and Hamilton (1991) and Bennett (1996) outline that otherwise unemployed labour resources utilised in a project should be valued in a BCA at their opportunity cost (wages less social security payments and income tax) rather than the wage rate which has the effect of increasing the net production benefits of the project. In addition, there may be social costs of unemployment that require the estimation of people's willingness to pay to avoid the trauma created by unemployment. These are non-market values.

More recently, it has been recognised that the broader community may hold non-environmental, non-market values (Portney 1994) for social outcomes such as employment (Johnson and Desvouges 1997) and the viability of rural communities (Bennett et al 2004). Gillespie Economics (2008) estimated the value the community hold for the 23 years that the Metropolitan Colliery provides 320 jobs, to be $756M (present value). Gillespie Economics (2009) estimated the value the community hold for the 30 years that the Bulli Seam Operations provides 1,170 jobs, to be $870M (present value). The value for 10 years that the Warkworth Mine provides 975 jobs was estimated at $286M (present value).

The Project will provide approximately 210 direct jobs for a period of 21 years. Using the more conservative Bulli Seam Operation employment value gives an estimated $107M for the employment benefits of the Project[3]. This community benefit value has been included in the BCA.

[3] This value was placed in year 1 of the analysis and discounted at 7%.

2.5 CONSOLIDATION OF VALUE ESTIMATES

The present value of costs and benefits of the Project, using a 7% discount rate are provided in Table 2.3.

Table 2.3
Benefit Cost Analysis Results of the Project (Present Values @ 7% discount rate)

COSTS ($M)		BENEFITS ($M)	
Production			
Opportunity cost of land	$2	Avoided decommissioning costs	$3
Opportunity cost of capital	$35	Coal value	$1,093
Capital costs	$71	Residual value of land	$1
Operating costs	$656	Residual value of capital	$12
Decommissioning costs	$1		
Total Production Costs	**$766**	**Total Production Benefits**	**$1,109**
		Net Production Benefits	**$343**
Potential Externalities			
Air quality impacts	Negligible impacts	Social and economic values of employment	$100
Greenhouse gas impacts	$166		
Acoustic impacts	Negligible impacts		
Aquatic ecology impacts	Negligible impacts		
Terrestrial ecology impacts	Negligible impacts		
Aboriginal and Non-Aboriginal heritage impacts	Negligible impacts		
Groundwater impacts	Negligible impacts		
Traffic and transport impacts	Negligible impacts		
Visual impacts	Negligible impacts		
Surface water impacts and sediment/erosion control	Negligible impacts		
TOTAL QUANTIFIED	**$931**	**TOTAL QUANTIFIED**	**$1,209**
NET QUANTIFIED BENEFITS (NPV)		**$278**	

The main decision criterion for assessing the economic desirability of a project to society is its net present value (NPV). NPV is the present value of benefits less the present value of costs. A positive NPV indicates that it would be desirable from an economic perspective for society to allocate resources to the Project, because the community as a whole would obtain net benefits from the Project. Table 2.3 indicates that the Project will have net production benefits of $343M.

The net production benefit shown in Table 2.3 is distributed amongst a range of stakeholders including:

- CMPL and its shareholders;
- The NSW Government via royalties; and
- The Commonwealth Government in the form of Company tax.

The NSW Government receives additional benefits in the form of payroll tax and local councils also benefit through rates and development contributions.

The external costs from the Project relate to greenhouse gas generation. Greenhouse gas costs have been valued at $166M. CMPL proposes internalising some of these costs by offsetting 10% of its Scope 1 emissions where opportunities to avoid or mitigate emissions are not available.

External benefits associated with employment provided by the Project have been estimated at $100M.

Overall, the Project is estimated to have net benefits of $278M and hence is desirable and justified from an economic efficiency perspective.

2.6 SENSITIVITY ANALYSIS

This NPV presented in Table 2.3 is based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a BCA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV.

In this analysis, the BCA result was tested for 20% changes to the following variables at a 4%, 7% and 10% discount rate:

- Opportunity cost of land;
- Opportunity cost of capital;
- Capital costs;
- Operating costs;
- Decommissioning costs;
- Value of coal;
- Residual value of capital and land;
- Greenhouse costs; and
- Employment benefits.

What this analysis indicates (refer to Appendix 2) is that the results of the BCA are not sensitive to reasonable changes in assumptions regarding any of these variables. In particular, significant increases in the value used for the external impact of greenhouse gas generation had little impact on the economic desirability of the Project.

The results were most sensitive to increases in operating costs and decreases in the economic value of the coal.

3 ECONOMIC IMPACT ASSESSMENT

3.1 INPUT-OUTPUT TABLE AND ECONOMIC STRUCTURE OF THE REGION

Economic impact assessment is primarily concerned with the effect of an impacting agent on an economy in terms of a number of specific indicators, such as gross regional output, value-added, income and employment.

These indicators can be defined as follows:

- ***Gross regional output*** – the gross value of business turnover;
- ***Value-added*** – the difference between the gross regional output and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output;
- ***Income*** – the wages paid to employees including imputed wages for self employed and business owners; and
- ***Employment*** – the number of people employed (including full-time and part-time).

An impacting agent may be an existing activity within an economy or may be a change to a local economy (Powell *et al.,* 1985; Jensen and West, 1986). This assessment is concerned with the impact of 2 Mtpa of ROM coal production at the Myuna Colliery.

The economy on which the impact is measured can range from a township to the entire nation (Powell *et al.,* 1985). In selecting the appropriate economy, regard needs to be had to capturing the local expenditure and employment associated with the Myuna Project, but not making the economy so large that the impact of the Project becomes trivial (Powell and Chalmers, 1995). Advice is that the workforce is likely to predominantly reside in the Newcastle Statistical Sub-Division (SSD) comprising Cessnock Statistical Local Area (SLA), Lake Macquarie SLA, Maitland SLA, Port Stephens SLA and Newcastle SLA. Consequently, for this study, the economic impacts of the Project have been estimated for the Australian Bureau of Statistics (ABS) Newcastle SSD.

A range of methods can be used to examine the economic impacts of an activity on an economy including economic base theory, Keynesian multipliers, econometric models, mathematical programming models and input-output models (Powell *et al.,* 1985). This study uses input-output analysis.

Input-output analysis essentially involves two steps:

- Construction of an appropriate input-output table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each sector of the economy; and
- Identification of the initial impact or stimulus of the Project (construction and/or operation) in a form that is compatible with the input-output equations so that the input-output multipliers and flow-on effects can then be estimated (West, 1993).

A 2005-06 input-output table of the regional economy (Newcastle SSD) was developed using the Generation of Input-Output Tables (GRIT) procedure (Appendix 3) and a 2005-06 input-output table of the NSW economy (developed by Monash University) as the parent table. The 109 sector input-output table of the regional economy was aggregated to 30 sectors and 6 sectors for the purpose of describing the economies.

A highly aggregated 2005-06 input-output table for the regional economy is provided in Table 3.1. The rows of the table indicate how the gross regional output of an industry is allocated as sales to other industries, to households, to exports and other final demands (OFD - which includes stock changes, capital expenditure and government expenditure). The corresponding column shows the sources of

inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA - which includes gross operating surplus and depreciation and net indirect taxes and subsidies) and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

Table 3.1
Aggregated Transactions Table: Regional Economy 2005-06 ($'000)

	Ag, forestry, fishing	Mining	Manuf.	Utilities	Building	Services	TOTAL	Household Expenditure	OFD	Exports	Total
Ag, forestry, fishing	5,210	104	53,983	17	640	20,108	80,062	36,107	88,978	146,046	351,193
Mining	16	42,584	83,271	125,586	6,359	4,153	261,969	1,394	-27,225	916,730	1,152,868
Manuf.	32,231	37,215	1,797,045	28,654	381,091	997,263	3,273,500	705,662	731,871	5,765,119	10,476,153
Utilities	3,584	7,473	163,699	979,533	16,256	193,578	1,364,123	144,583	20,054	618,646	2,147,406
Building	2,463	8,617	24,290	28,291	672,890	271,283	1,007,834	0	2,038,505	164,397	3,210,736
Services	41,939	66,754	1,167,476	68,708	361,460	4,469,637	6,175,975	4,392,512	5,466,987	8,009,805	24,045,279
TOTAL	85,443	162,747	3,289,764	1,230,788	1,438,697	5,956,023	12,163,463	5,280,258	8,319,170	15,620,743	41,383,635
Household Income	69,912	150,384	1,581,260	155,696	817,163	8,675,384	11,449,801	0	0	0	11,449,801
OVA	62,747	709,177	1,345,491	411,354	308,138	4,021,630	6,858,537	672,889	294,152	28,076	7,853,654
Imports	133,091	130,559	4,259,637	349,568	646,738	5,392,241	10,911,834	6,242,146	1,580,417	1,107,411	19,841,809
TOTAL	351,193	1,152,868	10,476,153	2,147,406	3,210,736	24,045,279	41,383,635	12,195,294	10,193,739	16,756,230	80,528,898
Employment	1,805	2,273	22,802	2,281	11,708	140,819	181,688				

Gross regional product (GRP or Value-added) for the regional economy is estimated at $19,3030M, comprising $11,449M to households as wages and salaries (including payments to self employed persons and employers) and $7,853M in OVA.

The employment total working in the region was 181,688 people.

The economic structure of the regional economy can be contrasted with that for NSW through a comparison of results from the respective input-output models (Figures 3.1 and 3.2). This reveals that the economies are not dissimilar with the main difference being the greater relative importance of the manufacturing sectors to the regional economy as well as the greater relative importance of GRP and output in the mining and utilities sectors to the regional economy. The agriculture/forestry/fishing sectors, building sectors and services sectors are of slightly lower relative importance to the regional economy than they are to the NSW economy.

