Appendix 7 – Biodiversity Assessment Report (RPS, 2017a)

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BIODIVERSITY ASSESSMENT REPORT
Mandalong Longwalls 24-24a Modification

Prepared for ***Centennial Mandalong***

27 APRIL 2017

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
1	Draft for Client review	AB	MA	24-04-2017
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Approval for Issue

Name	Signature	Date
Arne Bishop		27-04-2017

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Summary

RPS Australia East Pty Ltd (RPS) has been engaged by Centennial Mandalong Pty Ltd (the proponent) to undertake a Biodiversity Assessment Report (BAR) to assess potential impacts of the Mandalong Mine Longwall Panel 24 to 24a Modification (the Project) on terrestrial biodiversity. Longwall Panels 24 to 24a (LW24-24a) are located at the Mandalong Mine on the western side of Lake Macquarie in NSW. LW24-24a adjacent to LW22-23 and hereafter are collectively referred to as the 'Study Area'. The Study Area encompasses the 26.5° angle of draw line from the limit of predicted subsidence in LW24-24a, however, this area overlaps an area to the north of LW 24- 24a which was previously assessed under the LW22-23 BAR (RPS 2016).

This biodiversity assessment is based on application of the NSW BioBank Assessment Methodology (BBAM) as part of the *Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects* (FBA). The FBA provides a dual assessment process for the developments impact and evaluation of suitable biodiversity offset options within a three stage investigation as listed below:

Stage 1 – Biodiversity Assessment;

Stage 2 – Impact Assessment (Biodiversity Values); and

Stage 3 – Biodiversity Offset Strategy.

Under Section 2.3.1.2 (c) of the FBA subsidence related impacts, such as ponding, are not required to be assessed unless specifically mentioned in the Secretary Environmental Assessment Requirements (SEARs). SEARs were not issued for the Project. Therefore, with regards to Stage 3 – Biodiversity Offset Strategy, currently, there is no specific offset site proposed.

Impact Analysis

Subsidence can lead to potential impacts to flora and fauna through habitat modification resulting from surface cracking, soil erosion due to slumping and changes in gradients, increased mixing of groundwater and surface water and hydrological changes to groundwater and surface water, including ponding. Predictions indicate that maximum first and final subsidence over LW24-24A could be up to 960 mm. No surface cracking is predicted to occur. No cliff falls are predicted as no cliff habitats have been identified within the Study Area.

The subsidence from longwall extraction can lead to increased ponding. Potential ponding depths may increase marginally after the proposed mining is complete within LW24-24a (Umwelt 2017). The minor subsidence impacts from the Project are expected to have a minor or temporary effect on ponding within the local watercourses and are not likely to significantly affect riparian vegetation, Endangered Ecological Communities (EECs), threatened species or their habitats.

Impact Minimisation

Mitigation measures have been recommended to minimise the potential flora and fauna impacts of the Project.

Credit Report

A summary of the ecosystem credits required for the Project in accordance with the FBA is provided in **Table 1** and a summary of the species credits required is provided in **Table 2**.

Table 1 Summary of Ecosystem Credits Required

PCT Code	PCT Name	Area (ha)	Credits
HU507	Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion	8.36	47
HU533	Coastal Freshwater Lagoons of the Sydney Basin bioregion and South East Corner Bioregion	1.82	10
HU782	Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	3.16	17
HU798	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	17.82	96
HU803	Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	24.41	132
HU806	Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	0.49	3
HU937	*Melaleuca biconvexa* - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast	1.42	19
Total		**57.48**	**324**[1]

Table 2 Summary of Species Credits Required

Species	Extent of Impact (individuals)	Credits
Melaleuca biconvexa	5	65
Maundia triglochinoides	20	520

[1] Note: the credit report sums part 'Credits Created' with the resultant total in the credit report being 324 credits. The additional credit is not allocated to any particular PCT and as such should not be included in the offsetting liability.

Stage 1 – Biodiversity Assessment

1.0 Introduction

RPS Australia East Pty Ltd (RPS) has been engaged by Centennial Mandalong Pty Ltd (the proponent) to undertake a biodiversity assessment to assess potential impacts of the Mandalong Longwall Panel 24 to 24a Modification (the Project) on terrestrial biodiversity. Longwall Panels 24 to 24a (LW24-24a) are located at Mandalong on the western side of Lake Macquarie in NSW. LW24-24a lie adjacent to LW22-23 and are hereafter collectively referred to as the 'Study Area'. The Study Area encompasses the 26.5° angle of draw line from the limit of predicted subsidence in LW24-24a, however, this area overlaps an area to the north of LW 24- 24a which was previously assessed under the LW22-23 BAR (RPS 2016). The area of assessment pertaining to this BAR will be referred to as the 'Impact Area'.

This biodiversity assessment is based on an application of the NSW BBAM (OEH 2014a) as part of the FBA (OEH 2014b). The FBA provides a dual assessment process for the developments impact and evaluation of suitable biodiversity offset options within a three stage investigation as listed below:

Stage 1 – Biodiversity Assessment;

Stage 2 – Impact Assessment (Biodiversity Values); and

Stage 3 – Biodiversity Offset Strategy.

Under Section 2.3.1.2 (c) of the FBA subsidence related impacts, including ponding, are not required to be assessed unless specifically mentioned in the SEARs. SEARs were not issued for the Project. Therefore, with regards to Stage 3 – Biodiversity Offset Strategy, currently, there is no specific offset site proposed.

1.1 Description of Development

Mandalong Mine operates under Development Consent SSD-5144 which was granted on 12 October 2015 by the NSW Planning Assessment Commission under Part 4, Division 4.1 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act), and provided for extension of the mining area extracting coal from the West Wallarah and Wallarah-Great Northern Seams.

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

- The Mandalong Mine Access Site, encompassing underground workings and associated surface infrastructure near Morisset.
- Delivery of run-of-mine coal from the underground workings to the Cooranbong Entry Site. The Cooranbong Entry Site coal handling and processing facilities are approved under the Northern Coal Logistic Project (SSD-5145).
- Delivery of run-of-mine coal from the underground workings to the Delta Entry Site, located near Wyee at the Vales Point Rail Unloader Facility. The coal handling facility is approved under DA35-2-2004.
- Mandalong South Surface Site (MSSS), which is yet to be constructed, encompassing ventilation shafts, ventilation fans and underground delivery boreholes located approximately 6 kilometres south-west of the Mandalong Mine Access Site.

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

Figure 1 illustrates the proposed extension of longwall mining within these two panels.

1.2 Study Area

For the purpose of this report, the Study Area encompasses the area contained within Longwalls 22-24a. At the time RPS was engaged to conduct surveys for the Project, the proposal combined LW22-23 and LW24-24a. The decision to divide the longwall areas into two individual projects was made subsequent to surveys being completed. Therefore, the Study Area will refer to the overall areas in which surveys were originally conducted.

The Study Area is located approximately 5 kilometres (km) to the west of the M1 Motorway, on the western side of Lake Macquarie. Lake Macquarie is located in the Hunter region approximately 20 km from Newcastle, NSW. The Study Area extent includes the 26.5 degree angle of draw (AOD) surrounding LW22-24a encompassing an area of approximately 279.90 hectares (ha).

The Study Area is displayed in **Figure 1**.

1.3 Impact Area

The Impact Area refers to the area contained within the LW24-24a boundary that would be subject to longwall mining, including the 26.5 degree angle of draw, as shown on **Figure 1**. As aforementioned, this area excludes the overlap of the 26.5 degree AOD area to the north of LW 24- 24a which was previously assessed under the LW22-23 BAR.

1.4 Study Area Particulars

LGA	The Study Area falls within the Lake Macquarie City Council Local Government Area (LGA).
Area	The Study Area encompasses an area of 279.90 ha, whilst the Impact Area encompasses an area of 107.62 ha.
Boundaries	The northern extent of the Study Area boundary extends marginally into the Olney State Forest. The eastern and southern boundaries occur in vegetated areas whilst the majority of the western boundary is situated within rural agricultural lands.
Current Land Use	The Study Area is a combination of rural pastoral areas and properties, creeks, roads and forest vegetation.

1.5 Background Information

A review of relevant information was performed to identify the biodiversity values occurring or potentially occurring within the Impact Area. This included previous ecological reports, vegetation maps, topographic maps, aerial photography and general scientific literature reviews. Of particular relevance was the Flora and Fauna Assessment carried out on part of the Impact Area (RPS 2017) and surrounds for the Mandalong Southern Extension Project by RPS (2013).

RPS has utilised the above information as a baseline, and undertaken a suite of ecological survey work across the Study Area in order to update the dataset, and to assess significant habitat features of the disturbance area and their potential to support threatened species, populations, endangered ecological communities (EECs) and their habitats. A copy of the Mandalong Mine Longwalls 24-24a inventory report has been produced and is included in **Appendix 1**.

Additional targeted fieldwork has also been undertaken in accordance with the FBA methodology to assess impacts and to inform biodiversity offsets considerations for the Project.

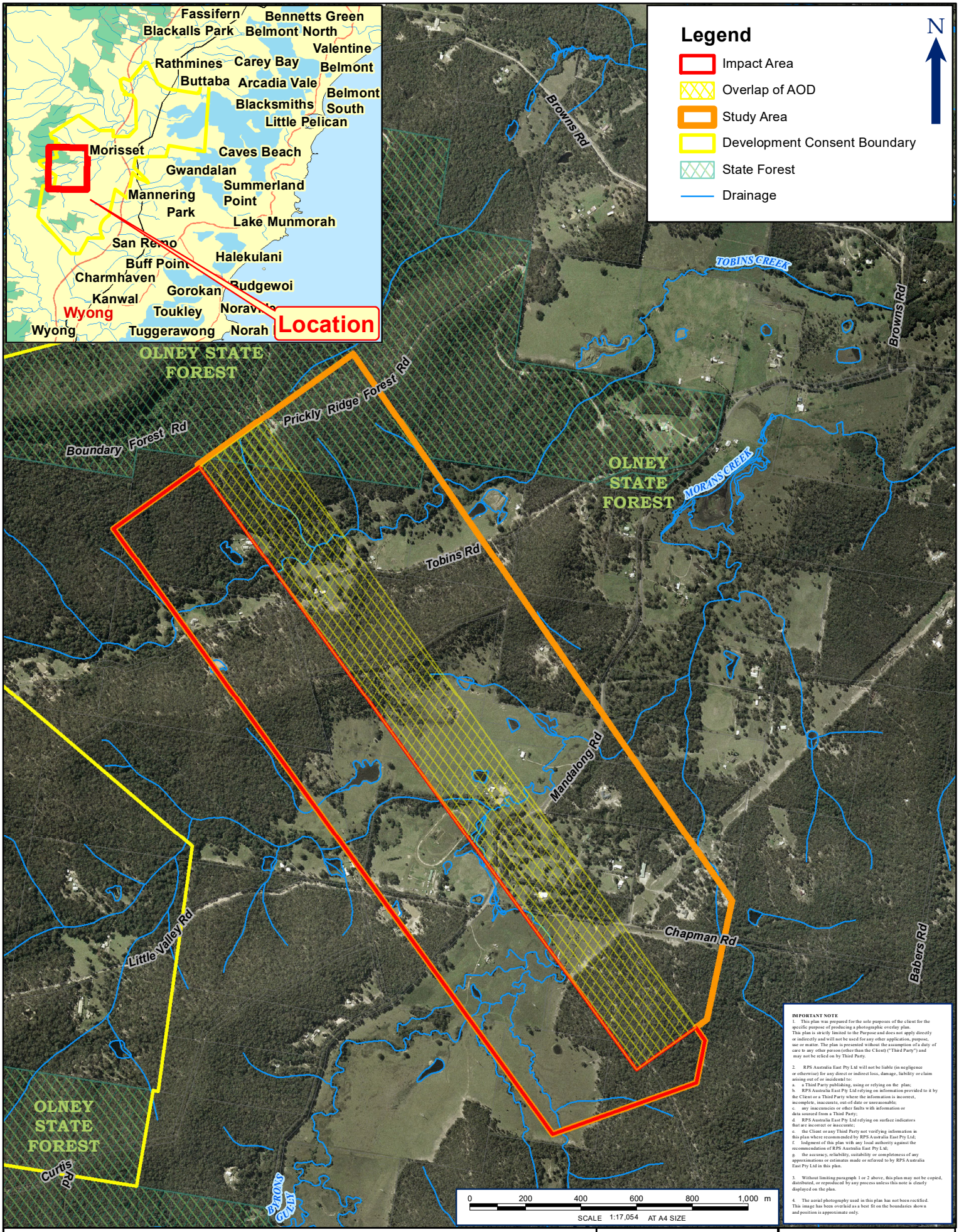

Figure 1: Study Area - Location Plan

LOCATION: Mandalong Longwalls 24-24A	DATUM: GDA94 PROJECTION: MGA Zone 56
JOB NO.: PR133215 PURPOSE: BAR Technician: mark.aitkens Date: 3/05/2017	Data Sources: RPS Client

CLIENT: Centennial Mandalong Pty Ltd

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Path: S:\Centennial\All Jobs\133215 Mandalong LW22-23 and LW 24-24a Eco' assesssments\10 - Drafting\Arcgis Map Documents\Eco\LW24-24A\BAR\133215 LW24-24a Figure 1 Location E A4 20170503.mxd

2.0 Biodiversity Assessment

2.1 Landscape Context - Regions

The Study Area is situated within the following regions:

- Sydney Basin Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion and the Wyong IBRA Subregion;
- Gosford – Cooranbong Coastal Slopes Mitchell Landscape; and
- Hunter/Central Rivers Catchment Management Area (CMA).

2.2 Calculating Landscape Value

The Study Area Landscape Value has been scored based on several variables including:

- Percentage Native Vegetation Cover;
- Connectivity Values; and
- Patch Size.

Details are provided in the following sections.

2.2.1 Percentage Native Vegetation Cover

Two landscape assessment circles, being 100 and 1,000 hectares in area, were centred over the proposed Impact Area using aerial imagery and Geographic Information System (GIS) software. The percentage native vegetation cover within each assessment circle was calculated in 5 % increments using GIS for 'Before' and 'After' development scenarios. The 1,000 hectare assessment circle was used to assess any loss (or negative impacts) from the Project on the percent native vegetation cover in the 'locality' and to identify threatened species that may occur within the Impact Area. The smaller 100 hectare circle was used to assess the loss of surrounding vegetation cover at an even more local scale as a result of the Project.

The results of the analysis of native vegetation cover within the two landscape assessment circles are summarised as follows:

- The 100 hectare inner assessment circle was calculated as having a native vegetation cover class of 41-45% for the 'Before development' scenario and 36-40% 'After development' scenario.
- The 1,000 hectare outer assessment circle was calculated as having a native vegetation cover of 71-75% for 'Before' and 'After' development scenarios.

The assessment circles and associated native vegetation that were assessed via GIS are shown in **Figure 2**.

2.2.2 Connectivity Value

Step 1

A desktop Connectivity Condition assessment was undertaken by assessing the average condition of native vegetation across the Study Area 'Primary' linkages to adjoining vegetation. It is clear that the Study Area is a part of a connecting link of native vegetation.

Step 2

Given these links, it is necessary to assess whether the study area contains a 'State Significant Biodiversity Link' and/or a 'Regionally Significant Biodiversity Link'. Examination of these factors reveals that the Study Area is within a 'strategic location', being 'a riparian buffer area on both sides of a 4th order stream'. As such,

the Study Area is considered to qualify for the strategic location connectivity score of 12, and no further steps of connectivity assessment are required.