Figure 3.1
Summary of Aggregated Sectors: Regional Economy (2005-06)

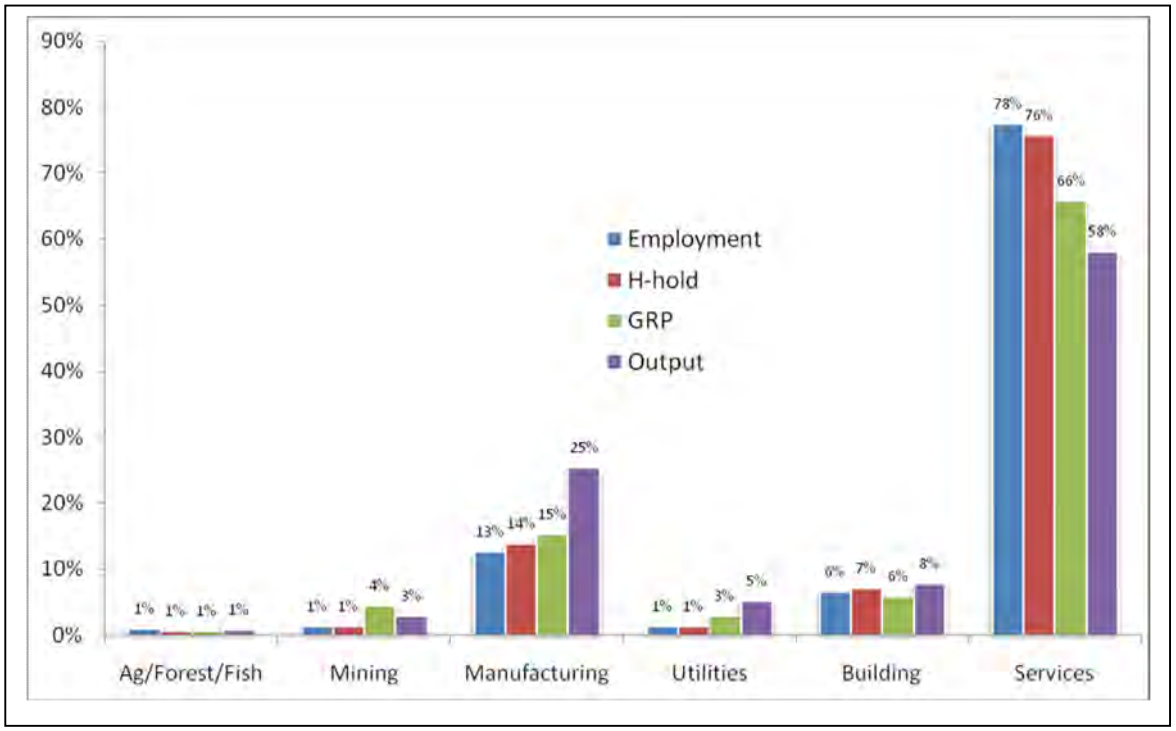
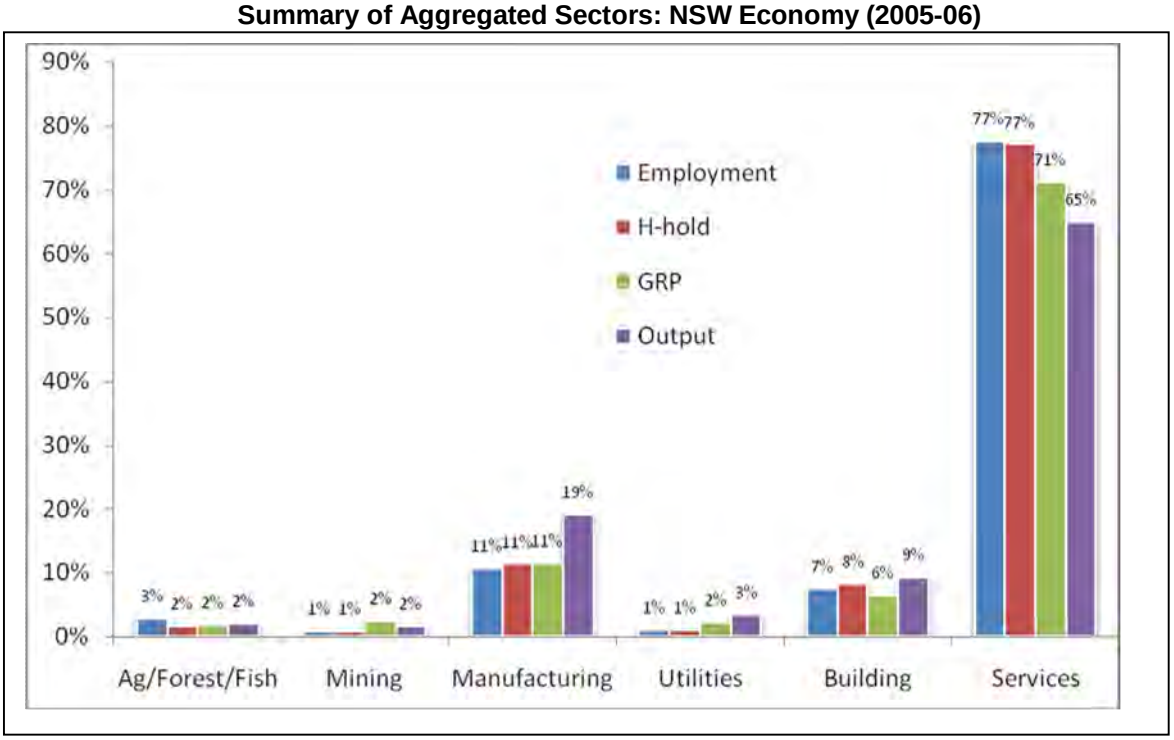


Figure 3.2
Summary of Aggregated Sectors: NSW Economy (2005-06)



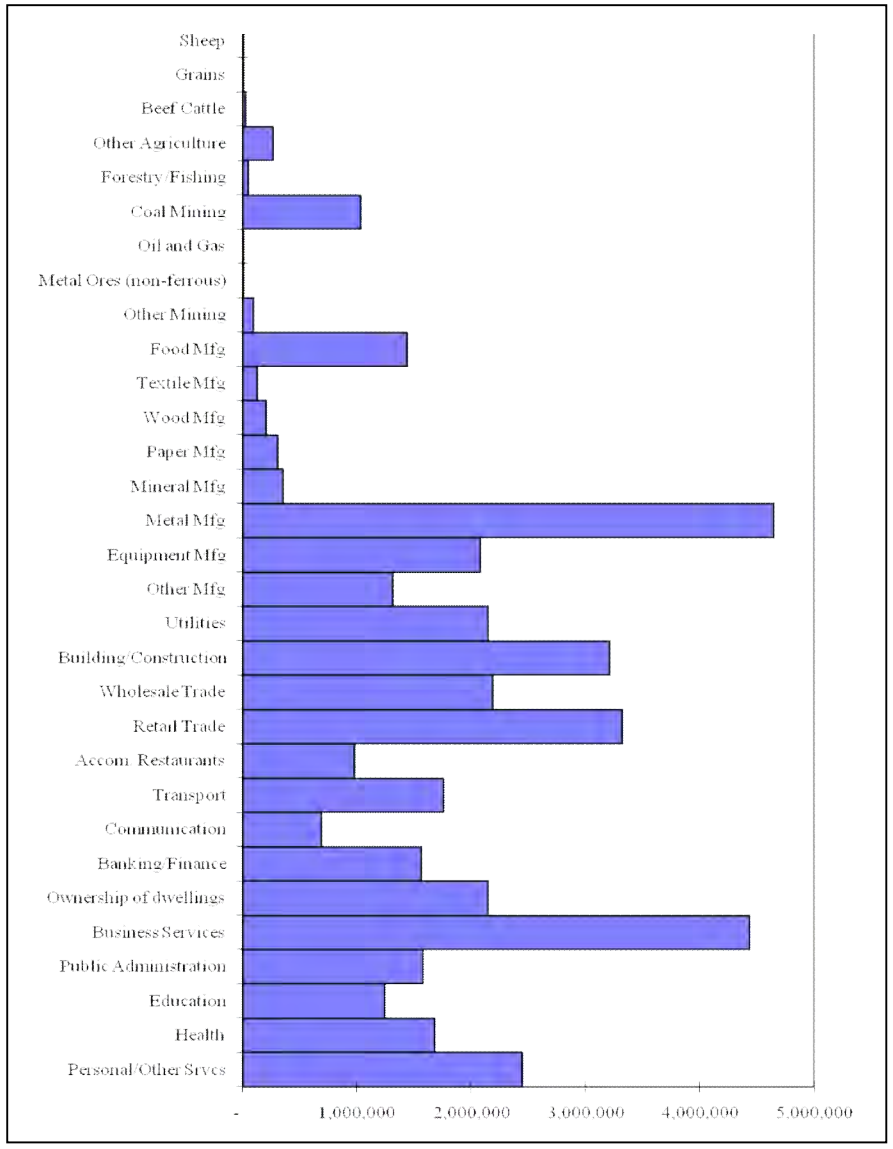
Figures 3.3 to 3.5 provide a more expansive sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the economic structure of the economy.

What is clear from these figures is the importance of the tertiary sectors and manufacturing sectors to the economy, with coal mining being the dominant primary sector activity. In terms of gross regional output the business services sectors and metal manufacturing sectors are the most significant, with the business services sectors also being the most significant in terms of value-added and income. The retail sector is the most significant sector in term of employment while the metal manufacturing sectors the most significant sectors in terms of exports and imports.

At an individual sector level the retail trade sector and basic non-ferrous metal manufacturing sector are the most significant sectors for output while the retail trade sector and health sector are the most significant sectors in terms of value-added, employment and income. The retail trade sector and basic non-ferrous metal manufacturing sector are the most significant sectors for imports and exports.

Figure 3.3 Sectoral Distribution of Gross Regional Output and Value-Added ($'000)