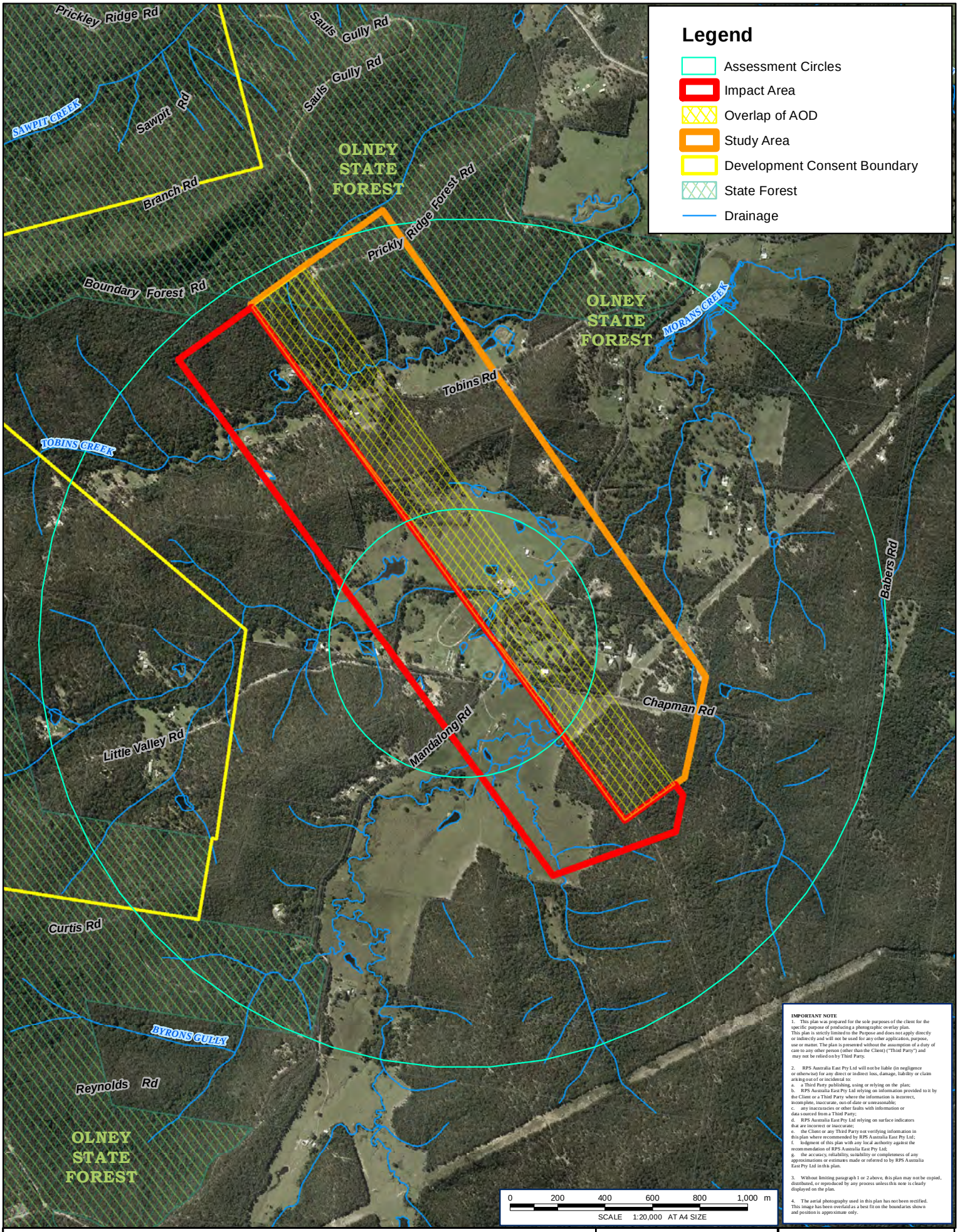

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Figure 2: Assessment Circles

LOCATION: Mandalong Longwalls 24-24A	DATUM: GDA94 PROJECTION: MGA Zone 56
JOB NO.: **PR133215** PURPOSE: BAR Technician: kieran.marshall Date: 20/04/2017	Data Sources: RPS Client

CLIENT: Centennial Mandalong Pty Ltd

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Path: S:\Centennial\All Jobs\133215 Mandalong LW22-23 and LW 24-24a Eco' assesssments\10 - Drafting\Arcgis Map Documents\Eco\LW24-24A\BAR\133215 LW24-24a Figure 2 Assessment Circles C A4 20170221.mxd

2.2.3 Patch Size

To assess the Patch Size, the assessment must:

- Determine the percent native vegetation cleared in the Mitchell Landscape in which most of the development occurs. In this case the Mitchell Landscape is 'Sydney-Newcastle Coastal Alluvial Plains' and this landscape is 62% cleared.
- Determine the Patch size class, which in this instance is 'extra large'.

Based on the above, the calculated Patch Size score is 12.

2.2.4 Landscape Score

The combined computation of data for 'Percentage Native Vegetation Cover', 'Connectivity' and 'Patch Size' resulted in the calculation of a 'Landscape Score' of 21.6 for the Impact Area.

2.3 Assessing Native Vegetation

2.3.1 Vegetation Zones

Vegetation types were classified based on the 'best fit' vegetation types listed in the PCTs Database (OEH 2017). Parameters used to select the 'best fit' PCT included overstorey and understorey floristics, soil landscape, location and topographic position. Listed in **Table 3** are the ground truthed RPS (2017) vegetation units (see **Appendix 1** for details), best fit PCTs and EEC equivalents. Full descriptions of these PCTs are presented within **Appendix 1**.

Table 3 PCTs within the Impact Area

RPS (2017)	PCT (OEH)	EEC Equivalent
MU 1 Coastal Wet Gully Forest	HU782: Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	-
MU 5 Alluvial Tall Moist Forest	HU507: Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
MU 12c Hunter Valley Moist Spotted Gum – Ironbark Forest	HU798: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	-
MU 15 Coastal Foothills Spotted Gum – Ironbark Forest	HU803: Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	-
MU 15m Jilliby Spotted Gum-Northern Ironbark – Mahogany Forest	HU803: Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	-
MU 15n Jilliby Spotted Gum – Ferguson's Ironbark – Mahogany Forest	HU803: Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	-
MU 17o hinterland Spotted Gum – Red Ironbark Forest	HU806: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	Lower Hunter Spotted Gum Ironbark Forest
MU46 Wetland Complex	HU533: Coastal Freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Freshwater Wetlands on Coastal Floodplains

RPS (2017)	PCT (OEH)	EEC Equivalent
Melaleuca biconvexa dominated area	HU937: *Melaleuca biconvexa* - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion
Cleared/disturbed lands (if native vegetation)	Derived variant of HU937: *Melaleuca biconvexa* - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion

Eight vegetation zones were entered into the BioBanking Credit Calculator. Details for these vegetation zones are provided in **Table 4** and shown in **Figure 3**.

Table 4 Vegetation Zones

Veg Zone #	Vegetation Class (Keith 2004)	Biobank Vegetation Type	Area (ha)	Condition Class	EEC	Estimate Percent Cleared[2]	Site Value Score
1	Dry Sclerophyll Forest (Shrubby)	HU806: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	0.49	Moderate/ Good	Yes[3]	44	86.98
2	Wet Sclerophyll Forest (Shrubby)	HU 507: Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion	8.36	Moderate/ Good	Yes[4]	20	68.92
3	Wet Sclerophyll Forest (Shrubby)	HU798: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	17.82	Moderate/ Good	No	42	63.02
4	Forested Wetlands	HU937: *Melaleuca biconvexa* - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast	0.79	Moderate/ Good	Yes[5]	92	98.00
5	Dry Sclerophyll Forest (Shrubby)	HU803: Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	24.41	Moderate/ Good	No	71	83.33
6	Dry Sclerophyll Forest (Shrubby)	HU782: Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	3.16	Moderate/ Good	No	40	62.15
7	Forested Wetlands	HU937: *Melaleuca biconvexa* - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast	0.63	Low	Yes[5]	92	40.00

[2] In corresponding Mitchell Landscape listed in Section 2.1
[3] Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion
[4] River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
[5] Swamp Sclerophyll Forest on Coastal Floodplains

Veg Zone #	Vegetation Class (Keith 2004)	Biobank Vegetation Type	Area (ha)	Condition Class	EEC	Estimate Percent Cleared[2]	Site Value Score
8	Freshwater Wetlands	HU533: Coastal Freshwater Lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	1.82	Moderate/ Good	Yes[6]	70	100

Management zones that distinguish between areas of predicted ponding (i.e. Project impact), as shown in **Figure 4**, and residual areas of native vegetation cover where there is no expectation of a measureable impact were also entered into the BioBanking Credit Calculator. Management zones created by the partitioning of vegetation zones by 'predicted ponding' are listed in **Table 5**.

[6] Freshwater Wetlands on Coastal Floodplains

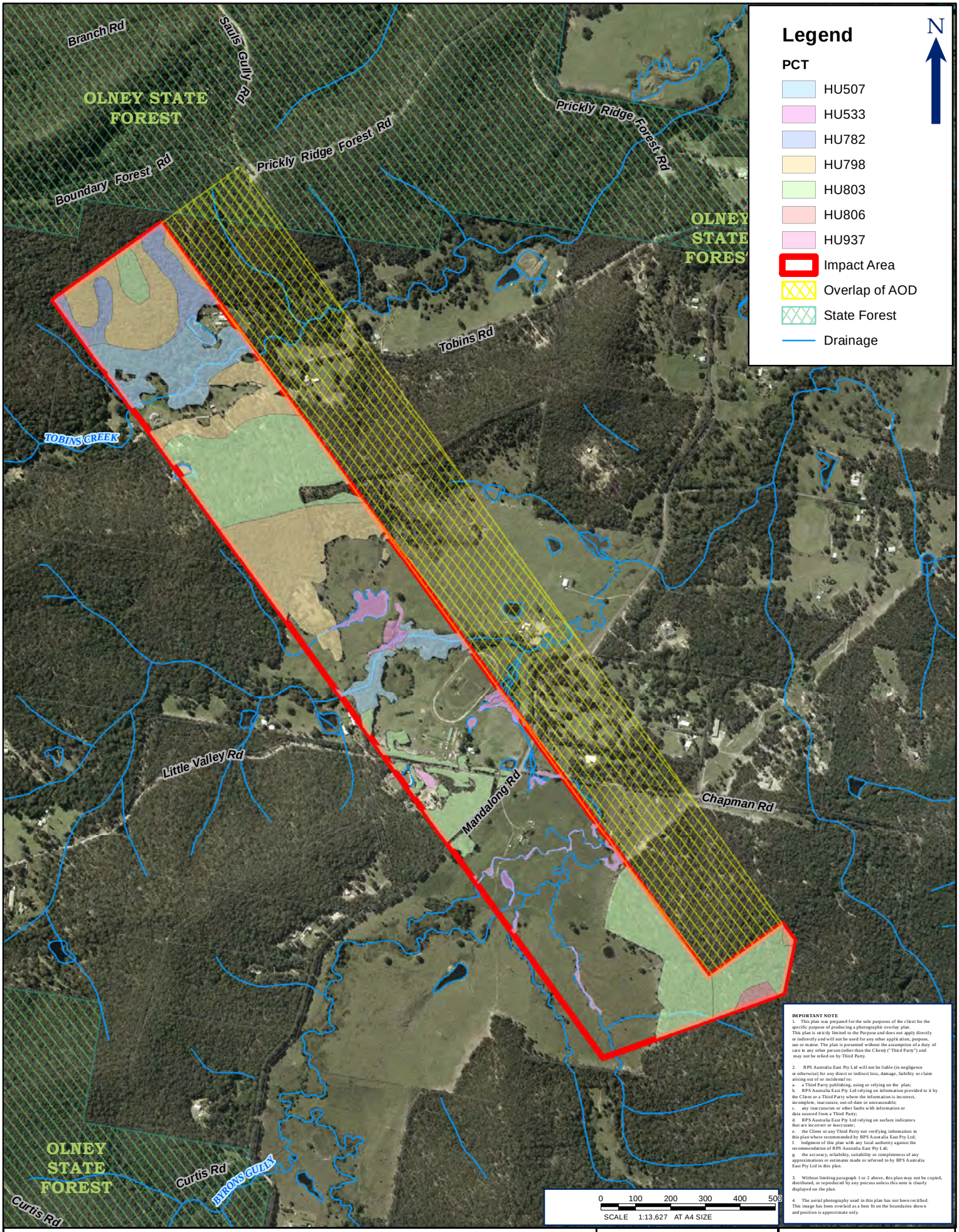

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Figure 3: Vegetation Zones

LOCATION: Mandalong Longwalls 24-24A

DATUM: GDA94

PROJECTION: MGA Zone 56

JOB NO.: **PR133215**

PURPOSE: BAR

Technician: mark.aitkens Date: 24/04/2017

Data Sources:
RPS
Client

CLIENT: Centennial Mandalong Pty Ltd

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Path: S:\Centennial\All Jobs\133215 Mandalong LW22-23 and LW 24-24a Eco' assesssments\10 - Drafting\Arcgis Map Documents\Eco\LW24-24A\BAR\133215 LW24-24a Figure 3 Veg and Plot Locations C A4 20170217.mxd

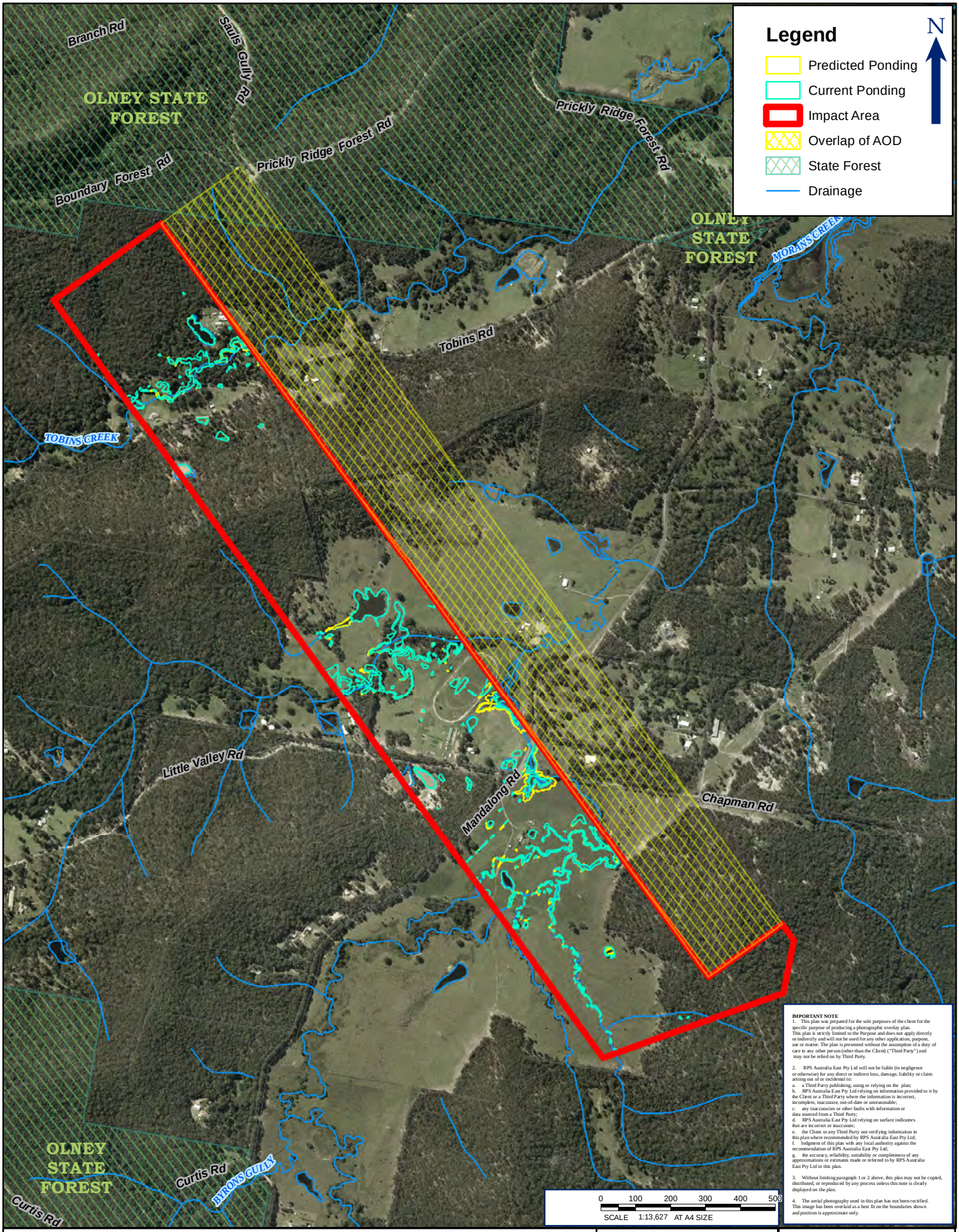

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Figure 4: Areas of Ponding Current and Predicted

LOCATION: Mandalong Longwalls 24-24A
DATUM: GDA94
PROJECTION: MGA Zone 56
JOB NO.: **PR133215**
PURPOSE: BAR
Technician: mark.aitkens Date: 24/04/2017
Data Sources: RPS Client

CLIENT: Centennial Mandalong Pty Ltd

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RPS

Path: S:\Centennial\All Jobs\133215 Mandalong LW22-23 and LW 24-24a Eco' assesssments\10 - Drafting\Arcgis Map Documents\Eco\LW24-24A\BAR\133215 LW24-24a Figure 4 Ponding Locations C A4 20170217.mxd

Table 5 Management Zones

Veg Zone #	Management Zone	Treatment	Area (ha)	Management
1	1	Impacted by subsidence related ponding	0.00	All site attribute scores reduced to 'zero' (i.e. maximum offset liability)
	2	No expected subsidence impacts	0.49	All pre-impact site attribute scores preserved (i.e. no net change in site attribute scores)
2	1	Impacted by subsidence related ponding	0.03	All site attribute scores reduced to 'zero' (i.e. maximum offset liability)
	2	No expected subsidence impacts	8.33	All pre-impact site attribute scores preserved (i.e. no net change in site attribute scores)
3	1	Impacted by subsidence related ponding	0.00	All site attribute scores reduced to 'zero' (i.e. maximum offset liability)
	2	No expected subsidence impacts	17.82	All pre-impact site attribute scores preserved (i.e. no net change in site attribute scores)
4	1	Impacted by subsidence related ponding	0.13	All site attribute scores reduced to 'zero' (i.e. maximum offset liability)
	2	No expected subsidence impacts	0.66	All pre-impact site attribute scores preserved (i.e. no net change in site attribute scores)
5	1	Impacted by subsidence related ponding	0.00	All site attribute scores reduced to 'zero' (i.e. maximum offset liability)
	2	No expected subsidence impacts	24.41	All pre-impact site attribute scores preserved (i.e. no net change in site attribute scores)
6	1	Impacted by subsidence related ponding	0.00	All site attribute scores reduced to 'zero' (i.e. maximum offset liability)
	2	No expected subsidence impacts	3.16	All pre-impact site attribute scores preserved (i.e. no net change in site attribute scores)
7	1	Impacted by subsidence related ponding	0.06	All site attribute scores reduced to 'zero' (i.e. maximum offset liability)
	2	No expected subsidence impacts	0.57	All pre-impact site attribute scores preserved (i.e. no net change in site attribute scores)
8	1	Impacted by subsidence related ponding	0.16	All site attribute scores reduced to 'zero' (i.e. maximum offset liability)
	2	No expected subsidence impacts	1.66	All pre-impact site attribute scores preserved (i.e. no net change in site attribute scores)

In entering the information tabulated in **Tables 4** and **5**, and corresponding BioBanking Plot data listed in **Table 6**, it should be noted that the BioBanking Credit Calculator has, by default, calculated a credit liability for all native vegetation within the Impact Area. It is important to note that there is no functionality in the BioBanking Credit Calculator to prevent the calculation of a credit liability for management zones not expected to experience a subsidence related impact as a consequence of longwall mining (i.e. a credit liability is calculated for all management zones identified as '2' in **Table 5**).

Accordingly, the credit profile represents an inflated credited calculation that combines credit calculations for ponding area (i.e. all management zones identified as '1' in **Table 5**) and management zones not expected to experience a subsidence related impact as a consequence of longwall mining (i.e. all management zones identified as '2' in **Table 5**). As such, credit calculations presented in this report represent a 'maximum offset liability'. The 'actual impact liability' would be represented by credit calculations limited to Management Zone

'1' in **Table 5**. Consultation with the Office of Environment and Heritage (OEH) is required to refine the definition of 'impact area' in terms of the BioBanking Credit Calculator to limit the credit calculation to ponding impacts (i.e. remove credit calculations attributed to native vegetation cover not impacted by the Project).

Table 6 Survey Plot/Transect Data

Plot ID #	Plant Species Richness	Native Over-Storey Cover	Native Mid Storey Cover	Native Ground Cover - grasses	Native Ground Cover - shrubs	Native Ground Cover - other	Exotic Plant Cover	# Tree Hollows	Overstorey Regeneration	Length Fallen Logs (m)	Easting (GDA 94-MGA 56)	Northing (GDA 94-MGA 56)
Veg Zone: – HU782: Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast - Moderate/Good Condition Class (3 plots completed; minimum 3 plots required)												
ABB01	22	50.5	59.5	4	14	64	0	0	1	29	351460	6333232
ABB03	30	39.5	55	22	4	58	0	0	1	12	351384	6333019
Veg Zone: – HU507: Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion - Moderate/Good Condition Class (4 plots completed; minimum 4 plots required)												
ABB04	32	18	80	40	6	68	0	0	1	4	351502	6332894
ABB05	31	55	38.5	68	2	42	0	2	1	5	352385	6331985
ABB02	21	24.5	78	18	10	88	0	0	1	11	351482	6333104
Veg Zone: - HU533: Coastal Freshwater Lagoons of the Sydney Basin Bioregion and South East Corner Bioregion (No plots completed; minimum 1 plot required; Benchmark data used)												
-	8	45	4	4	0	75	0	0	1	0	23333	63333
Veg Zone: – HU798: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley - Moderate/Good Condition Class (5 plots completed; minimum 4 plots required)												
ABT3	34	67	45	50	0	8	2	0	1	26	351359	6333310
ABT4	31	52	7	20	2	14	0	3	1	8	351384	6333202
MBB08	38	37.5	11	32	0	8	0	0	1	0	351784	6332450
MBB11	33	45	3.5	82	0	8	0	0	1	0	351880	6332848
Veg Zone: – HU803 Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast - Moderate/Good Condition Class (5 plots completed; minimum 4 plots required)												
MBB03	30	52.5	4	20	12	0	0	0	1	36.5	352935	6331133
MBB04	36	40.5	29	28	6	6	0	2	1	23	352825	6331083

Plot ID #	Plant Species Richness	Native Over-Storey Cover	Native Mid Storey Cover	Native Ground Cover - grasses	Native Ground Cover - shrubs	Native Ground Cover - other	Exotic Plant Cover	# Tree Hollows	Overstorey Regeneration	Length Fallen Logs (m)	Easting (GDA 94-MGA 56)	Northing (GDA 94-MGA 56)
MBB09	29	44	4	26	10	2	0	3	1	43	351942	6332572
MBB10	32	40.5	7	40	8	0	0	2	1	46.5	352198	6332715
MBB13	32	43.5	7.5	60	4	0	0	11	1	50	351589	6333488
Veg Zone: – HU806: Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest (4 plot completed; minimum 2 plot required)												
MBB01	21	34.5	11	28	2	0	0	0	1	22.5	352940	6331451
MBB02	36	35.2	1.5	38	12	0	0	1	1	20	352710	6331423
MBB05	18	53	43	30	26	0	0	2	1	38	353030	6330965
MBB06	33	33.5	16.5	88	6	2	0	1	1	52	352748	6331341
Veg Zone: – HU937: Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast - Moderate/Good Condition Class (2 plots completed; minimum 2 plots required)												
ABB07	31	68.5	22.5	60	10	44	0	0	1	6	352605	6331452
MBB07	37	14	63	52	2	20	0	0	1	83.5	352031	6332040
Veg Zone: – Derived variant of HU937: Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast - Low Condition Class (2 plots completed; minimum 2 plots required)												
ABB06	21	3.5	4	44	0	0	92	0	1	0	352682	6331607
ABB08	22	0	8	40	0	0	96	0	1	0	3525832	6331338

2.4 Geographic and Habitat Features

The Biobanking Credit Calculator has considered the habitat values inherent within the Impact Area and asks whether 26 listed Geographic and Habitat Features (GHFs) occur on the Impact Area. Nineteen of the 26 GHFs listed in the Credit Calculator were identified as occurring within the Impact Area (i.e. having broad features that match site habitats). These are shown below in **Table 7**. The remaining GHFs listed in the Biobanking Credit Calculator were considered as not having broad features that match the disturbance area habitats and thus were not 'ticked' as relevant to the Impact Area (and were filtered out of the subsequent steps of the Biobank assessment).

Table 7 Geographic and Habitat Features within Impact Area

Common Name	Scientific Name	Feature
Heath Wrinklewort	*Rutidosis heterogama*	heath on sandy soils, or moist areas in open forest
Pale-headed Snake	*Hoplocephalus bitorquatus*	land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber
Brush-tailed Rock-wallaby	*Petrogale penicillata*	land within 1 km of rock outcrops or clifflines
Common Planigale	*Planigale maculata*	rainforest, eucalypt forest, heathland, marshland, grassland or rocky areas
Green and Golden Bell Frog	*Litoria aurea*	land within 100 m of emergent aquatic or riparian vegetation
Green-thighed Frog	*Litoria brevipalmata*	land within 100 m of semi-permanent or ephemeral ponds or depressions containing leaf litter
Stuttering Frog	*Mixophyes balbus*	rainforest or tall open wet forest with understorey and/or leaf litter and within 100 m of streams
Giant Barred Frog	*Mixophyes iteratus*	land below 1000 m in altitude and within 40 m of rainforest or eucalypt forest with deep leaf litter
Red Helmet Orchid	*Corybas dowlingii*	Sheltered areas such as gullies and southerly slopes in tall open forest on well-drained gravelly soil at elevations of 10-200 m
Biconvex Paperbark	*Melaleuca biconvexa*	swamps, swamp margins or creek edges
Wallum Froglet	*Crinia tinnula*	land within 40 m of swamps, wet or dry heaths or sedge grasslands
Black Bittern	*Ixobrychus flavicollis*	land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation
Wyong Sun Orchid	*Thelymitra adorata*	Occurs from 10-40 m a.s.l. in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils. The vegetation type in which the majority of populations occur (including the largest colony) is a Spotted Gum - Ironbark Forest.
Diuris bracteata	*Diuris bracteata*	Dry sclerophyll woodland and forest with a predominantly grassy understorey
Zannichellia palustris	*Zannichellia palustris*	Land containing freshwater bodies
Comb-crested Jacana	*Irediparra gallinacea*	Land within 40 m of permanent wetlands with a good surface cover of floating vegetation
Black-necked Stork	*Ephippiorhynchus asiaticus*	Land within 40 m of freshwater or saline wetlands (e.g. Saltmarsh, mangroves, mudflats, swamps, billabongs, floodplains, watercourse pools, wet heathland and/or farm dams)

Common Name	Scientific Name	Feature
Maundia triglochinoides	*Maundia triglochinoides*	Swamps or shallow fresh water on clay
Australasian Bittern	*Botaurus poiciloptilus*	Land containing brackish or freshwater wetlands

3.0 Threatened Species

Threatened species have been classified into two types; 'Ecosystem Credit' and 'Species Credit' type species, as detailed within the Threatened Species Profile Database (TSPD). Ecosystem Credit species are species with habitat needs that can be reliably predicted based on vegetation type and location. The BioBanking Credit Calculator considers the impacts to these species based on the impact to the vegetation types or localities that they are predicted to occur within. Species Credit species are species with habitat needs that are not reliably predicted by the vegetation type or location. Only species that are considered to be Species Credit species require targeted surveys.

'Tg' value is a representation of a species' life history characteristics, rarity, and the amount of information available on the species. Some species are 'split' with species credits applying to, for example, breeding habitat whereas ecosystem credits applied to foraging habitat for a species. The 'Tg' value of both ecosystem and species type species weights the significance of habitat and in the case of ecosystem credit type species the species with the highest 'Tg' value is applied to the Study Area.

3.1 Ecosystem Credit Species

The 'Site Survey details' section of the BioBanking Credit Calculator lists a total of 38 'predicted' species that may potentially occur within the Impact Area. Predicted species are listed below in Table 8. The 'Tg' score and likelihood of occurrence findings for each species is presented in **Appendix 1**.

Table 8 Predicted Ecosystem Credit Species

Common Name	Scientific Name	Recorded from Within 10km (NSW Wildlife Atlas 2017) Y/N	Recorded from the disturbance area (all previous surveys) Y/N
Australian Painted Snipe	*Rostratula australis*	N	N
Barking Owl	*Ninox connivens*	N	N
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis subsp. gularis*	N	N
Black-tailed Godwit	*Limosa limosa*	N	N
Blue-billed Duck	*Oxyura australis*	N	N
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus subsp. victoriae*	Y	Y
Bush Stone-curlew	*Burhinus grallarius*	Y	N
Diamond Firetail	*Stagonopleura guttata*	Y	N
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	N	N
Eastern Freetail-bat	*Mormopterus norfolkensis*	Y	Y
Flame Robin	*Petroica phoenicea*	N	N
Freckled Duck	*Stictonetta naevosa*	N	N
Gang-gang Cockatoo	*Callocephalon fimbriatum*	Y	Y
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	Y	Y
Greater Broad-nosed Bat	*Scoteanax rueppellii*	N	N
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis subsp. temporalis*	Y	N
Little Eagle	*Hieraaetus morphnoides*	Y	N

Common Name	Scientific Name	Recorded from Within 10km (NSW Wildlife Atlas 2017) Y/N	Recorded from the disturbance area (all previous surveys) Y/N
Little Lorikeet	*Glossopsitta pusilla*	Y	Y
Long-nosed Potoroo	*Potorous tridactylus*	Y	N
Magpie Goose	*Anseranas semipalmata*	N	N
Masked Owl	*Tyto novaehollandiae*	Y	N
Painted Honeyeater	*Grantiella picta*	N	N
Powerful Owl	*Ninox strenua*	Y	Y
Rose-crowned Fruit-dove	*Ptilinopus regina*	N	N
Scarlet Robin	*Petroica boodang*	Y	N
Speckled Warbler	*Chthonicola sagittata*	Y	N
Spotted Harrier	*Circus assimilis*	N	N
Spotted-tailed Quoll	*Dasyurus maculatus*	Y	N
Square-tailed Kite	*Lophoictinia isura*	Y	N
Squirrel Glider	*Petaurus norfolcensis*	Y	N
Superb Fruit-dove	*Ptilinopus superbus*	N	N
Swift Parrot	*Lathamus discolor*	Y	N
Turquoise Parrot	*Neophema pulchella*	Y	N
Varied Sittella	*Daphoenositta chrysoptera*	Y	N
White-fronted Chat	*Epthianura albifrons*	N	N
Wompoo Fruit-dove	*Ptilinopus magnificus*	N	N
Yellow-bellied Glider	*Petaurus australis*	Y	N
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	Y	N

3.2 Species Credit Species

'Site Survey details' of the Credit Calculator lists a total of 39 'Species Credit' species that potentially occur within the Impact Area, as shown in **Table 9**.