Gross Regional Output



Gross Value-Added

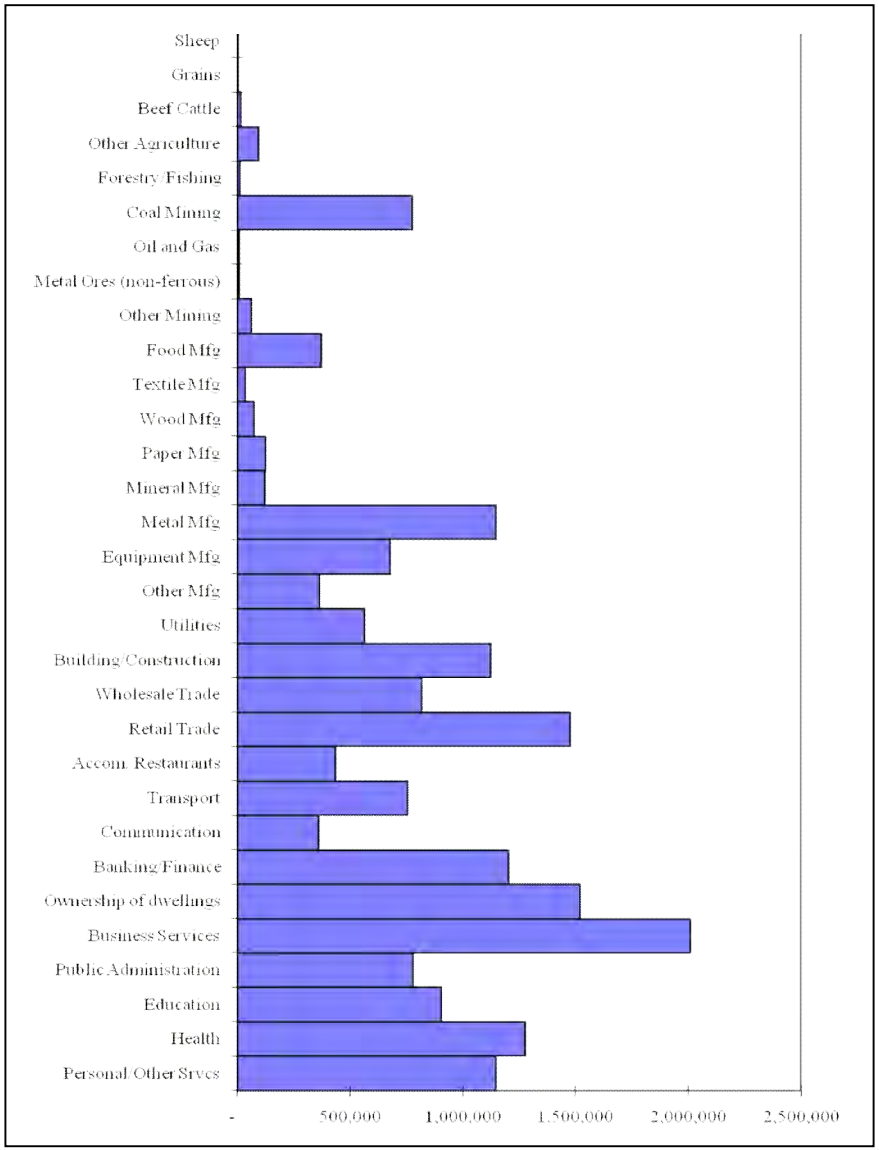
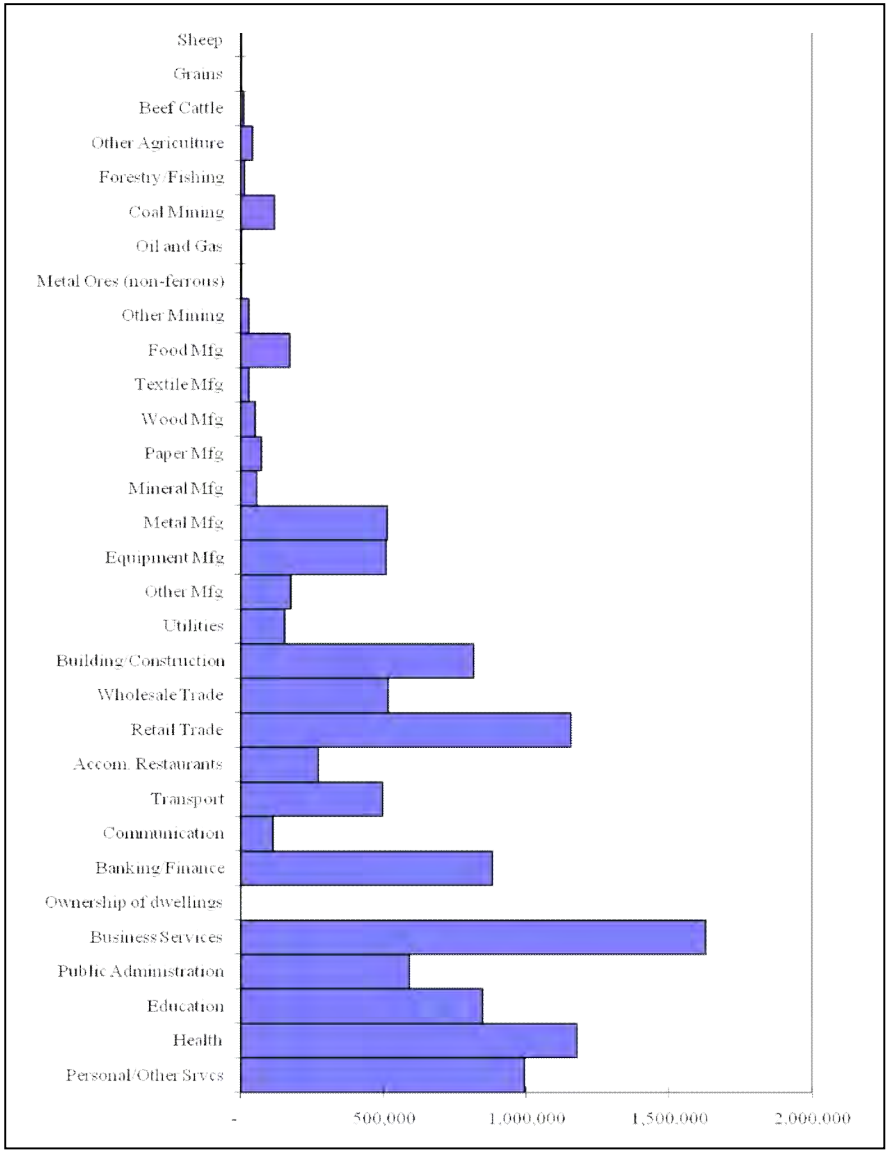


Figure 3.4 Sectoral Distribution of Gross Regional Income ($'000) and Employment (No.)

Income



Regional Employment

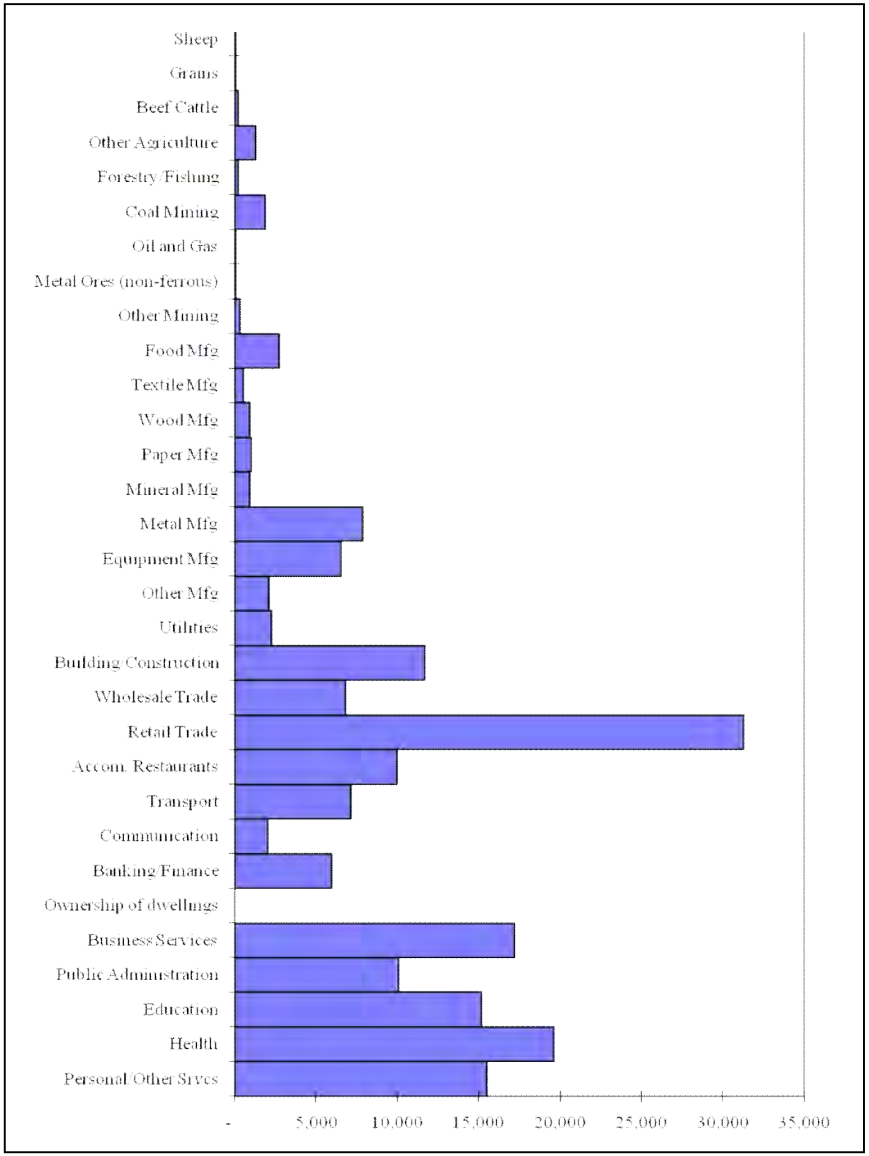
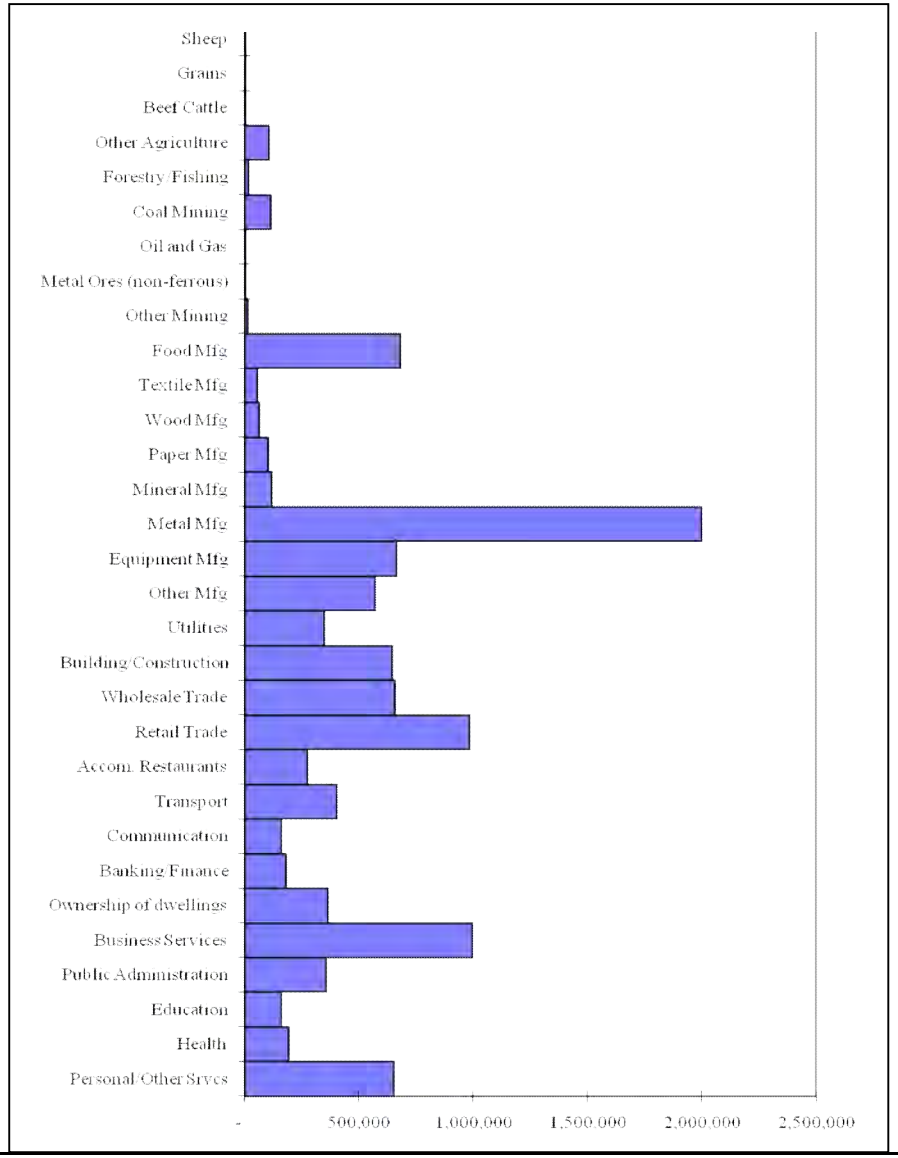
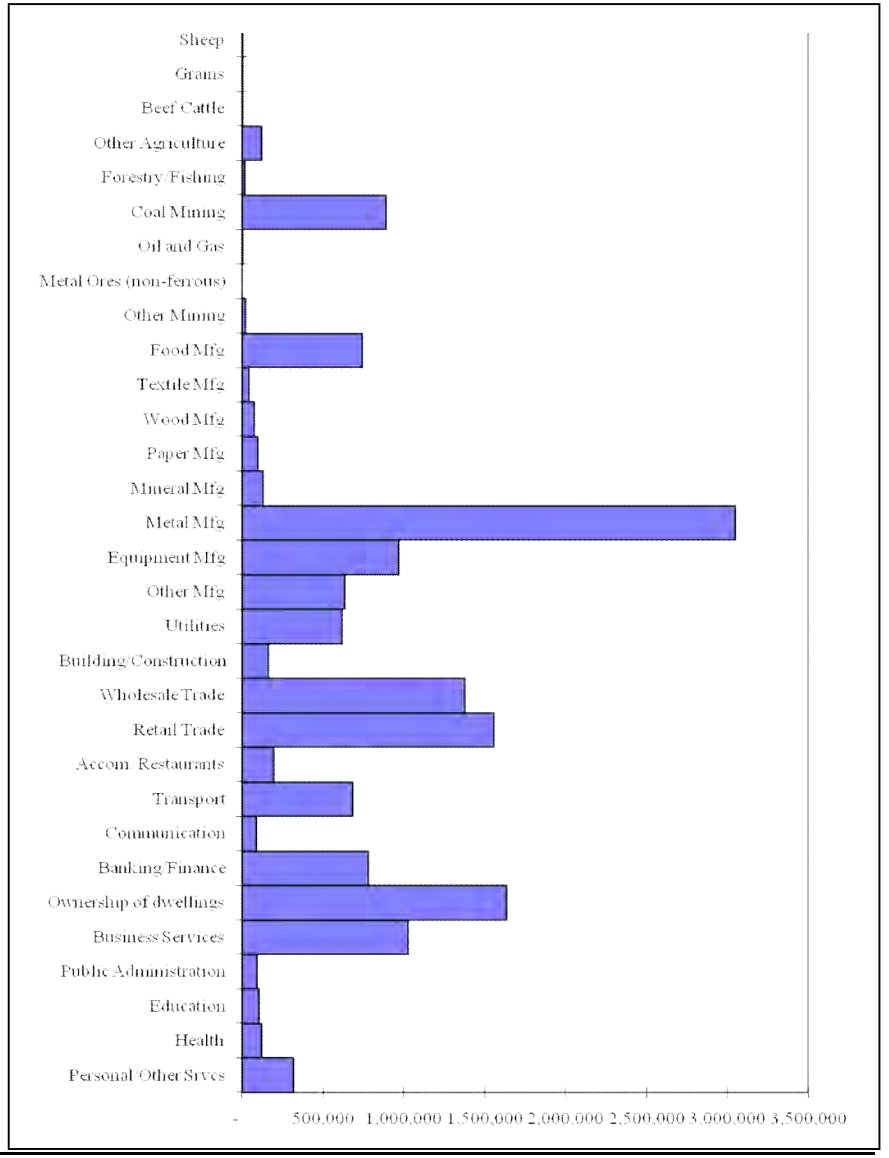