Table 9 Species Credit Species

Common Name	Scientific Name	Recommended Survey Period	Surveyed in Recommended Period? Y/N	Recorded from the Site? Y/N	Assumed Presence Y/N
Australasian Bittern	*Botaurus poiciloptilus*	All year round	Y	N	N
Biconvex Paperbark	*Melaleuca biconvexa*	All year round	Y	Y	N
Black Bittern	*Ixobrychus flavicollis*	All year round	Y	N	N
Black-eyed Susan	*Tetratheca juncea*	July-December	Y	N	N
Black-necked Stork	*Ephippiorhynchus asiaticus*	All year round	Y	N	N

Common Name	Scientific Name	Recommended Survey Period	Surveyed in Recommended Period? Y/N	Recorded from the Site? Y/N	Assumed Presence Y/N
Brush-tailed Phascogale	*Phascogale tapoatafa*	All year round	Y	N	N
Brush-tailed Rock-wallaby	*Petrogale penicillata*	All year round	Y	N	N
Bynoe's Wattle	*Acacia bynoeana*	September - March	Y	N	N
Comb-crested Jacana	*Irediparra gallinacea*	All year round	Y	N	N
Common Planigale	*Planigale maculata*	All year round	Y	N	N
Cotton Pygmy-Goose	*Nettapus coromandelianus*	All year round	Y	N	N
Diuris bracteata	*Diuris bracteata*	August - September	Y	N	N
Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*	All year round	Y	Y	N/A
Eastern Pygmy-possum	*Cercartetus nanus*	None specified	None specified	N	N
Giant Barred Frog	*Mixophyes iteratus*	October - April	Y	N	N
Golden-tipped Bat	*Kerivoula papuensis*	October - March	Y	N	N
Green and Golden Bell Frog	*Litoria aurea*	August - March	Y	N	N
Green-thighed Frog	*Litoria brevipalmata*	October- March	Y	N	N
Grove's Paperbark	*Melaleuca groveana*	All year round	Y	N	N
Heath Wrinklewort	*Rutidosis heterogama*	All year round	Y	N	N
Koala	*Phascolarctos cinereus*	All year round	Y	N	N
Leafless Tongue Orchid	*Cryptostylis hunteriana*	November - February	Y	N	N
Maundia triglochinoides	*Maundia triglochinoides*	November - March	Y	Y	N
Netted Bottle Brush	*Callistemon linearifolius*	October – April	Y	N	N
Pale-headed Snake	*Hoplocephalus bitorquatus*	September - March	Y	N	N
Parma Wallaby	*Macropus parma*	All year round	Y	N	N
Red Helmet Orchid	*Corybas dowlingii*	June - August	Y	N	N
Red-backed Button-quail	*Turnix maculosus*	All year round	Y	N	N
Regent Honeyeater	*Anthochaera phrygia*	All year round	Y	N	N
Rough Doubletail	*Diuris praecox*	July - August	Y	N	N
Small-flower Grevillea	*Grevillea parviflora subsp. parviflora*	All year round	Y	N	N
Stephens Banded Snake	*Hoplocephalus stephensii*	None specified	None specified	N	N
Stuttering Frog	*Mixophyes balbus*	September - May	Y	N	N

Common Name	Scientific Name	Recommended Survey Period	Surveyed in Recommended Period? Y/N	Recorded from the Site? Y/N	Assumed Presence Y/N
Tall Knotweed	*Persicaria elatior*	December-May	Y	N	N
Thick Lip Spider Orchid	*Caladenia tessellata*	September - October	Y	N	N
Wallum Froglet	*Crinia tinnula*	All year round	Y	N	N
White-flowered Wax Plant	*Cynanchum elegans*	All year round	Y	N	N
Wyong Sun Orchid	*Thelymitra sp. adorata*	September - October	Y	N	N
Zannichellia palustris	*Zannichellia palustris*	March-November	Y	N	N

'Species Credit' Species recorded within the Impact Area include *Melaleuca biconvexa* and *Maundia triglochinoides*. The location of these species is shown in **Figure 5**.

Amphibian species such as the Green-thighed Frog, are likely to benefit from ponding impacts. In relation to this species, the predicted incidence of ponding within areas of native vegetation that are broadly classed as suitable for this species it is considered that breeding opportunities are likely to be increased and enhanced for this species. Thus, on this basis, no detrimental impact is expected as a consequence of the Project.

3.2.1 Threatened Species Survey Methodologies

The recommended survey period for the 'Species Credit' species is detailed in **Table 9**. Targeted surveys were performed for these species using methods specified in DEC (2004) (See **Appendix 1**). Surveys were suitably stratified and replicated across the Study Area. On this basis it is considered that the survey requirements for 'Species Credit' species have been met. Where any doubt remained, the precautionary principle was adopted and presence assumed.

3.2.2 Species Polygons

A species polygon has been developed for each of the various threatened species considered to potentially utilise the Impact Area. No species polygon was created for the Eastern Chestnut Mouse because its habitat requirements do not occur within the Impact Area.

3.2.2.1 *Melaleuca biconvexa*

As indicated in the biodiversity inventory report (RPS 2017) contained in **Appendix 1**, *Melaleuca biconvexa* occurs throughout the floodplain of the Impact Area where it forms a dense almost continuous midstorey in relatively undisturbed vegetation to heavily modified lands. There was difficulty in determining its population size due to its clonal character and as such a conservative estimate of 1,000 individuals is assumed in this assessment. This estimation will be refined if and when monitoring identifies a mining related impact on this species due to ponding.

The likelihood for an adverse impact on this species is considered low. Ponding is likely to enhance habitat conditions for this species, although in some case it might be detrimental. Assuming a net loss outcome occurs, which is considered unlikely, it is assumed for the purpose of this assessment that 5 individuals would be adversely impacted by ponding.

3.2.2.2 *Maundia triglochinoides*

As indicated in the biodiversity inventory report (RPS 2017), *Maundia triglochinoides* occurs throughout the floodplain of the Impact Area where it forms localised dense patches in heavily modified lands. There was difficulty in determining its population size due to the lack of flowering material across all specimens

observed (i.e. uncertainty in distinguishing between Maundia triglochinoides and other species with similar vegetative character such as *Philydrum lanuginosum*). As such a conservative estimate of 1200 individuals is assumed in this assessment.

The likelihood for an adverse impact on this species is considered low. Ponding is likely to enhance habitat conditions for this species, although in some case it might be detrimental. Assuming a net loss outcome occurs, which is considered unlikely, it is assumed for the purpose of this assessment that 20 individuals would be adversely impacted by ponding Where *M. triglochinoides* occurs, there appears to be negligible change in predicted ponding compared to current ponding (refer to **Figure 4**).

3.3 Identified Populations

The Director General of OEH may develop an 'Identified Populations' Database that identifies population(s) of Threatened species present in an area of land that require assessment under the BBAM (either for a Biobank or Disturbance area). To date, the BBAM has not determined any 'Identified Populations'.

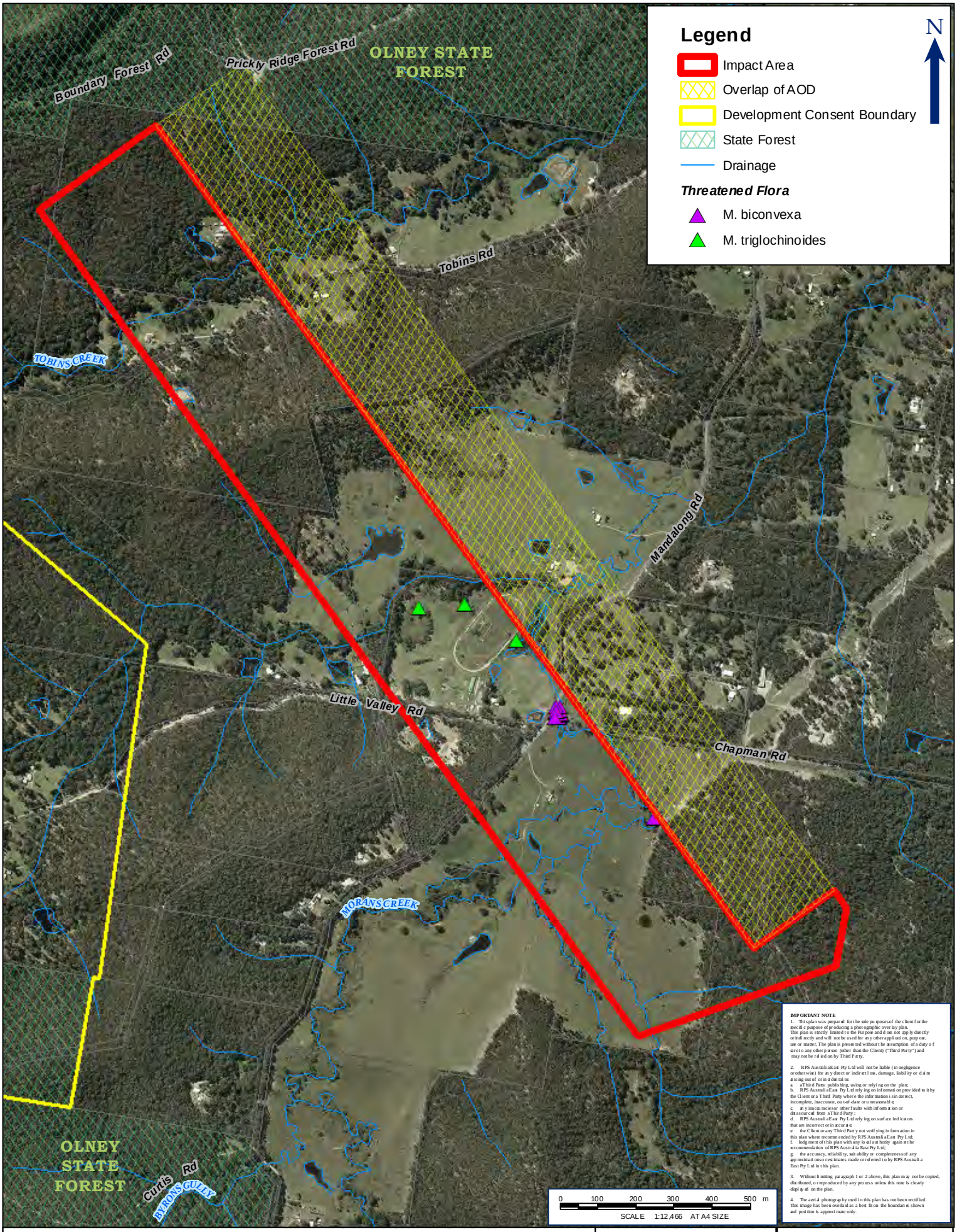

Figure 5: Threatened Species Polygons

LOCATION: Mandalong Longwalls 24-24A	DATUM: GDA94 PROJECTION: MGA Zone 56
JOB NO.: **PR133215** PURPOSE: BAR Technician: mark.aitkens Date: 24/04/2017	Data Sources: RPS Client

CLIENT: Centennial Mandalong Pty Ltd

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Stage 2 – Impact Assessment (Biodiversity Values)

4.0 Impacts

4.1 Direct Impacts

Prior to the consideration of impact avoidance and minimisation strategies, the Project has been identified as having a broad subsidence related impact throughout the Impact Area (i.e. varying degrees of surface landform alteration). No areas of native vegetation cover would be cleared for the Project. Subsidence modelling indicates that surface landform alterations that may have an impact on the biodiversity values of the Study Area where additional ponding is predicted as shown in **Figure 4** (i.e. increased water accumulation in areas where a reduced relative height coincides with areas of low relief such as the floodplain). Impacts arising from the effects of increased ponding are tabulated in **Table 10**.

Table 10 Predicted Subsidence Impacts (ponding)

PCT Code	PCT Name	Area of Subsidence Induced Ponding (ha)
HU507	Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion	0.03
HU533	Coastal Freshwater Lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	0.16
HU782	Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	0.00
HU798	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	0.00
HU803	Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	0.00
HU806	Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	0.00
HU937	*Melaleuca biconvexa* - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast	0.06
HU937d	*Melaleuca biconvexa* - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast	0.13
Total		**0.38**

As indicated in **Section 2.3.1**, each vegetation zone has been divided into two management areas to partition ponding impacts (see **Table 5**). From a maximum offset liability perspective, management areas subject to predicted ponding will default to a site value score of zero following impact; however, it should be noted that the actual impact will not be a total loss. Native vegetation cover located outside ponding areas will be treated as having no change in site value score as no ponding, surface cracking or adverse impacts on areas of cliff line, caves or similar structures are expected within these areas (Umwelt 2017, Seedsman Geotechnics Pty Ltd 2017). As noted in **Section 2.3**, the inclusion of native vegetation cover within the impact assessment and BioBanking Credit Calculator will result in an inflated credit calculation (i.e. includes credits generated for vegetated lands not impacted by ponding).

4.2 Indirect Impacts

Indirect impacts arising are further discussed in **Section 4.4** (Key Threatening Processes).

4.3 Impact Avoidance Measures

It is considered impractical to implement any meaningful impact avoidance measures given the small predicted total area of increased ponding within areas mapped as native vegetation (i.e. estimated to be 0.38

ha) and its scattered distribution throughout the Impact Area. No impact avoidance measures have been considered in this assessment.

4.4 Key Threatening Processes

The project may contribute to a number of Key Threatening Processes (KTP) as listed under the TSC Act. Those considered relevant to the Project are discussed below.

4.4.1 Alteration of Habitat Following Subsidence Due to Longwall Mining

The Project is predicted to result in active subsidence with a maximum lowering of the surface above mined areas expected to be approximately 960 mm. No areas of surface cracking or upsidence are predicted, thus it is expected that the valley landforms will evenly subside without additional alteration.

The main impact predicted from the subsidence is ponding, as indicated in **Figure 4**. The extant area of remnant ponding (i.e. existing conditions) where coincident with native vegetation cover is estimated to be 4.49 ha. Additional ponding exceeding existing approvals will compliment areas of remnant ponding and cover an estimated area of 0.38 ha. This represents an 8% increase in remnant ponding compared with the current approved mining activities at the Mandalong Mine (SSD-5144 Mod 4).

4.4.2 Invasion, Establishment and Spread of Lantana (*Lantana camara*)

Lands disturbed by surface cracking may result in localised improvement in habitat values for *Lantana camara* (i.e. eroding soils and increased sediment loads may aid Lantana propagation and growth). However, the Project is unlikely to result in any surface cracking and as such not likely to result in the development of habitat conditions beneficial for *Lantana camara*.

Vegetated lands peripheral to areas of subsidence related ponding may contribute to the KTP "*Lantana camara*" by provided localised habitat improvements in terms of water and nutrient availability. In this respect, the Project will be subject to an existing weed control program that is part of the site specific Biodiversity Management Plan to ameliorate the existing impact of this KTP. Lasting negative impacts from this potential impact are not expected as a consequence of the Project.

4.4.3 Anthropogenic Climate Change

The Project will contribute to "Human Caused Climate Change" through fugitive gas emissions (methane).