Figure 3.5 Sectoral Distribution of Imports and Exports ($'000)

Regional Imports



Regional Exports



3.2 REGIONAL ECONOMIC IMPACT OF THE PROJECT

3.2.1 *Introduction*

For the analysis of the extension of mining at Myuna Colliery, a new Myuna Coal Mine sector was inserted into the regional input-output table reflecting production levels of approximately 2 Mtpa of coal for the Project and employment levels of 210. The revenue, expenditure and employment data for this new sector was obtained from financial information provided by CMPL. For this new sector:

- the estimated gross annual revenue was allocated to the *Output* row;
- the estimated wage bill of the direct employment residing in the region (100%) was allocated to the *household wages* row;
- non-wage expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added*;
- allocation was then made between *intermediate sectors* in the local economy and *imports* based on regional location quotients;
- purchase prices for expenditure in each sector in the region were adjusted to basic values and margins and taxes and allocated to appropriate sectors using relationships in the 2001-02 National Input-Output Tables;
- the difference between total revenue and total costs was allocated to the *other value-added* row*;* and
- employment that resides in the region was allocated to the *employment* row.

3.2.2 *Impacts of the Project on the Regional Economy*

The total and disaggregated annual impacts of the Project on the regional economy in terms of output, value-added, income and employment (in 2010 dollars) are shown in Table 3.2.

Table 3.2
Annual Regional Economic Impacts of the Project

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	85,130	42,843	31,329	74,172	159,302
Type 11A Ratio	*1.00*	*0.50*	*0.37*	*0.87*	*1.87*
VALUE ADDED ($'000)	40,778	15,501	14,756	30,256	71,035
Type 11A Ratio	*1.00*	*0.38*	*0.36*	*0.74*	*1.74*
INCOME ($'000)	31,552	10,677	10,850	21,527	53,079
Type 11A Ratio	*1.00*	*0.34*	*0.34*	*0.68*	*1.68*
EMPL. (No.)	210	104	138	241	451
Type 11A Ratio	*1.00*	*0.49*	*0.66*	*1.15*	*2.15*

In total, the Project is estimated to make up to the following contribution to the regional economy:

- $159M in annual direct and indirect regional output or business turnover;
- $71M in annual direct and indirect regional value added;
- $53M in annual household income; and
- 451 direct and indirect jobs.

3.2.3 *Multipliers*

The Type 11A ratio multipliers for the Project range from 1.68 for income up to 2.15 for employment.

Capital intensive industries tend to have a high level of linkage with other sectors in an economy thus contributing substantial flow-on employment while at the same time only having a lower level of direct employment (relative to output levels). This tends to lead to a relatively high ratio multiplier for employment. A lower ratio multiplier for income (compared to employment) also generally occur as a result of comparatively higher wage levels in the mining sectors compared to incomes in the sectors that would experience flow-on effects from the Project. Capital intensive mining projects also typically have a relatively low ratio multiplier for value-added reflecting the relatively high direct value-added for the Project compared to that in flow-on sectors. The low output ratio multiplier largely reflects the high direct output value of the Project compared to those sectors that experience flow-on effects from the Project.

3.2.4 *Main Sectors Affected*

Flow-on impacts from the Project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be the:

- Structural metal products manufacturing;
- Agricultural and mining machinery manufacturing sector;
- Electricity sector;
- Health services sector;
- Wholesale trade sector;
- Retail trade sector;
- Other business services sector; and
- Hotels, cafes and restaurants sector.

Examination of the estimated direct and flow-on employment impacts gives an indication of the sectors in which employment opportunities will be generated (Table 3.3).

Table 3.3
Sectoral Distribution of Total Regional Employment Impacts

Sector	Average Direct Effects	Production induced	Consumption-induced	Total
Primary	0	0	1	1
Mining	210	2	0	212
Manufacturing	0	49	8	58
Utilities	0	4	2	6
Wholesale/Retail	0	14	30	44
Accommodation, cafes, restaurants	0	2	21	23
Building/Construction	0	2	1	3
Transport	0	7	5	12
Services	0	22	70	92
Total	**210**	**104**	**138**	**451**

Note: Totals may have minor discrepancies due to rounding.

Table 3.3 indicates that direct, production-induced and consumption-induced employment impacts of the Project on the regional economy are likely to have different distributions across sectors. Production-induced flow-on employment will occur mainly in the manufacturing sectors, wholesale/retail sectors and services sectors while consumption induced flow-on employment will be mainly in the services sectors, wholesale/retail sectors and accommodation/cafes/restaurants sectors.

Businesses that can provide the inputs to the production process at Myuna Colliery and/or the products and services required by employees will directly benefit from the Project by way of an increase in economic activity. However, because of the inter-linkages between sectors, many indirect businesses also benefit.

3.3 STATE ECONOMIC IMPACTS OF THE PROJECT

3.3.1 *Introduction*

The State economic impacts of the Project were assessed in the same manner as for estimation of the regional impacts. A new Myuna Coal Mine sector was inserted into a 2010 NSW input-output table in the same manner described in Section 3.2.1. The primary difference from the sector identified for the regional economy was that a greater level of expenditure was captured by NSW economy compared to the regional economy.

3.3.2 *Impacts of the Project on NSW*

The total and disaggregated annual impacts of the Project on the NSW economy in terms of output, value-added, income and employment (in 2010 dollars) are shown in Table 3.4.

Table 3.4
Annual State Economic Impacts of the Project

	Direct Effect	Production Induced	Consump. Induced	Total Flow-on	TOTAL EFFECT
OUTPUT ($'000)	85,130	54,394	82,432	136,826	221,956
Type 11A Ratio	*1.00*	*0.64*	*0.97*	*1.61*	*2.61*
VALUE ADDED ($'000)	40,779	20,864	41,987	62,851	103,630
Type 11A Ratio	*1.00*	*0.51*	*1.03*	*1.54*	*2.54*
INCOME ($'000)	31,553	15,493	24,028	39,521	71,074
Type 11A Ratio	*1.00*	*0.49*	*0.76*	*1.25*	*2.25*
EMPL. (No.)	210	179	343	522	732
Type 11A Ratio	*1.00*	*0.85*	*1.64*	*2.49*	*3.49*

In total, the Project is estimated to make the following contribution to the NSW economy:

- $222M in annual direct and indirect output or business turnover;
- $104M in annual direct and indirect value added;
- $71M in annual household income; and
- 732 direct and indirect jobs.

The impacts on the NSW economy are greater than for the regional economy, as the NSW economy is able to capture more mine and household expenditure, and there is a greater level of intersectoral linkages in the larger NSW economy.

3.4 PROJECT CESSATION

The Project will continue to stimulate demand in the regional and NSW economy leading to sustained business turnover in a range of sectors and ongoing employment opportunities. Conversely, the cessation of the mining operations in the future would result in a contraction in regional economic activity.

The magnitude of the regional economic impacts of cessation of the Project would depend on a number of interrelated factors at the time, including:

- The movements of workers and their families;
- Alternative development opportunities; and
- Economic structure and trends in the regional economy at the time.

Ignoring all other influences, the impact of Project cessation would depend on whether the workers and their families affected would leave the region. If it is assumed that some or all of the workers remain in the region, then the impacts of Project cessation would not be as severe compared to a greater level leaving the region. This is because the consumption-induced flow-ons of the decline would be reduced through the continued consumption expenditure of those who stay (Economic and Planning Impact Consultants, 1989). Under this assumption, the regional economic impacts of Project cessation would approximate the direct and production-induced effects in Table 3.2. However, if

displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 3.2.

The decision by workers, on cessation of the Project, to move or stay would be affected by a number of factors including the prospects of gaining employment in the local region compared to other regions, the likely loss or gain from homeowners selling, and the extent of "attachment" to the local region (Economic and Planning Impact Consultants, 1989).

To the extent that alternative development opportunities arise in the regional economy, the regional economic impacts associated with mining closure that arise through reduced production and employment expenditure can be substantially ameliorated and absorbed by the growth of the region. One key factor in the growth potential of a region is its capacity to expand its factors of productions by attracting investment and labour from outside the region (BIE, 1994). This in turn can depend on a region's natural endowments. In this respect, the Newcastle SSD region is highly prospective with considerable coal resources (NSW DPI, 2009). It is therefore likely that over time, new mining developments will occur, offering potential to strengthen and broaden the economic base of the region and hence buffer against impacts of the cessation of individual activities.

Ultimately, the significance of the economic impacts of cessation of the Project would depend on the economic structure and trends in the regional economy at the time. For example, if Project cessation takes place in a declining economy, the impacts might be more significant. Alternatively, if Project cessation takes place in a growing diversified economy where there are other development opportunities, the ultimate cessation of the Project may not be a cause for concern.

Nevertheless, given that it is not possible to foresee the likely circumstances within which Project cessation would occur, it is important that regional authorities and leaders take every advantage from the stimulation to regional economic activity and skills and expertise that the Project would maintain in the region.

4 CONCLUSION

A BCA identified a range of potential economic costs and benefits of the Project. Values were placed on production costs and benefits as well as external costs and benefits. The net production benefits of the Project were estimated at $343M. The main external cost from the Project relate to greenhouse gas generation, estimated at $166. External benefits associated with employment provided by the Project have been estimated at $100M.

Overall, the Project is estimated to have net benefits of $278M and hence is desirable and justified from an economic efficiency perspective.

A regional economic impact analysis, using input-output analysis, estimated that in total, the Project will contribute the following to the regional economy:

- $159M in annual direct and indirect regional output or business turnover;
- $71M in annual direct and indirect regional value added;
- $53M in annual household income; and
- 451 direct and indirect and indirect direct jobs.

At the State level the Project will make the following contribution to the economy:

- $222M in annual direct and indirect output or business turnover;
- $104M in annual direct and indirect value added;
- $71M in annual direct and indirect household income; and
- 732 direct and indirect jobs.

This stimulus would be felt across a range of sectors in the economy including the coal mining sector, structural metal products manufacturing sector, agricultural and mining machinery manufacturing sector, electricity sector, wholesale trade sector, retail trade sector, health sector, other business services sector, and hotels, cafes and restaurants sector.

A 21-year approval is being sought for the Project. On cessation of mining the economic stimulus provided by the Project will cease. The significance of these Project cessation impacts will depend on:

- The degree to which any displaced workers and their families remain within the region;
- The economic structure and trends in the regional economy at the time.
- Whether other mining developments or other opportunities in the region arise that allow employment of displaced workers.

Nevertheless, given the uncertainties about the circumstances within which Project cessation will occur, it is important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the Project brings to the region, to strengthen and broaden the region's economic base.

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Appendix 1 – Valuing Greenhouse Gas Emissions

To place an economic value on CO_2-e emissions a shadow price of carbon is required that reflects its social costs. The social cost of carbon is the present value of additional economic damages now and in the future caused by an additional tonne of carbon emissions.

A prerequisite to valuing this environmental damage is scientific dose-response functions identifying how incremental emissions of CO_2-e would impact climate change and subsequently impact human activities, health and the environment on a spatial basis. Only once these physical linkages are identified is it possible to begin to place economic values on the physical changes using a range of market and non market valuation methods. Neither the identification of the physical impacts of additional greenhouse gas nor valuation of these impacts is an easy task, although various attempts have been made using different climate and economic modelling tools. The result is a great range in the estimated damage costs of greenhouse gas.

The Stern Review: Economics of Climate Change (Stern 2006) acknowledged that the academic literature provides a wide range of estimates of the social cost of carbon. It adopted an estimate of US$85/t CO_2-e for the "business as usual" case, i.e. an environment in which there is an annually increasing concentration of greenhouse gas in the atmosphere.

Tol (2006) highlights some significant concerns with Stern's damage cost estimates including:

- that in estimating the damage of climate change Stern has consistently selected the most pessimistic study in the literature in relation to impacts;
- Stern's estimate of the social cost of carbon is based on a single integrated assessment model, PAGE2002, which assumes all climate change impacts are necessarily negative and that vulnerability to climate change is independent of development;
- Stern uses a near zero discount rate which contravenes economic theory and the approach recommended by Treasury's around the world

All these have the effect of magnifying the social cost of carbon estimate, providing what Tol (2006) considers to be an outlier in the marginal damage cost literature.

Tol (2005) in a review of 103 estimates of the social cost of carbon from 28 published studies found that the range of estimates was right-skewed: the mode was US$0.55/t CO_2-e (in 1995 US$), the median was US$3.82/t CO_2-e, the mean US$25.34/t CO_2-e and the 95th percentile US$95.37/t CO_2-e. He also found that studies that used a lower discount rate and those that used equity weighting across regions with different average incomes per head, generated higher estimates and larger uncertainties. The studies did not use a standard reference scenario, but in general considered 'business as usual' trajectories.

Tol (2005) concluded that "it is unlikely that the marginal damage costs of carbon dioxide emissions exceed US$14/t CO_2-e and are likely to be substantially smaller than that". Nordhaus's (2008) modelling using the DICE-2007 Model suggests a social cost of carbon with no emissions limitations of US$30 per tonne of carbon (/tC) (US$8/t CO_2-e).

An alternative method to trying to estimate the damage costs of carbon dioxide is to examine the price of carbon credits. This is relevant because emitters can essentially emit CO_2-e resulting in climate change damage costs or may purchase credits that offset their CO_2-e impacts, internalising the cost of the externality at the price of the carbon credit. The price of carbon credits therefore provides an alternative estimate of the economic cost of greenhouse gas. However, the price is ultimately a function of the characteristics of the scheme and the scarcity of permits etc and hence may or may not reflect the actual social cost of carbon.

In 2008 the price of carbon credits under the European Union Emissions Trading Scheme were around €24/t CO_2-e, the equivalent of about US$38 t CO_2-e while spot prices in the Chicago Climate Exchange were in the order of US$3.95 t CO_2-e.

As of July 2008 the spot price under the NSW Government Greenhouse Gas Reduction Scheme was AUS$7.25 t CO_2-e. Prices under the Commonwealth Governments Greenhouse Friendly Voluntary Scheme were AUS$8.30 t CO_2-e and Australian Emissions Trading Unit (in advance of the Australian Governments Emissions Trading Scheme) was priced at AUS$21 t CO_2-e (Next Generation Energy Solutions pers. comms. 24 July 2008).

A National Emissions Trading Scheme was foreshadowed in Australia by 2010. While the ultimate design and hence liabilities under any scheme are still a work in progress, the National Emissions Trading Taskforce cited a carbon permit price of around AUS$35 t CO_2-e.

The Carbon Pollution Reduction Scheme: Australia's Low Pollution Future White Paper (Australian Government,2008) cited a carbon permit price of AUS$23/t CO_2-e in 2010 and AUS$35/t CO_2-e in 2020 (in 2005) dollars for a 5% reduction in carbon pollution below 2000 levels by 2020.

Given the above information and the great uncertainty around damage cost estimates, a range for the social cost of greenhouse gas emissions from AUS$8/ t CO_2-e to AUS$40/ t CO_2-e was used in the sensitivity analysis in Section 2.6, with a conservatively high central value of AUS$30/ t CO_2-e.

Appendix 2 – Sensitivity Testing (NPV A$M)

INCREASE 20%	4%	7%	10%
Opportunity cost of land	$357	$278	$226
Opportunity cost of capital	$353	$273	$221
Capital costs	$338	$264	$215
Operating costs	$179	$147	$126
Decommissioning costs	$357	$278	$227
Value of coal	$653	$497	$393
Residual value of capital and land	$362	$281	$228
Greenhouse costs @$40/t	$282	$223	$184
Employment benefits	$378	$298	$246
DECREASE 20%			
Opportunity cost of land	$357	$278	$227
Opportunity cost of capital	$361	$283	$231
Capital costs	$376	$292	$237
Operating costs	$535	$409	$326
Decommissioning costs	$357	$278	$226
Value of coal	$61	$59	$60
Residual value of capital and land	$352	$276	$225
Greenhouse costs @ $8/t	$521	$399	$319
Employment benefits	$336	$258	$207

Appendix 3 – The GRIT System for Generating Input-Output Tables

"The Generation of Regional Input-Output Tables (GRIT) system was designed to:

- combine the benefits of survey based tables (accuracy and understanding of the economic structure) with those of non-survey tables (speed and low cost);
- enable the tables to be compiled from other recently compiled tables;
- allow tables to be constructed for any region for which certain minimum amounts of data were available;
- develop regional tables from national tables using available region-specific data;
- produce tables consistent with the national tables in terms of sector classification and accounting conventions;
- proceed in a number of clearly defined stages; and
- provide for the possibility of ready updates of the tables.