4.4.4 Degradation of Native Riparian Vegetation along NSW Watercourses

The Project will incrementally contribute to the 'degradation of native riparian vegetation along NSW watercourses' by increasing the area of existing remnant ponding. No stream bed or surface impacts are predicted and as such it is considered that the Project is not likely to result in a decline of groundwater dependent species.

4.4.5 Introduction and Establishment of Exotic Rust Fungi of the Order Pucciniales Pathogenic on Plants of the Family Myrtaceae

The Project may increase the level of stress and lower resistance of some members of the family Myrtaceae due to alteration of their habitat within the Impact Area. In this respect, the Project will be subject to an existing pathogen management protocols as part of the site specific Biodiversity Management Plan to minimise the spread of Exotic Rust Fungi if present within the Impact Area.

4.5 Impact Minimisation Measures

Impact minimisation measures for predicted ponding impacts reflect those listed in Umwelt (2017) viz.:

- Monitoring of predicted subsidence areas where coinciding with remnant ponding to determine the mitigation/ remediation measures need to alleviate any undesirable outcomes; and
- Use of drainage works to alleviate the impacts of excessive ponding predictions as specified in Table 4.6 of Umwelt (2017).

It is recommended that the Project be subject to the regional and site specific Biodiversity Management Plan to minimise the effect of KTPs discussed in Section 4.4.

5.0 Impacts Requiring Further Consideration

Certain impacts on biodiversity values will require further consideration by the consent authority (Section 9.2 of the FBA). These are impacts that are considered to be complicated or severe. A decision will be made by the consent authority on whether it is appropriate for these impacts to occur. The consent authority may determine:

- The Major Project cannot be approved with that particular impact;
- Modifications are required to the Major Project to reduce the severity of the impact; or
- The Major Project can be approved but it will require additional offsets, supplementary measures or other actions to be undertaken with respect to that impact.

As defined in Section 9.2 of the FBA, impacts on biodiversity values that require further consideration are:

- Impacts on landscape features, being:
  - impacts that will reduce the width of vegetation in the riparian buffer zone bordering significant streams and rivers, important wetlands or estuarine areas, or
  - impacts that will prevent species movement along corridors that have been identified as providing significant biodiversity linkages across the state, and
- Impacts on native vegetation that are likely to cause the extinction of an EEC/CEEC from an IBRA subregion or significantly reduce its viability, and
- Impacts on critical habitat or on threatened species or populations that are likely to cause the extinction of a species or population from an IBRA subregion or significantly reduce its viability.

The following commentary is provided in respect to 'impacts requiring further consideration'.

5.1 Impacts on Landscape Features

5.1.1 Width Reduction of Riparian Buffer or Important Rivers, Streams and Estuaries

The Project is likely to result in the enlargement of remnant ponding areas within 20 m of a 4th order stream. This subsidence impact is likely to result in a widening of inundated areas (ephemeral and/ or permanent), and as such is unlikely to reduce the width of the riparian buffer. Notwithstanding, at least 50% of the riparian buffer for 4th order stream section occurring within the Study Area is already cleared of its overstorey and midstorey vegetation cover (i.e. derived state). Landform modifications at this location are unlikely to exacerbate these conditions such that the riparian buffer width would contract as a consequence of the Project.

5.1.2 Important Wetlands

No important wetlands occur within the Impact Area. Important wetlands located downstream of the Impact Area are not likely to be adversely impacted by the Project.

5.1.3 Species Movements along Corridors

No changes in vegetation cover or habitat connectivity are expected as a consequence of the Project. On this basis it is considered that species movements are not likely to be adversely impacted by the Project.

5.1.4 Impacts on Native Vegetation

EECs observed within the Impact Area, their condition, associated predicted impacts arising from ponding and percent incidence within the impact area are outlined in **Table 11**.

Table 11 EECs within the Impact Area, Predicted Impact Magnitude and Relative Impact

PCT Code	EEC Name	Condition	Ponding Impact (ha)	Total Area in Study Area (ha) and % Impact
HU507	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Moderate/ good (medium)	0.03	8.36 ha (0.4%)
HU533	Freshwater Wetlands on Coastal Floodplains	Moderate/ good (medium)	0.16	1.82 ha (8.79%)
HU806	Lower Hunter Spotted Gum Ironbark Forest	Moderate/ good (medium)	0.00	0.49 ha (0%)
HU937	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion	Moderate/ good (medium)	0.06	0.79 ha (7.59%)
HU937	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion	Low	0.13	0.63 ha (20.63%)
Total			**0.38**	**12.09 (3.14%)**

No further consideration of these EECs is required due to the following:

- None are listed as critically endangered; and
- None are specifically nominated in the SEARs as an EEC that is likely to become extinct or have its viability significantly reduced in the IBRA subregion if it is impacted on by development.

5.1.5 Impacts on Threatened Species

No further consideration of the Project impacts on threatened species is warranted as the threatened species known to occur within the impact area and predicted to be impacted by the Project are not:

- Critically endangered species; or
- A threatened species or population that is specifically nominated in the SEARS as a species or population that is likely to become extinct or have its viability significantly reduced in the IBRA subregion if it is impacted on by the development, or
- A threatened species is present on the proposed development site, and the threatened species has not previously been recorded in the IBRA subregion according to records in the NSW Wildlife Atlas.

5.1.6 Impacts on Critical Habitat

No areas mapped as critical habitat occur within the Impact Area.

6.0 Offset Requirements

6.1 Credit Report

Data inputs described in Section 2 were entered into the BioBanking Credit Calculator using the FBA module to generate a Credit Profile for the Project. The Credit Report generated by the BioBanking Credit Calculator is provided as **Appendix 2**. A summary of the ecosystem credits required is provided in **Table 12** and a summary of the species credits required is provided in **Table 13**.

Table 12 Summary of Ecosystem Credits Required

PCT Code	PCT Name	Area (ha)	Credits
HU507	Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion	8.36	47
HU533	Coastal Freshwater Lagoons of the Sydney Basin bioregion and South East Corner Bioregion	1.82	10
HU782	Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	3.16	17
HU798	White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	17.82	96
HU803	Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	24.41	132
HU806	Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest	0.49	3
HU937	*Melaleuca biconvexa* - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast	1.42	19
Total		**57.48**	**324**[7]

Table 13 Summary of Species Credits Required

Species	Extent of Impact (individuals)	Credits
Melaleuca biconvexa	5	65
Maundia triglochinoides	20	520

[7] Note: the credit report sums part 'Credits Created' with the resultant total in the credit report being 324 credits. The additional credit is not allocated to any particular PCT and as such should not be included in the offsetting liability.

Stage 3 – Biodiversity Offset Strategy

The Project is only predicted to have subsidence related impacts, which are defined as negligible under Section 2.3.1.2 (c) of the FBA. Subsidence related impacts are not required to be assessed (i.e. no clearing of native vegetation or associated habitat). Therefore, with regards to Stage 3 – Biodiversity Offset Strategy, currently, there is no specific offset strategy proposed. Rather, it is considered that the continual implementation of the regional and site specific Biodiversity Management Plan would be sufficient for the detection and management of unforeseen impacts arising from the Project.

7.0 References

Department of Environment & Climate Change (2009) Draft Operational Manual for using the BioBanking Credit Calculator v2.0.

Landcom (2004) Managing Urban Stormwater: Soils and Construction 4th Ed. 'The Blue Book'. NSW Government.

Office of Environment and Heritage (2017) NSW Bionet Atlas of NSW Wildlife. Accessed January 2017. http://www.bionet.nsw.gov.au/

Office of Environment and Heritage (2014a) BioBanking Assessment Methodology 2014, September 2014.

Office of Environment and Heritage (2014b) Framework for Biodiversity Assessment: NSW Biodiversity Offsets Policy for Major Projects. September 2014.

Office of Environment and Heritage (2012) Assessors Guide to using the BioBanking Credit Calculator v2, April 2012.

OEH Threatened Species, Populations and Ecological Communities website (http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/).

RPS (2013) Mandalong Southern Extension Project, Flora and Fauna Assessment Prepared for Centennial Coal, August 2013.

RPS (2016) Mandalong Longwalls 22-23 Ecological Impact Assessment, Prepared for Centennial Coal, December 2016.

RPS (2017) Mandalong Offset Site. Longwalls 22-23 Flora and Fauna Inventory Report. Unpublished report to Centennial Mandalong by RPS, Newcastle.

RPS (2017b) Mandalong Offset Site. Longwalls 24-24a Flora and Fauna Inventory Report. Unpublished report to Centennial Mandalong by RPS, Newcastle.

Umwelt (2017) Centennial Mandalong Flood Assessment Longwalls 24 to 24a. Report to Centennial Coal.

Appendix 1

Biodiversity Inventory Report

(RPS 2017)

RPS

MANDALONG MINE LONGWALLS 24-24A
Biodiversity Inventory Report

Prepared for ***Centennial Coal - Mandalong***

27 APRIL 2017

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In preparing this report RPS has made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. As such we would not be aware of any reason if any of the assumptions were incorrect.

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
Draft	Draft for client review	SM/JD	LE/MA	21-04-2017
Final	Submission	JM	LE	27-04-2017

Approval for Issue

Name	Signature	Date
Arne Bishop		27-04-2017

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Executive Summary

Mandalong Mine is operated by Centennial Mandalong Pty Limited (Centennial Mandalong), a wholly owned subsidiary of Centennial Coal Company (Centennial).

RPS was engaged by Centennial to provide an Offset Site Flora and Fauna Inventory Report for the area above longwalls 24-24a with the key objective to describe the existing environment of the site using database searches, literature reviews and diverse ecological surveys. Special attention was paid to threatened and vulnerable species listed under the *NSW Threatened Species Conservation Act 1995* (TSC Act) and Matters of National Environmental Significance listed (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A total of 231 flora species were found during surveys of the Study Area. Two of these species were listed as 'Vulnerable' under the TSC Act, one of which was also listed as 'Vulnerable' under the EPBC Act. A total of 99 fauna species were detected within the Study Area, with seven of these being listed as 'Vulnerable' under the TSC Act, as listed below;

Threatened Flora

- *Melaleuca biconvexa* (Biconvex Paperbark), Vulnerable under the TSC Act and EPBC Act; and
- *Maundia triglochinoides*, Vulnerable under the TSC Act.

Threatened Fauna

- Powerful Owl (*Ninox strenua*), Vulnerable under the TSC Act;
- Sooty Owl (*Tyto tenebricosa*), Vulnerable under the TSC Act;
- Glossy Black Cockatoo (*Calyptorhynchus lathami*) Vulnerable under the TSC Act;
- Gang Gang Cockatoo (*Callocephalon fimbriatum*), Vulnerable under the TSC Act;
- Little Lorikeet (*Glossopsitta pusilla*) Vulnerable under the TSC Act;
- Yellow-bellied Glider (*Petaurus australis*) Vulnerable under the TSC Act; and
- Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*) Vulnerable under the TSC Act.

Ground truthing of flora communities within the Study Area resulted in refining of previously mapped vegetation communities into ten (Bell, 2016) vegetation community categories. Of these, three were commensurate with a threatened ecological community listed under the TSC act. The threatened ecological communities mapped within the Study Area are listed below:

- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (i.e. MU 5 - Alluvial Tall Moist Forest);
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion (i.e. MU 5 'XXX' and MU 5 - derived Alluvial Tall Moist Forest); and
- Lower Hunter Spotted Gum Ironbark Forest (i.e. MU 17o).

Koala Spot Assessment Technique (SAT) surveys were carried out but detected no Koalas or traces of Koalas within the Study Area. Despite this, a large proportion of Koala feed trees were found in some areas of the Study Area, leading to its classification as potential Koala habitat.

Significance assessments were performed for MNES listed under the EPBC Act. Assessments conclude that the project is not likely to have a significant impact on threatened species, populations, ecological communities and their habitats listed under the EPBC Act.

Terms and Abbreviations

Abbreviation	Description
API	Aerial Photograph Interpretation
CEEC	Critically Endangered Ecological Community
DBH	Diameter at Breast Height
DEC	NSW Department of Environment and Conservation – now known as OEH
DECC	NSW Department of Environment and Climate Change – now known as OEH
DECCW	NSW Department of Environment, Climate Change and Water– now known as OEH
DLWC	Former NSW Department of Land and Water Conservation
DoEE	Commonwealth Department of the Environment and Energy
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP&A Act	NSW *Environmental Planning and Assessment Act* 1979
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
GPS	Global Positioning System
KTP	Key Threatening Process
LGA	Local Government Area
MU	Map Unit
MNES	Matters of National Environmental Significance
NPWS	NSW National Parks and Wildlife Services
NSW Fisheries	NSW Department of Industry & Investment - Fisheries
OEH	NSW Office of Environment and Heritage
PFC	Projected Foliage Cover
ROTAP	Rare or Threatened Australian Plants
RPS	RPS Australia East Pty Ltd
SEPP	State Environmental Planning Policy
TEC	Threatened Ecological Community
TSC Act	NSW *Threatened Species Conservation Act* 1995

1.0 Introduction

This Biodiversity Inventory Report is an appendix to the Biodiversity Assessment Report (BAR) for the Mandalong Mine Longwall Panel 24 to 24a Modification (the Project). The Project proposes to modify the approved Mandalong Mine Development Consent SSD-5144. Such investigations will form a component of the environmental assessment reporting to modify SSD-5144, the latest modification of which was approved on 12th October 2015 (Mod 4).

The Project aims to increase coal resource recovery from areas located adjacent to the existing approved development. It comprises the secondary extraction of extended longwall (LW) panels 24 and 24a (LWs 24-24a), as shown in **Figure 1**. Biodiversity investigations have been performed across the corresponding surface located above the longwall panels and adjoining lands where subsidence impacts may be experienced (i.e. the 26.5 degree angle of draw).

1.1 Background

Mandalong Mine operates under Development Consent SSD-5144 which was granted on 12 October 2015 by the NSW Planning Assessment Commission under Part 4, Division 4.1 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act), and provided for extension of the mining area extracting coal from the West Wallarah and Wallarah-Great Northern Seams.

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

- The Mandalong Mine Access Site, encompassing underground workings and associated surface infrastructure near Morisset.
- Delivery of run-of-mine coal from the underground workings to the Cooranbong Entry Site. The Cooranbong Entry Site coal handling and processing facilities are approved under the Northern Coal Logistic Project (SSD-5145).
- Delivery of run-of-mine coal from the underground workings to the Delta Entry Site, located near Wyee at the Vales Point Rail Unloader Facility. The coal handling facility is approved under DA35-2-2004.
- Mandalong South Surface Site (MSSS), which is yet to be constructed, encompassing ventilation shafts, ventilation fans and underground delivery boreholes located approximately 6 kilometres south-west of the Mandalong Mine Access Site.

1.2 Study Area

For the purpose of this report, the Study Area encompasses the area contained within Longwalls 22-24a as shown in **Figure 1**. At the time RPS was engaged to conduct surveys for this project, the proposal combined LWs 22-23 and LWs 24-24a. The decision to divide the longwall areas into two individual projects was made subsequent to surveys being completed. Therefore, the Study Area will refer to the overall areas in which surveys were originally conducted.

The Study Area is located approximately 5 kilometres (km) to the west of the M1 Motorway, on the western side of Lake Macquarie. Lake Macquarie is located in the Hunter region approximately 20 km from Newcastle, NSW. The Study Area extent includes the 26.5 degree angle of draw (AOD) surrounding LW22-24a encompassing an area of approximately 288.3 hectares (ha).