The resultant GRIT procedure has a number of well-defined steps. Of particular significance are those that involve the analyst incorporating region-specific data and information specific to the objectives of the study. The analyst has to be satisfied about the accuracy of the information used for the important sectors; in this case the non-ferrous metals and building and construction sectors. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study. It also means that the method should be used by an analyst who is familiar with the economy being modelled, or at least someone with that familiarity should be consulted.

An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important. Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). That means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table A-1" (Powell and Chalmers, 1995).

Table A-1
The GRIT Method

Phase	Step	Action
PHASE 1		ADJUSTMENTS TO NATIONAL TABLE
	1	Selection of national input-output table (106-sector table with direct allocation of all imports, in basic values).
	2	Adjustment of national table for updating.
	3	Adjustment for international trade.
PHASE II		ADJUSTMENTS FOR REGIONAL IMPORTS
		(*Steps 4-14 apply to each region for which input-output tables are required*)
	4	Calculation of 'non-existent' sectors.
	5	Calculation of remaining imports.
PHASE III		DEFINITION OF REGIONAL SECTORS
	6	Insertion of disaggregated superior data.
	7	Aggregation of sectors.
	8	Insertion of aggregated superior data.
PHASE IV		DERIVATION OF PROTOTYPE TRANSACTIONS TABLES
	9	Derivation of transactions values.
	10	Adjustments to complete the prototype tables.
	11	Derivation of inverses and multipliers for prototype tables.
PHASE V		DERIVATION OF FINAL TRANSACTIONS TABLES
	12	Final superior data insertions and other adjustments.
	13	Derivation of final transactions tables.
	14	Derivation of inverses and multipliers for final tables.

Source: Bayne and West (1988)

Appendix P

Schedule of Land

Lot	Schedule	DP
		37670
		45057
		70772
1		1018646
1		1039389
1		1058010
1		1074358
1		1088536
1		1092888
1		1094699
1		1107356
1		11539
1		12863
1		13120
1		13123
1		15556
1		16793
1		17781
1		18060
1		204202
1		204737
1		22842
1		23604
1		250973
1		251160
1		25985
1		262960
1		26549
1		26634
1		270423
1		28046
1		285482
1		317336
1		436113
1		500470

Lot	Schedule	DP
1		505798
1		533069
1		542486
1		548107
1		551113
1		551787
1		561577
1		566927
1		567633
1		568311
1		579042
1		583186
1		602008
1		608817
1		621171
1		622484
1		629396
1		632417
1		651963
1		704468
1		704490
1		727245
1		727939
1		746870
1		778463
1		803077
1		806513
1		807936
1		814599
1		861549
1		870118
1	C	27655
1	F	27655
1	H	2458
1	J	2458

Lot	Schedule	DP
10		1022724
10		1055349
10		1071069
10		11287
10		11995
10		13123
10		15556
10		16793
10		17367
10		17781
10		22842
10		23604
10		248691
10		26634
10		28046
10		28068
10		582048
10		808724
10	C	27655
10	D	2458
10	E	2458
10	E	27655
10	F	27655
10	J	27655
100		1088711
100		11539
100		11995
100		13123
100		15556
100		17367
100		713777
100		790729
100		8055
100		863278
100		880089

Lot	Schedule	DP
1003		650194
101		1014736
101		1088711
101		1119224
101		11539
101		11995
101		15556
101		17367
101		558722
101		730402
101		790729
101		8055
101		844302
101		863278
101		880089
102		1014736
102		1088711
102		1119224
102		11287
102		11539
102		11995
102		13123
102		17367
102		238489
102		558722
102		730402
102		8055
102		844302
103		1014736
103		1088711
103		1119224
103		11287
103		11539
103		11995
103		13123

Lot	Schedule	DP
103		15556
103		17367
103		238489
103		730402
103		8055
104		1088711
104		1119224
104		11287
104		11539
104		11995
104		13123
104		17367
104		238489
104		8055
105		1088711
105		1119224
105		11287
105		11539
105		11995
105		13123
105		15556
105		17367
105		238489
105		8055
106		1088711
106		1119224
106		11287
106		11539
106		11995
106		13123
106		15556
106		17367
106		8055
107		1088711
107		11539

Lot	Schedule	DP
107		11995
107		13123
107		15556
107		17367
107		8055
108		1088711
108		11287
108		11539
108		11995
108		13123
108		17367
108		8055
109		1088711
109		11287
109		11995
109		13123
109		15556
109		17367
109		8055
11		1022724
11		1050120
11		11287
11		11995
11		13120
11		13123
11		15556
11		16793
11		17367
11		22842
11		23604
11		248691
11		26634
11		28046
11		582048
11		625009

Lot	Schedule	DP
11		701829
11		803842
11		808724
11	C	27655
11	D	2458
11	E	2458
11	E	27655
11	F	27655
11	J	27655
110		1088711
110		11995
110		13123
110		15556
110		17367
110		8055
111		1088711
111		1116254
111		13123
111		15556
111		17367
111		629441
111		8055
112		1088711
112		1116254
112		11287
112		11995
112		13123
112		15556
112		17367
112		629441
112		8055
113		1088711
113		1116254
113		11995
113		13123

Lot	Schedule	DP
113		15556
113		17367
113		8055
114		1088711
114		11995
114		13123
114		15556
114		17367
114		8055
115		1088711
115		11287
115		11995
115		13123
115		15556
115		17367
115		8055
116		1088711
116		11287
116		11995
116		13123
116		15556
116		17367
116		8055
117		1088711
117		11287
117		11995
117		13123
117		15556
117		17367
117		8055
118		1088711
118		11287
118		11995
118		13123
118		15556

Lot	Schedule	DP
118		17367
119		1088711
119		11287
119		11995
119		13123
119		17367
119		8055
12		1022724
12		1050193
12		11287
12		11995
12		13120
12		13123
12		15556
12		16793
12		17367
12		22842
12		23604
12		248691
12		26634
12		582049
12		621361
12		625009
12		701829
12		716529
12	C	27655
12	D	2458
12	E	2458
12	E	27655
12	F	27655
12	J	27655
120		1088711
120		11287
120		11539
120		11995

Lot	Schedule	DP
120		13123
120		15556
120		17367
120		8055
121		1088711
121		11287
121		11539
121		11995
121		13123
121		15556
121		17367
121		8055
121		836139
122		1088711
122		11287
122		11539
122		11995
122		13123
122		15556
122		17367
122		8055
123		1088711
123		11287
123		11539
123		11995
123		13123
123		15556
123		17367
123		8055
124		1088711
124		11287
124		11539
124		11995
124		13123
124		15556

Lot	Schedule	DP
124		17367
124		8055
125		11287
125		11539
125		11995
125		13123
125		15556
125		17367
125		8055
126		11287
126		11539
126		13123
126		15556
126		17367
126		8055
127		11539
127		13123
127		15556
127		17367
127		8055
1271		1010499
1272		1010499
128		11287
128		11539
128		13123
128		15556
128		17367
128		8055
129		11287
129		13123
129		15556
129		17367
129		8055
13		11287
13		11995

Lot	Schedule	DP
13		13120
13		13123
13		15556
13		17367
13		22842
13		23604
13		248691
13		26634
13		28068
13		582049
13		625009
13		701829
13		716529
13	C	27655
13	D	2458
13	E	2458
13	E	27655
13	J	27655
130		11287
130		13123
130		15556
130		17367
130		8055
131		11287
131		13123
131		15556
131		17367
131		249719
131		8055
131		859693
132		11287
132		15556
132		17367
132		249719
132		6945

Lot	Schedule	DP
132		8055
132		859693
133		11287
133		15556
133		17367
133		249719
133		6945
133		8055
134		11287
134		15556
134		17367
134		249719
134		8055
1341		844700
1342		844700
135		11287
135		15556
135		17367
135		249719
135		8055
136		11287
136		15556
136		17367
136		249719
136		8055
137		11287
137		15556
137		17367
137		249719
137		8055
138		11287
138		13123
138		15556
138		17367
138		8055

Lot	Schedule	DP
139		13123
139		15556
139		17367
139		8055
1391		580454
1392		580454
14		11287
14		11995
14		13120
14		13123
14		15556
14		17367
14		22842
14		23604
14		248691
14		26634
14		28068
14		538780
14		582049
14	C	27655
14	D	2458
14	E	2458
14	E	27655
14	J	27655
140		13123
140		15556
140		17367
140		656807
140		8055
141		1105594
141		11287
141		13123
141		15556
141		17367
141		852383

Lot	Schedule	DP
142		1105594
142		11287
142		13123
142		15556
142		17367
142		8055
142		852383
143		1105594
143		11287
143		13123
143		17367
144		11287
144		13123
144		17367
144		8055
145		11287
145		13123
145		17367
145A		17367
146		11539
146		13123
146		17367
1461		856874
147		11287
147		11539
147		13123
147		17367
147		8055
148		11287
148		11539
148		13123
148		17367
1482		562711
149		11287
149		11539

Lot	Schedule	DP
149		13123
149		17367
15		11287
15		11995
15		13120
15		13123
15		15556
15		22842
15		23604
15		248691
15		26634
15		28068
15		538780
15		582049
15	C	27655
15	D	2458
15	E	2458
15	E	27655
15	J	27655
150		11287
150		11539
150		13123
150		17367
150		6945
151		11287
151		11539
151		13123
151		17367
151		6945
151		734618
151		854877
152		11539
152		13123
152		17367
152		854877

Lot	Schedule	DP
153		11287
153		11539
153		13123
153		17367
154		11287
154		11539
154		13123
154		17367
154		8055
155		11287
155		11539
155		13123
155		17367
155		8055
156		11287
156		11539
156		13123
156		17367
156		8055
157		11287
157		11539
157		13123
157		8055
1572		1043970
158		11287
158		11539
158		13123
158		17367
158		8055
159		11539
159		13123
159		17367
159		8055
16		11287
16		11995

Lot	Schedule	DP
16		13120
16		13123
16		15556
16		22842
16		23604
16		248691
16		26634
16		573091
16		582050
16	C	27655
16	D	2458
16	E	2458
16	E	27655
16	F	2458
16	J	27655
160		11287
160		11539
160		13123
160		17367
161		11287
161		11539
161		13123
161		17367
162		11287
162		11539
162		13123
162		17367
163		11287
163		11539
163		13123
163		17367
164		11287
164		11539
164		13123
164		17367

Lot	Schedule	DP
164		8055
165		11287
165		11539
165		13123
165		17367
165		8055
166		11287
166		13123
166		17367
166		8055
167		11287
167		13123
167		8055
168		11287
168		13123
168		15556
168		8055
169		8055
1691		1110053
1692		1110053
1693		1110053
17		11287
17		11995
17		13120
17		13123
17		15556
17		22842
17		23604
17		248691
17		26634
17		28068
17		573091
17		582050
17	C	27655
17	D	2458

Lot	Schedule	DP
17	E	2458
17	E	27655
17	F	2458
17	J	27655
170		8055
171		8055
172		11287
172		8055
173		11287
173		15556
173		8055
174		11287
174		8055
175		11287
175		8055
176		11287
176		15556
176		8055
177		11287
177		8055
178		11287
178		8055
179		11287
179		15556
179		8055
18		11287
18		11995
18		13120
18		13123
18		15556
18		22842
18		23604
18		248691
18		26634
18		28068

Lot	Schedule	DP
18		527120
18		582050
18	C	27655
18	D	2458
18	E	2458
18	E	27655
18	F	2458
18	J	27655
180		11287
180		8055
181		11287
181		8055
182		11287
183		11287
183		8055
184		11287
184		8055
185		11287
185		15556
185		8055
186		11287
186		15556
186		8055
187		11287
187		15556
188		11287
189		11287
189		8055
19		11287
19		11995
19		13120
19		13123
19		15556
19		22842
19		23604

Lot	Schedule	DP
19		248691
19		26634
19		582051
19	C	27655
19	D	2458
19	E	27655
19	F	2458
190		11287
190		8055
191		1046133
191		11287
191		8055
191		880592
192		1046133
192		11287
192		8055
192		880592
193		11287
193		8055
194		11287
194		8055
195		11287
195		8055
196		11287
196		8055
197		11287
197		8055
198		11287
198		8055
199		11287
199		8055
2		1013763
2		1018646
2		1058010
2		1074358

Lot	Schedule	DP
2		1094699
2		1107356
2		11539
2		13120
2		13123
2		15556
2		16793
2		17367
2		17781
2		18060
2		204202
2		204737
2		22842
2		23604
2		251160
2		25985
2		262960
2		26634
2		270423
2		28046
2		28068
2		285482
2		311027
2		375836
2		500470
2		505798
2		512166
2		533069
2		542486
2		548107
2		548546
2		551787
2		561577
2		567633
2		568311

Lot	Schedule	DP
2		568493
2		579042
2		583186
2		585142
2		597631
2		614183
2		621171
2		629396
2		632417
2		634668
2		704490
2		746870
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2		810981
2		814599
2		861549
2		870118
2	C	27655
2	E	27655
2	F	27655
2	H	2458
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20		11995
20		13120
20		13123
20		15556
20		22842
20		23604
20		248691
20		26634
20		582051
20	C	27655

Lot	Schedule	DP
20	D	2458
20	E	27655
20	F	2458
200		11287
200		600959
200		8055
200		843074
201		1093288
201		700345
201		8055
201		843074
2011		1052556
2012		1052556
202		1020262
202		1093288
202		11287
202		700345
202		8055
203		1020262
203		11287
203		8055
204		1017819
204		11287
204		8055
205		1017819
205		11287
205		8055
206		11287
206		15556
2061		1011261
2062		1011261
207		11287
207		8055
208		11287
208		8055

Lot	Schedule	DP
209		11287
209		8055
21		1029069
21		1075811
21		11995
21		13120
21		13123
21		15556
21		17367
21		23604
21		248691
21		27749
21		582052
21	C	27655
21	D	2458
21	E	27655
21	F	2458
21	F	27655
21	J	27655
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211		8055
212		11287
212		8055
213		11287
214		11287
215		11287
215		8055
216		8055
2161		580453
2162		580453
2163		580453
2164		580453
2165		580455

Lot	Schedule	DP
2166		580455
2167		580455
217		11287
217		8055
218		11287
218		8055
219		11287
219		8055
22		1016699
22		1029069
22		13120
22		13123
22		15556
22		23604
22		248691
22		27749
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22	D	2458
22	E	27655
22	F	2458
22	F	27655
220		11287
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221		1066814
221		11287
221		8055
222		1066814
222		11287
222		8055
222		833454
223		1004649
223		11287
223		8055
223		833454

Lot	Schedule	DP
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224		11287
224		8055
225		11287
225		8055
226		11287
226		8055
227		11287
227		8055
228		12507
228		8055
229		8055
2291		554538
2292		554538
23		1016699
23		11287
23		13120
23		13123
23		15556
23		23604
23		248691
23		26634
23		27749
23		582052
23	C	27655
23	D	2458
23	E	27655
23	F	2458
23	F	27655
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230		8055
231		11287
231		8055
232		11287
232		8055

Lot	Schedule	DP
233		11287
233		8055
234		11287
234		8055
235		11287
235		8055
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236		8055
237		8055
2371		1042396
2372		1042396
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2381		574218
2382		574218
239		11287
239		8055
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24		13120
24		13123
24		15556
24		17367
24		23604
24		27749
24		582052
24	C	27655
24	D	2458
24	E	27655
24	F	27655
240		8055
241		8055
242		8055
243		8055
244		8055
245		8055
246		8055

Lot	Schedule	DP
247		12507
247		8055
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248		8055
249		12507
249		8055
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25		11995
25		13120
25		13123
25		15556
25		17367
25		23604
25		27749
25		582053
25	C	27655
25	D	2458
25	E	27655
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252		8055
253		8055
254		8055
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256		8055
257		12507
259		8055
26		11287
26		11995
26		13120
26		13123
26		15556
26		23604
26		27749

Lot	Schedule	DP
26		582053
26	C	27655
26	D	2458
26	E	27655
26	F	27655
260		8055
264		11287
265		11287
266		11287
267		11287
268		11287
27		11287
27		11995
27		13120
27		13123
27		15556
27		23604
27		27749
27		582054
27	C	27655
27	D	2458
27	F	27655
271		845831
272		845831
274		11287
274		755207
275		11287
276		11287
277		11287
278		11287
279		11287
28		11287
28		11995
28		13120
28		13123

Lot	Schedule	DP
28		15556
28		23604
28		27749
28		582054
28	C	27655
28	D	2458
28	E	27655
280		11287
284		11287
285		11287
286		11287
287		11287
288		11287
29		11287
29		11995
29		13120
29		13123
29		15556
29		23604
29		27749
29		548114
29		582054
29	C	27655
29	D	2458
29	E	27655
29	F	2458
3		1018646
3		1074358
3		1079794
3		11539
3		11995
3		13120
3		13123
3		15556
3		16793

Lot	Schedule	DP
3		17781
3		18060
3		204737
3		22842
3		23604
3		250973
3		251160
3		25985
3		262960
3		26549
3		26634
3		270423
3		28046
3		28068
3		285482
3		315830
3		375836
3		533069
3		548107
3		548546
3		561577
3		568311
3		579042
3		621171
3		627231
3		629396
3		778463
3		803077
3		814599
3		861549
3		981104
3	C	27655
3	E	27655
3	F	27655
3	H	2458

Lot	Schedule	DP
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30		11995
30		13120
30		13123
30		15556
30		23604
30		27749
30		548114
30		582055
30	C	27655
30	D	2458
30	E	27655
30	F	2458
302		11287
303		11287
304		11287
305		11287
306		11287
307		11287
308		11287
309		658235
31		1083788
31		11287
31		11995
31		13120
31		13123
31		15556
31		23604
31		27749
31		548114
31		582055
31	C	27655
31	D	2458
31	E	27655
31	F	2458

Lot	Schedule	DP
313		11287
314		11287
315		11287
316		11287
316		755242
317		11287
318		11287
319		11287
32		1083788
32		11287
32		11995
32		13120
32		13123
32		15556
32		23604
32		524726
32		582055
32	C	27655
32	D	2458
32	E	27655
32	F	2458
320		11287
321		11287
322		11287
323		11287
324		11287
325		11287
326		11287
327		11287
328		11287
33		11287
33		11995
33		13120
33		13123
33		15556

Lot	Schedule	DP
33		23604
33		524726
33		582056
33	C	27655
33	D	2458
33	F	2458
330		710063
34		11287
34		11539
34		11995
34		13120
34		13123
34		15556
34		23604
34		27749
34		582056
34	D	2458
34	F	2458
340		11287
341		11287
341		556246
342		11287
342		556246
343		11287
343		556246
344		11287
345		11287
346		11287
347		11287
348		11287
349		11287
35		11287
35		11539
35		11995
35		13120

Lot	Schedule	DP
35		13123
35		17367
35		27749
35		582056
35	C	27655
35	D	2458
35	F	2458
350		11287
351		11287
351		840188
352		11287
352		840188
353		11287
3530		555858
3531		555858
354		11287
355		11287
356		11287
357		11287
358		11287
359		11287
36		11287
36		11995
36		13120
36		13123
36		15556
36		17367
36		27749
36		582056
36	C	27655
36	D	2458
36	F	2458
360		11287
361		11287
363		11287

Lot	Schedule	DP
364		11287
365		11287
365		46746
366		11287
3671		874598
3672		874598
37		11287
37		11539
37		11995
37		13120
37		13123
37		15556
37		17367
37		27749
37		582057
37	C	27655
37	D	2458
370		11287
371		11287
372		11287
373		11287
374		11287
374		727253
375		11287
376		11287
376		727253
377		11287
378		11287
379		11287
38		11287
38		11539
38		11995
38		13120
38		13123
38		15556

Lot	Schedule	DP
38		17367
38		27749
38		582057
38	C	27655
38	D	2458
380		11287
380		755242
3810		1049904
3811		1049904
3812		1049904
383		755242
385		755242
386		727264
386		755242
387		755242
388		727264
388		755242
389		755242
39		11287
39		11539
39		11995
39		13120
39		13123
39		15556
39		17367
39		27749
39		582057
39	C	27655
39	D	2458
390		755242
391		729419
391		755242
392		755242
393		755242
394		11287

Lot	Schedule	DP
394		755242
395		755242
396		755242
397		755242
398		755242
399		755242
4		1018646
4		1063845
4		1074358
4		11539
4		11995
4		13120
4		13123
4		15556
4		16793
4		17367
4		17781
4		18060
4		23604
4		248691
4		250973
4		251160
4		25985
4		262960
4		26634
4		270423
4		28046
4		28068
4		548107
4		568311
4		778463
4		981106
4	C	27655
4	E	27655
4	F	27655