1.3 Impact Area

The Impact Area refers to the area contained within the LWs 24-24a boundary as shown on **Figure 1** that is subject to impacts from longwall mining.

1.4 Study Area Particulars

LGA	The Study Area falls within the Lake Macquarie City Council Local Government Area (LGA).
Area	The Study Area encompasses an area of 279.90 ha, whilst the Impact Area encompasses an area of 107.62 ha.
Boundaries	The northern extent of the Study Area boundary extends marginally into the Olney State Forest. The eastern and southern boundaries occur in vegetated areas whilst the majority of the western boundary is situated within rural agricultural lands.
Current Land Use	The Study Area is a combination of rural pastoral areas and properties, creeks, roads and forest vegetation.

1.5 Project Description

Centennial Mandalong has prepared a Statement of Environmental Effects (SEE) to support an application seeking to modify development consent SSD-5144 under Part 4 of the EP&A Act. The modification is seeking to undertake the secondary extraction of extended LWs 24-24a within the development consent boundary of SSD-5144 as illustrated on **Figure 1**.

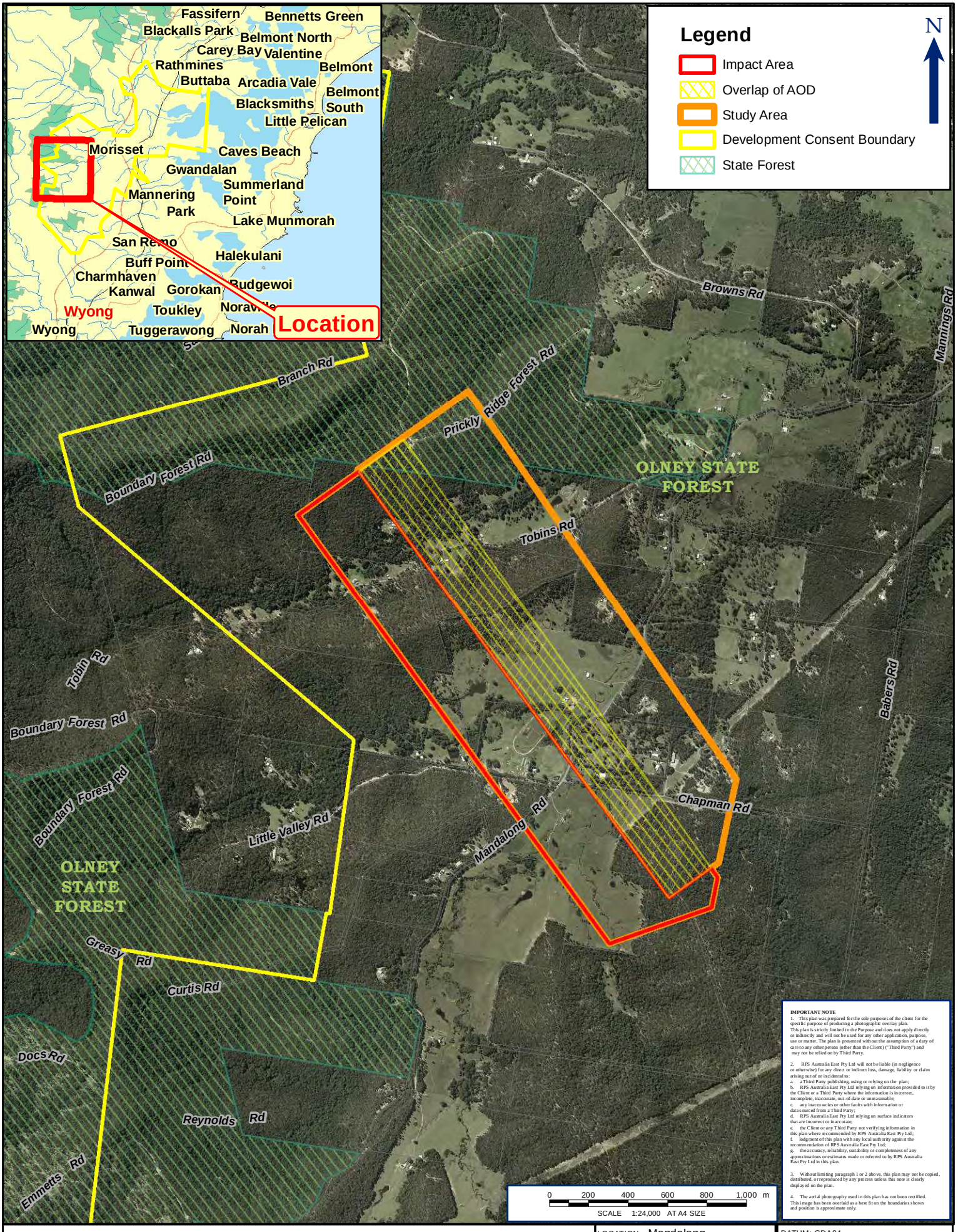
1.6 Investigation Purpose and Tasks

The purpose of this report is to document the biodiversity values of the Study Area to support the BAR prepared for the Project. Objectives addressed in this report are:

- The mapping of native vegetation cover and condition;
- Presence of threatened species, populations, ecological communities and their habitats (i.e. threatened biodiversity) listed under the *Threatened Species Conservation Act 1995* (TSC Act) and/ or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- Provision of 'Significance Assessments' for matters of national environmental significance performed in accordance with *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* (DoE 2013).

The investigation tasks reported here are listed below:

- Undertake a desktop review of databases, reports, aerial photographs, vegetation and habitat mapping relevant to the Study Area;
- Identify and map the vegetation communities and areas to be cleared within the Study Area;
- Assess the status of identified plant species and vegetation communities under relevant legislation;
- Identify existing habitat types within the Study Area and assess the habitat potential for threatened species, populations, or ecological communities known from the proximate area;
- Identify potential threatened terrestrial fauna and flora within the Study Area; and
- Identify potential threatened aquatic fauna and flora within the Study Area.



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

Figure 1: Study Area Location

LOCATION: Mandalong Longwalls 24-24A	DATUM: GDA94
	PROJECTION: MGA Zone 56
JOB NO.: **PR133215**	Data Sources: RPS Client
PURPOSE: Bio Inventory	
Technician: Natalie.Wood Date: 10/04/2017	

CLIENT: Centennial Mandalong Pty Ltd

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RPS

Path: S:\Centennial\All Jobs\133215 Mandalong LW22-23 and LW 24-24a Eco' assesssments\10 - Drafting\Arcgis Map Documents\Eco\LW24-24A\Bio Intentory Figures\133215 LW24-24a Figure 1 Location C A4 20170410.mxd

1.7 Regulatory Context

1.7.1 NSW Environmental Planning and Assessment Act 1979

The Project is declared a State Significant Development under the *State Environmental Planning Policy (State and Regional Development)* 2011, which requires consent under Part 4 Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This report aims to supplement Stage 1 of the Framework for Biodiversity Assessment (FBA) by examining the likelihood of occurrence of threatened species, populations or ecological communities (i.e. threatened biodiversity) listed under the TSC Act and EPBC Act.

1.7.2 Framework for Biodiversity Assessment

A BAR prepared in accordance with the FBA for SSD is based on an application of the NSW BioBank Assessment Methodology 2014 (BBAM 2014) (OEH 2014b). The FBA provides a dual assessment process for the developments impact and evaluation of suitable biodiversity offset options within a three stage investigation as listed below:

Stage 1 – Biodiversity Assessment;

Stage 2 – Impact Assessment (Biodiversity Values); and

Stage 3 – Biodiversity Offset Strategy.

This report has the purpose of defining the biodiversity values of the Study Area (i.e. Stage 1) and forms an appendix to the BAR (Stage 2 and 3). In addition to the BAR this report provides an assessment of the MNES and any other matters such as relevant State Environmental Planning Policies (SEPP) which are currently not assessed under the FBA.

1.7.3 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (MNES). MNES identified in the Act include:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Threatened species and communities (Section 18 and 18A).
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear Actions.
- A water resource, in relation to coal seam gas development and large coal mining development (the water trigger).

The first step in considering MNES protected under the EPBC Act (e.g. threatened species and communities listed under Section 18 and 18A) is a self-assessment performed in accordance with the Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (DoE 2013). This is performed to determine if there is likelihood for a proposed action to have a significant impact on MNES. Regulatory approval from the Commonwealth Minister for the Environment is required for actions that have, or are likely to have, a significant impact on MNES. The decision to refer a proposed action must have due regard for directions specified under Section 68 of the Act.

1.7.4 NSW Threatened Species Conservation Act 1995

The TSC Act provides legal status for biota of conservation significance in NSW. The Act aims to, *inter alia,* '*conserve biological diversity and promote ecologically sustainable development*'. It provides for:

- The listing of 'threatened species, endangered populations and Endangered Ecological Communities (EEC)' under Schedule 1.
- 'Critically endangered' species and Critically Endangered Ecological Communities (CEEC) listed under Schedule 1A.
- Vulnerable species and communities listed under Schedule 2.
- 'Key Threatening Processes' listed under Schedule 3.
- The preparation and implementation of Recovery Plans and Threat Abatement Plans.
- Requirements, or otherwise, for the preparation of a Species Impact Statement (SIS).

The lists of threatened species, populations and ecological communities gazetted under the TSC Act are relevant to this assessment and have been considered in the preparation of this constraints report.

1.7.5 NSW *National Parks and Wildlife Act 1974*

Part 8A of the *National Parks and Wildlife Act 1974* (NPW Act) regulates the undertaking of activities which may impact on threatened species, populations and ecological communities listed under the TSC Act and their habitats. The NPW Act provides that a person must not harm any animal that is a threatened species, population or ecological community; pick any plant which is part of a threatened species, population or ecological community; damage any critical habitat; or damage any habitat of a threatened species, population or ecological community without a licence being obtained under the NPW Act or TSC Act or unless another exception applies.

1.7.6 State Environmental Planning Policy No. 44 (Koala Habitat Protection)

Schedule 2 of SEPP No. 44 – 'Koala Habitat Protection' aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range, and reverse the current state trend of koala population decline. SEPP 44 applies to the Lake Macquarie LGA.

1.7.7 NSW Noxious Weeds Act 1993

The *NSW Noxious Weeds Act 1993* provides for the identification and classification for noxious weeds in each NSW LGA. The Act imposes obligations on occupiers of land to control noxious weeds declared for their LGA.

1.7.8 Groundwater Dependent Ecosystems Policy 2002

The definitions for Groundwater Dependent Ecosystems (GDEs) have been adopted based on the following three literature sources:

- The NSW State Groundwater Dependent Ecosystems Policy (Department of Land and Water Conservation 2002) defines GDEs as: *'Ecosystems which have their species composition and their natural ecological process determined by groundwater'* (ARNCANZ & ANZECC, 1996 as cited in DLWC, 2002).
- Identifying groundwater dependent ecosystems, a guide for land and water managers (Eamus 2009) defines GDEs as: *'ecosystems whose current composition, structure and function are reliant on a supply of groundwater'.*

- Risk assessment guidelines for groundwater dependent ecosystems (Serov et al. 2012) defines GDEs as: *'any ecosystem that uses groundwater at any time or for any duration in order to maintain its composition and condition'.*

As defined by Eamus (2009) GDEs are; 'ecosystems whose current composition, structure and function are reliant on a supply of groundwater. This reliance might be expressed every day of the year, or only for a few months every few years, but the reliance becomes apparent when the supply of groundwater is removed for a sufficient length of time that changes in plant function (typically rates of water use decline first) are observable'.

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

1.8 Qualifications

This report was written by Kieran Marshall B.EnvSc (Hons) and reviewed by Mark Aitkens BSc. and Lauren Eather BSc. of RPS.

1.9 Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S100536 (Valid 31 December 2017);
- Animal Research Authority (Trim File No: 16/361) issued by NSW Department of Primary Industries (Valid 21 March 2017);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 16/361) issued by NSW Department of Primary Industries (Valid 21 March 2019);
- 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 2017); and
- Forestry Corporation of NSW Forest Permit – Research (Licence number PB54359) (Valid 01 July 2017).

2.0 METHODOLOGY

2.1 Desktop Research

Investigation methods, including desktop information sources and survey methods, are detailed in the following sections.

2.2 Guidelines and Standards

2.2.1 Survey Guidelines

Surveys were performed with reference to methods outlined in relevant guidelines listed below:

- Threatened biodiversity survey and assessment: guidelines for development and activities - Working Draft (NSW Department of Environment and Conservation, 2004);
- Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECC 2009);
- NSW BioBanking Assessment Methodology (OEH 2016b), including the consideration of an operational method to assess impacts of land clearing on terrestrial biodiversity (BioMetric) (Gibbons et al. 2009);
- Survey guidelines for Australia's threatened mammals (DEWHA, 2011a);
- Survey guidelines for Australia's threatened frogs (DEWHA, 2010a);
- Survey guidelines for Australia's threatened birds (DEWHA, 2010b);
- Survey guidelines for Australia's threatened bats (DEWHA, 2010c); and
- Survey guidelines for Australia's threatened reptiles (DEWHA, 2011b).

Amendments to the BBAM (OEH 2014b), as introduced by the FBA for assessing development under Part 4 Division 4.1 of the EP&A Act (State Significant Development), is also recognised and has been referred to in preparing this report. Some methods have been varied, where necessary, to suit species, populations and communities identified as relevant to the Project.

2.2.2 Data Recording

A hand held Trimble differential global positioning system (D-GPS), accurate to less than one metre, was used to record the location of survey methodologies along with notable results including the location of threatened flora and/or fauna species.

2.2.3 Nomenclature

2.2.3.1 Plant taxonomy

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

2.2.3.2 Fauna Taxonomy

Taxonomy and common names of fauna in this report were from the following sources.

- Mammals: Menkhorst and Knight (2010), Churchill (2008), Pennay et al. (2004).
- Frogs: Tyler and Knight (2009).
- Birds: Simpson and Day (2010).
- Reptiles: Wilson and Swan (2013).

2.2.3.3 Plant Community Types (PCTs)

The assigning of PCTs to describe mapped vegetation cover was in accordance with the NSW Vegetation Types Database (OEH 2017a). Published scientific literature, where available, was used to aid in the interpretation of this database (e.g. referenced source documents).

2.3 Desktop Assessment

2.3.1 Literature

Grey literature was reviewed in preparing the background analysis of the Study Area biodiversity values. Information sources reviewed are listed below:

- Mandalong Transmission Line TL24 Relocation Project Flora and Fauna Assessment, Report to Centennial Coal (RPS 2016);
- Mandalong South Extension Project Flora and Fauna Assessment, Report to Centennial Coal (RPS 2013);
- Lower Hunter and Central Coast Regional Environmental Mapping Strategy (LHCCREMS) (NPWS 2003);
- Vegetation Mapping of Lake Macquarie LGA: Stages 1-6 (Bell and Driscoll 2015);
- Centennial Mandalong LW22-24a EP Vegetation Communities (Hunter Eco 2016);
- DECC (2007) The Threatened Species Assessment Guideline – The Assessment of Significance;
- Department of Land and Water Conservation (2002) NSW State Groundwater Dependent Ecosystem Policy;
- Eamus, D. (2009) Identifying groundwater dependent ecosystems, a guide for land and water managers. Australian Government – Land and Water Australia;
- Lake Macquarie City Council (2015) The Lake Macquarie City Council Native Vegetation & Corridors 2015 Map 3; and
- Aerial Photograph Interpretation (API).