Lot	Schedule	DP
4	G	2458
4	H	2458
40		1102122
40		11287
40		11539
40		11995
40		13120
40		13123
40		15556
40		17367
40		27749
40		582057
40	C	27655
40	D	2458
402		48820
409		11287
41		1073017
41		11287
41		11995
41		13120
41		13123
41		15556
41		17367
41		27749
41		539413
41		559640
41		582058
41		872109
41	C	27655
41	D	2458
410		11287
411		11287
412		11287
413		11287
413		755242

Lot	Schedule	DP
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414		755242
415		755242
416		755242
417		755242
418		755242
419		755242
42		1073017
42		11287
42		11995
42		13120
42		13123
42		15556
42		17367
42		27749
42		539413
42		582058
42		872109
42	C	27655
42	D	2458
420		755242
421		755242
423		755242
424		755242
43		1073017
43		11287
43		11995
43		13120
43		13123
43		15556
43		17367
43		27749
43		539413
43		582058
43	C	27655

Lot	Schedule	DP
43	D	2458
430		12507
437		12507
439		755242
44		11287
44		11995
44		13120
44		13123
44		15556
44		17367
44		27749
44		548118
44		582058
44		862349
44	C	27655
44	D	2458
45		1109834
45		11287
45		11995
45		13120
45		13123
45		15556
45		654334
45	C	27655
45	D	2458
450		818534
46		11287
46		11995
46		13120
46		13123
46		15556
46		27749
46		654032
46		859972
46	C	27655

Lot	Schedule	DP
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469		1138964
47		11287
47		11995
47		13120
47		13123
47		15556
47		17367
47		27749
47		755207
47		859972
471		1138964
472		1138964
48		11287
48		11995
48		13120
48		13123
48		15556
48		17367
48		27749
48	C	27655
49		11287
49		11995
49		13120
49		13123
49		15556
49		17367
49		27749
49	C	27655
5		1018646
5		1063845
5		1074358
5		11287
5		11539
5		11995

Lot	Schedule	DP
5		13120
5		13123
5		15556
5		16793
5		17367
5		17781
5		18060
5		22842
5		23604
5		248691
5		250973
5		251160
5		25985
5		262960
5		26634
5		270423
5		28046
5		285482
5		519261
5		582046
5		778463
5		981103
5	C	27655
5	E	2458
5	E	27655
5	F	27655
50		11287
50		11995
50		13120
50		13123
50		15556
50		17367
50		27749
50	C	27655
500		755242

Lot	Schedule	DP
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51		13120
51		13123
51		15556
51		17367
51		27749
51		785435
51		792987
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519		12507
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52		11995
52		13120
52		15556
52		17367
52		27749
52		785435
52		792987
52	C	27655
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521		1054794
521		12507
521		543408
522		1054794
522		12507
522		543408
523		12507
524		12507
525		12507
526		12507
527		12507
528		12507

Lot	Schedule	DP
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53		11287
53		11995
53		13120
53		15556
53		17367
53		27749
53		755207
53		785435
53	C	27655
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532		12507
533		12507
534		12507
536		12507
537		12507
538		12507
539		12507
54		11287
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54		13123
54		15556
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54		785435
54	C	27655
540		12507
541		12507
542		12507
543		12507
544		12507
545		12507
55		11287

Lot	Schedule	DP
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55		13120
55		13123
55		15556
55		17367
55		27749
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56		13123
56		15556
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57		15556
57		17367
57		27749
58		11287
58		11995
58		13120
58		15556
58		17367
58		27749
582		12507
583		12507
584		12507
585		12507
586		12507
587		12507

Lot	Schedule	DP
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589		12507
59		11287
59		11995
59		13120
59		15556
59		17367
59		27749
590		12507
591		12507
592		12507
593		12507
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595		12507
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6		13123
6		15556
6		16793
6		17367
6		17781
6		18060
6		22842
6		248691
6		251160
6		25985
6		26549
6		26634

Lot	Schedule	DP
6		270423
6		28046
6		285482
6		519261
6		582047
6	C	27655
6	E	2458
6	E	27655
6	F	27655
60		1074161
60		11287
60		11995
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60		15556
60		17367
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609		12507
61		1074161
61		11995
61		15556
61		17367
61		27749
610		12507
611		12507
611		816224

Lot	Schedule	DP
612		12507
612		816224
613		12507
613		816224
614		12507
615		12507
6161		870274
6162		870274
617		12507
617		821603
618		12507
619		12507
62		1074161
62		11995
62		15556
62		17367
62		27749
620		12507
621		12507
6221		819628
6222		819628
6231		806876
6232		806876
624		12507
6271		792607
6272		792607
6273		792607
628		12507
629		12507
63		1074161
63		11995
63		13123
63		17367
63		27749
630		12507

Lot	Schedule	DP
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631		872639
632		12507
632		872639
633		12507
634		12507
64		11995
64		13123
64		15556
64		17367
64		27749
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65		15556
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66		11995
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663		12507
664		12507
665		12507
666		12507
667		12507
668		12507
669		12507
67		11539
67		11995
67		13123
67		15556

Lot	Schedule	DP
67		17367
67		27749
670		12507
671		12507
672		12507
673		12507
674		12507
675		12507
677		12507
678		12507
679		12507
68		11539
68		11995
68		12507
68		13123
68		15556
68		17367
68		27749
680		12507
681		12507
682		12507
683		12507
684		12507
685		12507
686		12507
687		12507
688		12507
689		12507
69		11539
69		11995
69		12507
69		13123
69		15556
69		17367
69		27749

Lot	Schedule	DP
690		12507
691		12507
692		12507
693		12507
694		12507
695		12507
696		12507
697		12507
698		12507
699		12507
7		11287
7		11995
7		13120
7		13123
7		15556
7		16793
7		17367
7		17781
7		18060
7		22842
7		248691
7		26634
7		28046
7		285482
7		524374
7		582047
7	A	2458
7	C	27655
7	D	2458
7	E	2458
7	E	27655
7	F	27655
70		11539
70		12507
70		13123

Lot	Schedule	DP
70		15556
70		17367
70		27749
700		12507
7001		1077055
7005		1066246
701		12507
7015		1119454
7016		1021267
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Lot	Schedule	DP
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Lot	Schedule	DP
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760		12507
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78		8055
781		1060935
782		1060935
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79		11995
79		13123
79		15556
79		17367
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8		13123
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8		16793
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Lot	Schedule	DP
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85		13123
85		17367
850		810843
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86		17367
861		557889
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Lot	Schedule	DP
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Lot	Schedule	DP
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92		11287
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93		13123
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Lot	Schedule	DP
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97		13123
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99		8055
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A		365476
A		367461
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A		391075
B		25385
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B		336081
B		340249
B		365476
B		367461
B		380066
B		391075
B		395654
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Lot	Schedule	DP
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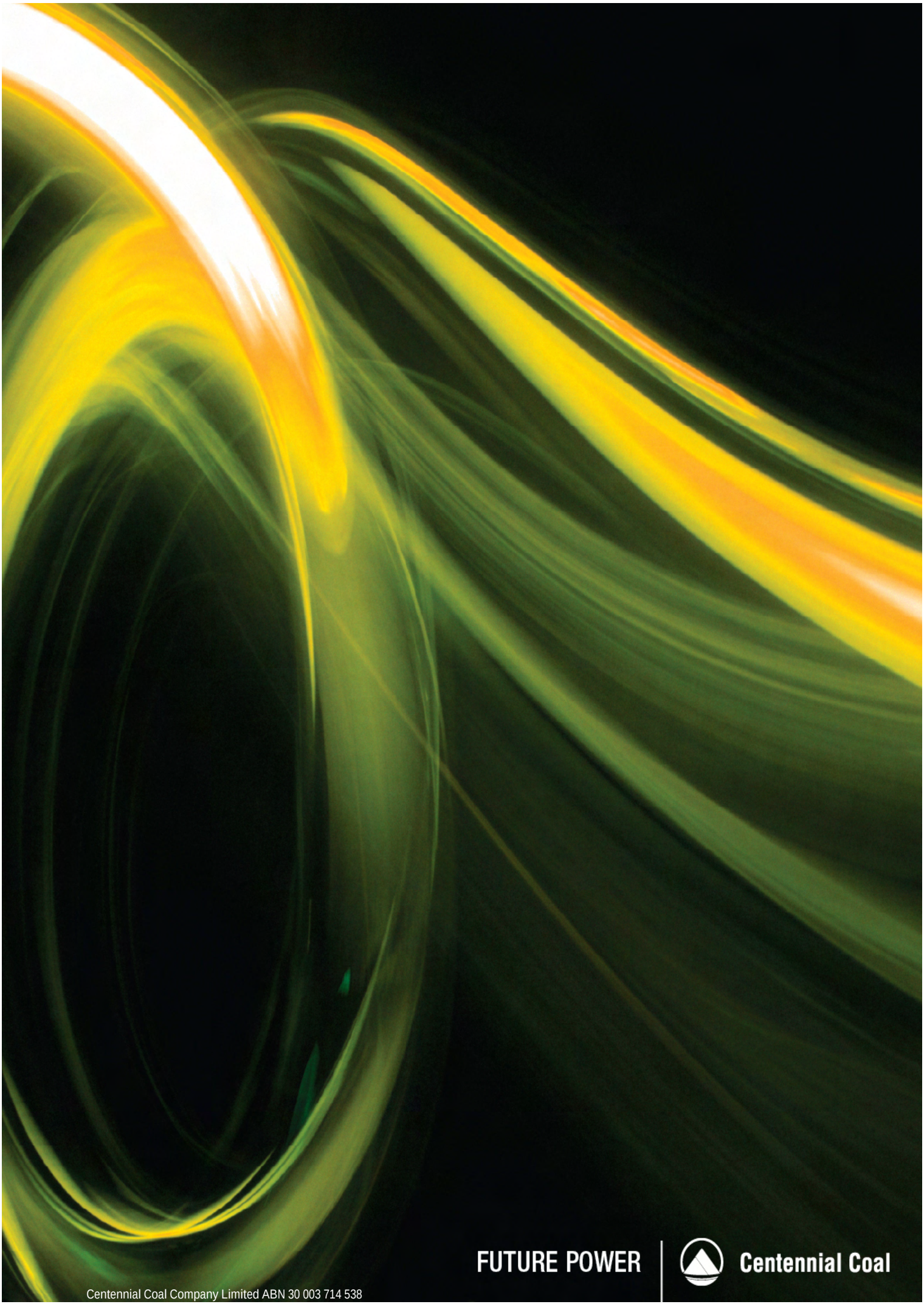

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