2.3.2 Biodiversity Databases

A review of relevant information was performed to gain an understanding of ecological values occurring or potentially occurring within the Study Area. Information sources reviewed for a 10 km radius of the Study Area (i.e. locality) included:

- Fauna and flora records contained in the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife that may occur within the locality (OEH 2017); and
- Fauna and flora records contained in the Department of the Environment and Energy (DoEE) Protected Matters Search tool that may occur within the locality (DoEE 2017).

The results of these database searches formed the basis for a preliminary 'likelihood of occurrence' assessment. This assessment was used as a framework for determining investigation methods necessary for performing adequate site investigation (i.e. determine target species and appropriate investigation methods).

2.3.3 Spatial Datasets

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

- Geographic Information System (GIS) data including (but not limited to) aerial photography, topographic maps and soil landscape maps;
- Mitchell Landscapes (NPWS 2003); and
- IBRA Region and subregion mapping (IBRA7).

In addition, the latest aerial photography was inspected to qualitatively appreciate the currency / accuracy of these spatial datasets.

2.3.4 Literature Review

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring in the Study Area and wider region. Reports, vegetation maps, topographic maps, aerial photography and literature reviewed included, but were not limited to, the following:

- *Mandalong Transmission Line TL24 Relocation Project Flora and Fauna Assessment*, Report to Centennial Coal (RPS 2016);
- Lower Hunter and Central Coast Regional Environmental Mapping Strategy (LHCCREMS) (NPWS 2003); and
- Aerial Photograph Interpretation (API).

2.3.5 Likelihood of Occurrence

Five 'likelihood of occurrence' categories, as listed in **Table 1**, were attributed to threatened biodiversity following consideration of habitat descriptions taken from the online Threatened Species Profile Database (TSPD) (OEH 2016a) and relevant vegetation mapping. The likelihood of occurrence assessment is provided in **Appendix 3**.

Table 1 Likelihood of Occurrence of Criteria

Likelihood Category	Threatened Fauna	Threatened Flora
None	Suitable habitat is absent from the Study Area.	
Low	It is unlikely that the species inhabits the study area and has not been recorded in the locality (10km) with the last five years. It may be an occasional visitor, but habitat similar to the Study Area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for breeding or important life cycle periods). Specific habitat is not present in the study area.	It is unlikely that the species inhabits the Study Area despite being recorded in the locality (10km) within the last five years. Habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for important life cycle processes). Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Moderate	Potential habitat is present in the Study Area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the Study Area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.	Potential habitat is present in the Study Area. The species is unlikely to be dependent on habitat within the Study Area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were seasonally targeted by surveys and were not recorded. Recorded in the locality (10km) within the last five years).
High	It is highly likely that a species inhabits the Study Area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the Study Area during regular seasonal movements or migration. Has not been recorded in the locality (10km) within the last five years.	It is highly likely that a species inhabits the Study Area and is dependent on identified suitable habitat (i.e. for reproduction), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the Study Area.
Known	The species was observed during the current survey.	

The preliminary likelihood of occurrence assessment was performed to guide future investigation methods and effort.

2.4 Flora

2.4.1 Existing Vegetation Mapping

The most accurate vegetation map pertaining to the Study Area was the LHCCREMS (NPWS 2003). This was therefore used as the basis for developing a preliminary assessment of likely vegetation patterns within the Study Area. This mapping was not intended to provide an accurate local scale assessment of vegetation patterns (e.g. within the current BioBank site) as it was undertaken using 1:25,000 scale mapping of vegetation boundaries. This mapping is however, suitable for providing a basis for stratification of the Study Area for this study and can also be used to compare local scale vegetation patterns with broader regional patterns. The mapping of LHCCREMS (NPWS 2003) was therefore adopted as a preliminary vegetation map and used for survey stratification and was also subsequently used for comparing the findings of this study with known regional patterns.

2.4.2 BioMetric Plots

BioMetric or BioBanking plots were undertaken in accordance with the BioBanking Operational Manual (OEH 2014) to delineate the corresponding vegetation community Map Unit. Transects and plots were established in each vegetation zone within the Study Area. Transects were used to assess the Study Area attributes that are measured by percent foliage cover while other attributes were assessed by the plots.

Each survey location was selected randomly within each vegetation zone. A 50 m transect was measured from the chosen location. Using the transect as the centre line, a 20 x 20 m plot was then measured. The following attributes were noted from the transect:

- Native over-storey cover;
- Native mid-storey cover;
- Native ground cover (grasses);
- Native ground cover (other); and
- Exotic plant cover.

The following attributes were collected within each plot:

- A list of:
  - Native over-storey species and cover abundance;
  - Native mid-storey species and cover abundance;
  - Native ground cover (grasses) species and cover abundance;
  - Native ground cover (shrubs) species and cover abundance
  - Native ground cover (other) species and cover abundance; and
  - Exotic plant species and cover abundance.
- Over-storey regeneration;
- Fallen logs; and
- Number of hollows.

Fallen logs and hollows were surveyed over a 20 x 50 m area.

A total of 30 BioMetric plots were surveys, 18 having full floristic data with reference with DECC (2004), to ground-truth vegetation communities on the Study Area in line with the FBA guidelines. All flora survey locations are displayed in **Figure 2**.

2.4.3 Flora Quadrats

Thirty 20 x 20 m flora quadrats were undertaken in each vegetation community to note the floristic structure and diversity of each community. Each quadrat was undertaken at the same location of the BioBanking plots for all vegetation communities.

2.4.4 Significant Flora Survey

A list of potentially occurring significant flora species from the locality was compiled, which included threatened species (endangered or vulnerable), populations and threatened ecological communities (TECs), listed under the TSC Act and/or the EPBC Act, Rare or Threatened Australian Plants (ROTAP) listed flora species (Briggs and Leigh 1996), as well as any other species deemed to be of local importance. General searches were undertaken for all threatened flora species known to occur within the locality and in the habitat types present within the Study Area.

Specific searches were undertaken on 26-29th September and 5-6th October 2016 to search for the presence of the cryptic threatened flora *Tetratheca juncea* (Black-eyed Susan) and *Cryptostylis hunteriana* (Leafless Tongue Orchid) within their flowering period (**Table 2** and **Figure 2** below).

Table 2 Known and Potentially Occurring Threatened Flora Flowering Periods

Threatened Flora Species	Recommended Survey Timing	Flowering Period in Months of the Year											
		January	February	March	April	May	June	July	August	September	October	November	December
Tetratheca juncea	Survey only during flowering period									■	■		
Cryptostylis hunteriana	Survey only during flowering period											■	■
Grevillea parviflora subsp. *parviflora*	Survey anytime							■	■	■	■	■	■
Maundia triglochinoides	Survey anytime	■	■										■
Persicaria elatior	Survey anytime	■										■	■
Rutidosis heterogama	Survey anytime			■	■	■							
Angophora inopina	Survey anytime	■											■
Melaleuca biconvexa	Survey anytime										■	■	

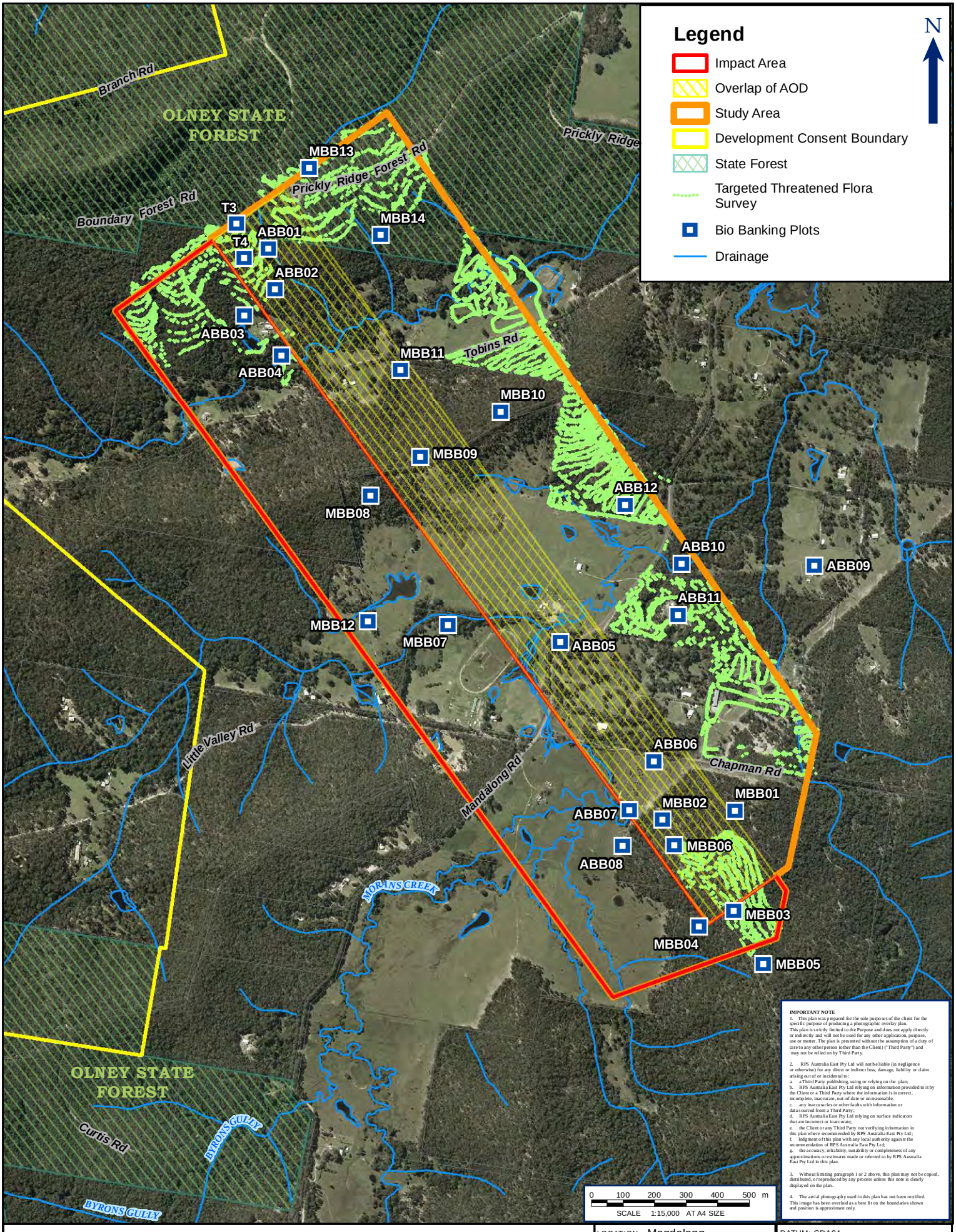

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FIGURE 2: FLORA SURVEY LOCATIONS

LOCATION: Mandalong Longwalls 24-24A	DATUM: GDA94 PROJECTION: MGA Zone 56
JOB NO.: **PR133215** PURPOSE: Bio Inventory Technician: Natalie.Wood Date: 10/04/2017	Data Sources: RPS Client

CLIENT: Centennial Mandalong Pty Ltd

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

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Path: S:\Centennial\All Jobs\133215 Mandalong LW22-23 and LW 24-24a Eco' assesssments\10 - Drafting\Arcgis Map Documents\Eco\LW24-24A\Bio Intentory Figures\133215 LW24-24a Figure 2 Flora Survey C A A4 20170410.mxd

2.5 Fauna

Fauna surveys, involving diurnal and nocturnal techniques, were conducted across the Study Area. The Study Area was traversed on foot and by vehicle; all species and evidence of fauna presence observed were recorded. An inventory of fauna species recorded within Study Area was compiled (**Appendix 2**). Fauna survey locations are displayed on **Figure 3**.

2.5.1 Ground Trapping

Terrestrial trapping was undertaken using Elliott A and Elliott B traps. Elliott traps were baited with a mixture of rolled oats, peanut butter and honey. Traps were checked within two hours of sunrise each morning, with any captures identified and released at point of capture. Traps were re-baited where necessary. The selected locations of the trap lines focused on stratification units as well as areas consisting of understorey that would provide protection for terrestrial mammal species.

Terrestrial traps targeted small terrestrial mammals such as dasyurids (e.g. Antechinus and Dunnarts) and rodents (e.g. rats and mice). A total of five traplines consisting of 20 Elliott A and 20 Elliott B traps were established for five nights (i.e. 500 Elliott A trap nights and 500 Elliott B trap nights).

2.5.2 Arboreal Trapping

Arboreal trapping was undertaken using tree mounted Elliott B size traps. Traps were mounted on brackets set at approximately four metres in height on trees with a diameter at breast height (DBH) greater than 30 cm. Traps were baited with a rolled oats, peanut butter and honey mixture, and the tree trunks were sprayed liberally with a brown sugar and water mix each day in the late afternoon. Traps were checked early each morning. Five transects of six arboreal Elliott B traps were established across the Study Area. Traps were set for five nights in line with Lake Macquarie City Council (LMCC) squirrel glider guidelines, with a total of 150 arboreal Elliott B trap nights.

2.5.3 Hair Tube

Surveys were undertaken using Faunatech Hair Tubes across the Study Area. These were baited with rolled oats, peanut butter and honey. Trees in which arboreal Hair Tubes were erected were sprayed with a brown sugar and water mix. Five hair tube transects containing 10 terrestrial and 10 arboreal traps were established for at least 10 nights totalling 100 ground and 100 arboreal trap nights.

2.5.4 Diurnal Avifauna Survey

The presence of avifauna Study Area was identified through systematic diurnal censuses and opportunistic surveys during all field work. All birds occurring at one location were identified during a 20 minute period. Birds were identified through visual and aural recognition of calls. Three systematic bird censuses were undertaken and a list of opportunistic observations was compiled.

2.5.5 Herpetofauna Surveys

Opportunistic and targeted herpetofauna searches were conducted across the Study Area encompassing a diversity of habitats. Herpetofauna searches involved inspecting rock crevices, raking leaf litter and turning logs, rocks and other debris.

2.5.6 Harp Traps

Three Harp Traps were set up for a five night period, each in conjunction with an Elliott Trap line. One harp trap was positioned in each of the major habitat types; Dry Sclerophyll Forest (Shrubby), Wet Sclerophyll Forest (Shrubby) and Forested Wetlands (see **Figure 3**).

2.5.7 Spotlighting

Spotlighting during nocturnal surveys was undertaken to identify nocturnal fauna species and roosting birds. Spotlighting was undertaken across the Study Area via the use of 75-Watt hand-held spotlights and head torches during walking and/or from a vehicle. Two spotlight nights were undertaken at each ground trapping location within the Study Area.

2.5.8 Call Playback

Call-playback was undertaken for aural recognition of threatened owls and nocturnal fauna. Pre-recorded calls of owl and mammal species with the potential to occur within the Study Area were broadcast in an effort to elicit vocal responses or to attract nocturnal fauna to the playback site. The calls were broadcast through an amplification system (a hand held megaphone) designed to project the sound for at least one kilometre under still night conditions. As described by Kavanagh and Peake (1993) and Debus (1995), the call of each species was broadcast for at least five minutes, followed by five minutes of listening, and stationary spotlighting. Following the final broadcast and listening, the area was spotlighted on foot. Call-playback was undertaken across two survey nights at two locations.

2.5.9 Infrared Camera Surveys

Infrared cameras were set up in suitable habitat within the Study Area. The cameras are designed to detect motion and take photographs when movement triggers the sensor. Target species included the Spotted-tailed Quoll (*Dasyurus maculatus maculatus*). Infrared cameras were established at five sites within the Study Area over at least ten nights.

2.5.10 Koala Spot Assessment Technique

Koala surveys and habitat assessments were undertaken during 26-29th September and 5-6th October 2016. The Koala Spot Assessment Technique (SAT) methodology as described by Phillips and Callaghan (2011) was conducted within the Study Area. One SAT, sampling 30 mature trees, was conducted within the Study Area. The SATs were used to measure Koala activity levels and establish the extent of habitat utilisation within the Study Area.

2.5.11 Secondary Indications and Incidental Observations

Opportunistic sightings of indirect evidence of fauna presence of resident fauna were noted. Such indicators included:

- Scats and scents (predator scats were collected for contents analysis);
- Nests;
- Burrows;
- Feather, fur remains, skin and skeletal material of vertebrate fauna;
- Tracks, scratches and diggings;
- Whitewash, regurgitation pellets and prey remains from owls; and
- Chewed *Allocasuarina* cones indicative of feeding by *Calyptorhynchus lathami* (Glossy Black-cockatoo).

2.5.12 Habitat Survey

An assessment of the relative habitat value present within the Study Area was undertaken. This assessment focused primarily on the identification of specific habitat types and resources in the Study Area favoured by known threatened species from the region. The assessment also considered the potential value of the Study Area (and surrounds) for all major guilds of native flora and fauna. Habitat assessment included:

- Presence, size and types of tree hollows;

- Presence of rocks, logs, caves, rocky outcrops, leaf litter, overhangs and crevices;
- Vegetation complexity, structure and quality;
- Presence of freshwater or estuarine aquatic habitats, noting permanency;
- Connectivity to adjacent areas of habitat;
- Extent and types of disturbance;
- Presence of foraging opportunities such as flowering eucalypts, fruits, seeds or other nectar bearing native plants; and
- Presence and abundance of various potential prey species.

Habitat assessment was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

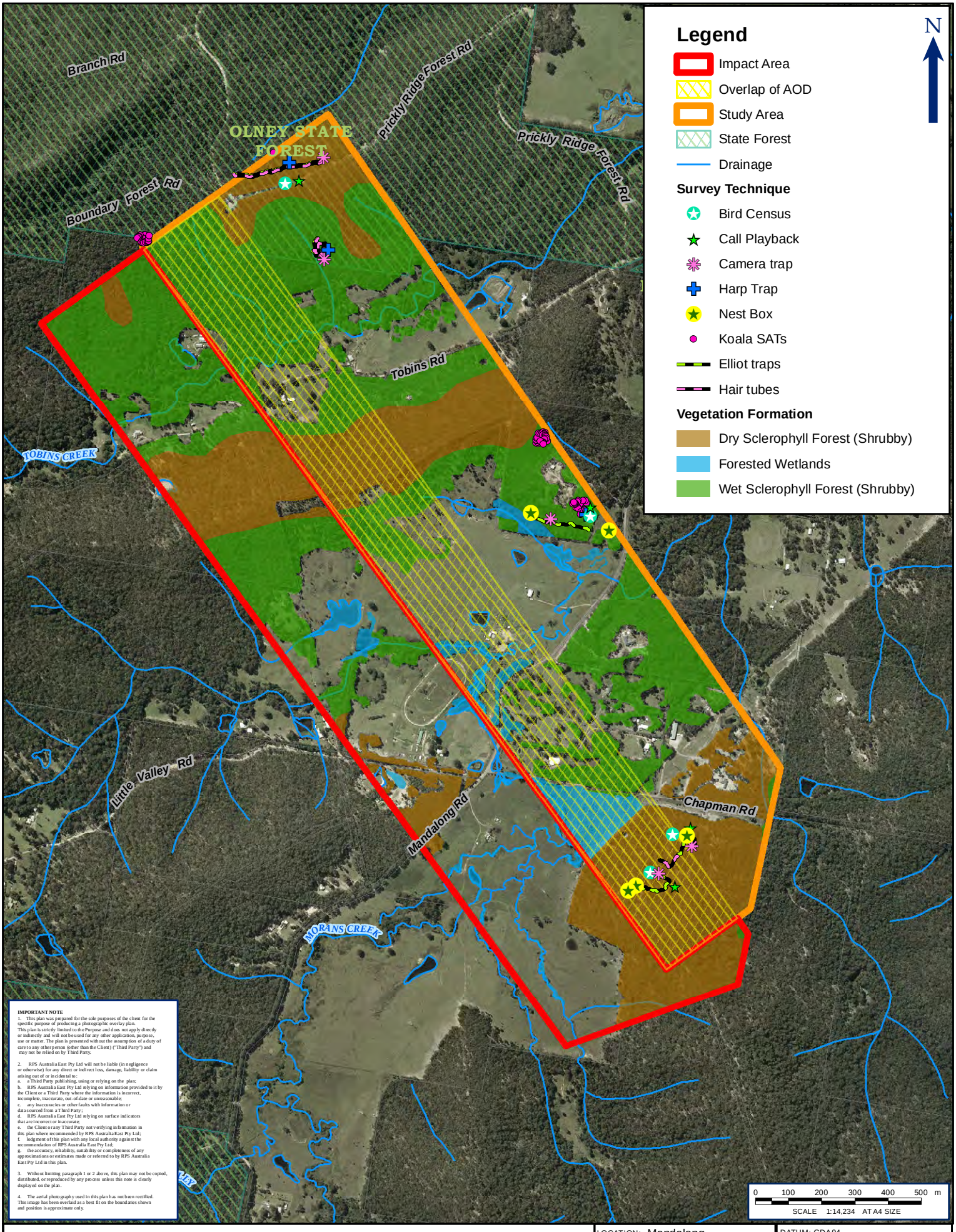

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Figure 3: Fauna Survey Locations

LOCATION: Mandalong Longwalls 24-24a	DATUM: GDA94 PROJECTION: MGA Zone 56
JOB NO.: **PR133215** PURPOSE: Bio Inventory Technician: kieran.marshall Date: 27/04/2017	Data Sources: RPS Client LMCC

CLIENT: Centennial Mandalong Pty Ltd

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2.6 Limitations

2.6.1 Access

Surveys were partially restricted by landholder access. This matter was largely overcome by the use of sampling in accordance with stratification units. Spatial representativeness was preserved, where possible, to minimise the effects of landholder access constraints. No threatened species searches were performed where landholder access constraints exist.

2.6.2 Seasonality

Prior to field surveys, eight flora species were identified as being known, or as having the potential to occur within the Study Area. Two of those species, namely *Tetratheca juncea* and *Cryptostylis hunteriana*, required surveys to be undertaken during their respective flowering seasons. Therefore, in order to maximise the potential of finding these species within the Study Area, flowering seasons were identified in **Table 2** and field surveys were conducted accordingly. Similarly, some fauna species that have been recorded in the local area occur on a seasonal or migratory basis. Subsequently, with regards to fauna, some may be absent from the locality for much for the year. Fauna behaviours may have also affected detectability; species that are easily disturbed or cryptic may not have been detected during surveys. It is possible that a number of flora and fauna species occurring in the Study Area were not detected during the current survey due to the above factors.

These potential limitations have been addressed by a thorough literature research and review and through identification of potential habitats for flora and fauna species and assessment of the potential for targeted species to occur on the site based on:

- Previous records;
- The type and condition of habitats present;
- The land use throughout the Study Area and surrounds; and
- The landscape context.

The precautionary principle was applied where marginal habitat was identified or predicted to occur or where species are migratory or nomadic and were therefore likely to utilise habitat components at some stage during their life cycle.

2.6.3 Bat Detection

Bat surveys were undertaken with Harp traps but ANABAT echolocation recording devices were not utilised. Bats that had recently been recorded within and near the Study Area, including in past RPS surveys (See 3.2) were assumed to be present.

2.6.4 Data Availability and Accuracy

The collated threatened flora and fauna species records provided by NSW Atlas of Wildlife Database for the region are known to vary in accuracy and reliability. Traditionally this is due to the reliability of information provided to the NSW Atlas of Wildlife Database for collation and/or the need to protect specific threatened species locations. For the purposes of this report this information has been considered to have an accuracy of ± one kilometre.

Threatened flora and fauna records within the region were predominantly sourced from the NSW Atlas of Wildlife Database and an EPBC Protected Matters Search. Similar limitations are known to exist with regards to these data sources and their accuracy.

Data recorded by RPS during the survey period, has been gathered with a Trimble Differential GPS unit, which is capable of sub-metre accuracy following post processing.

3.0 Results

3.1 Desktop Research

3.1.1 Database Interrogation – Species

21 threatened flora species and 55 threatened fauna species may occur in the Study Area.

The results of database searches using the National Parks and Wildlife Services (NPWS) Atlas of NSW Wildlife (Accessed February 2017) and the EPBC Act Protected Matters Search (Accessed February 2017) indicated that 21 threatened flora species and 55 threatened fauna species have been previously recorded and/or have potential habitat within 10 km of the Study Area. These species are listed in **Table 3** below.

Table 3 Threatened Flora and Fauna Species within a 10km radius

Scientific Name	Common Name	TSC Act	EPBC Act	No. of Records
Flora				
Acacia bynoeana	Bynoe's Wattle	E	V	-
Angophora inopina	Charmhaven Apple	V	V	197
Asterolasia elegans	-	E	E	-
Caladenia tessellata	Thick-lipped Spider Orchid	E	V	-
Corunastylis insignis	Wyong Midge Orchid 1	CE	CE	-
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	-
Eucalyptus camfieldii	Camfield's Stringybark	V	V	-
Genoplesium baueri	Yellow Gnat-orchid	E	E	-
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	10
Maundia triglochinoides	-	V	-	5
Melaleuca biconvexa	Biconvex Paperbark	V	V	206
Pelargonium sp. striatellum	Omeo Stork's-bill	E	E	
Persicaria elatior	Tall Knotweed	V	V	1
Pterostylis gibbosa	Illawarra Greenhood	E	E	-
Rhizanthella slateri	Eastern Underground Orchid	V	E	-
Rutidosis heterogama	Heath Wrinklewort	V	V	6
Senna acclinis	Rainforest Cassia	E	-	13
Syzygium paniculatum	Magenta Lilly Pilly	E	V	2
Tetratheca juncea	Black-eyed Susan	V	V	170
Thelymitra adorata	Wyong Sun Orchid	CE	CE	-
Thesium australe	Austral Toadflax	V	V	-
Amphibians				
Heleioporus australiacus	Giant Burrowing Frog	V	V	4
Litoria aurea	Green and Golden Bell Frog	E	V	1
Litoria brevipalmata	Green-thighed Frog	V	-	12

Scientific Name	Common Name	TSC Act	EPBC Act	No. of Records
Litoria littlejohni	Littlejohn's Tree Frog	V	V	31
Mixophyes balbus	Stuttering Frog	V	V	92
Mixophyes iteratus	Giant Barred Frog	E	V	38
Pseudophryne australis	Red-crowned Toadlet	V	-	56
Reptiles				
Hoplocephalus stephensii	Stephens' Banded Snake	V	-	10
Hoplocephalus bungaroides	Broad-headed Snake	E	V	-
Avifauna				
Anthochaera phrygia	Regent Honeyeater	CE	CE	3
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	3
Botaurus poiciloptilus	Australian Bittern	E	E	-
Burhinus grallarius	Bush Stone-curlew	E	-	4
Calidris ferruginea	Curlew Sandpiper	-	CE	-
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	-
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	99
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	3
Daphoenositta chrysoptera	Varied Sittella	V	-	16
Dasyornis brachypterus	Eastern Bristlebird	E	E	-
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	16
Glossopsitta pusilla	Little Lorikeet	V	-	11
Grantiella picta	Painted Honeyeater	V	V	-
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	C	1
Irediparra gallinacea	Comb-crested Jacana	V	-	2
Lathamus discolor	Swift Parrot	E	CE	-
Limosa lapponica baueri	Bar-tailed Godwit	-	V	-
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit	-	CE	-
Lophoictinia isura	Square-tailed Kite	V	-	2
Neophema pulchella	Turquoise Parrot	V	-	3
Ninox strenua	Powerful Owl	V	-	38
Numenius madagascariensis	Eastern Curlew	-	CE	-
Pachyptila turtur subantarctica	Fairy Prion	-	V	-
Rostratula australis	Australian Painted Snipe	E	E	-
Tyto novaehollandiae	Masked Owl	V	-	7
Tyto tenebricosa	Sooty Owl	V	-	72
Mammals				
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	3

Scientific Name	Common Name	TSC Act	EPBC Act	No. of Records
Dasyurus maculatus	Spotted-tailed Quoll	V	E	20
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	7
Kerivoula papuensis	Golden-tipped Bat	V	-	33
Macropus parma	Parma Wallaby	V	-	7
Miniopterus australis	Little Bentwing-bat	V	-	19
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	31
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	14
Myotis macropus	Southern Myotis	V	-	18
Petauroides volans	Greater Glider	-	V	126
Petaurus australis	Yellow-bellied Glider	V	-	381
Petaurus norfolcensis	Squirrel Glider	V	-	7
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	7
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	2
Phascolarctos cinereus	Koala	V	V	10
Potorous tridactylus	Long-nosed Potoroo	V	V	4
Pseudomys novaehollandiae	New Holland Mouse	-	V	2
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	58
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	1
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	14

Key:
V Vulnerable
E Endangered
CE Critically Endangered

Migratory terrestrial and wetland species listed under the EPBC Act have also been considered in this assessment. A Protected Matters Search was undertaken (accessed February 2017) which lists potential migratory species. **Table 4** displays the potentially occurring migratory species within a 10 km radius of the Study Area.

Table 4 Potentially Occurring Migratory Species within a 10 km radius

Scientific Name	Common Name	EPBC Act Status
Apus pacificus	Fork-tailed Swift	M
Cuculus optatus	Oriental Cuckoo	M
Hirundapus caudacutus	White-throated Needletail	M
Monarcha melanopsis	Black-faced Monarch	M
Monarcha trivirgatus	Spectacled Monarch	M
Motacilla flava	Yellow-wagtail	M
Myiagra cyanoleuca	Satin Flycatcher	M
Rhipidura rufifrons	Rufous Flycatcher	M
Calidris ferruginea	Curlew Sandpiper	CE
Gallinago hardwickii	Latham's Snipe	M

Scientific Name	Common Name	EPBC Act Status
Limosa lapponica	Bar-tailed Godwit	M
Numenius madagascariensis	Eastern Curlew	CE
Pandion haliaeetus	Osprey	M
Pluvialis fulva	Pacific Golden Plover	M
Tringa nebularia	Common Greenshank	M

Key:
M Migratory
CE Critically Endangered

3.1.2 Database Interrogation – Threatened Ecological Communities

Seven threatened ecological community (TECs) occur within the greater Mandalong area namely:

- Lower Hunter Spotted Gum-Ironbark Forest in the Sydney Basin Bioregion;
- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions;
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Swamp oak floodplain forest of 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; and
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Bell (2016) vegetation mapping indicates the presence of some of these TECs within the Study Area.

3.2 Literature Review

A number of ecological studies previously conducted within and near the Study Area were reviewed with regard to survey timing, methodology, effort and results. A summary of the methods and results of these studies is provided below.

3.2.1 Hunter Eco 2008

The Hunter Eco (2008) report was prepared to support a Review of Environmental Factors (REF) for Centennial Mandalong to conduct an exploration drilling program in an area of approximately 4,170 ha. The Hunter Eco (2008) REF Study Area occurs to the immediate north of the current Study Area (EL 6317).

Methods

Hunter Eco (2008) undertook vegetation mapping and targeted threatened flora surveys within the REF boundary. Vegetation mapping surveys employed the Rapid Data Point (RDP) technique, with a total of 400 ground-truthed RDPs undertaken. These surveys were supplemented by literature reviews of relevant work undertaken in the area and database searches.

Vegetation Communities

Hunter Eco (2008) identified 11 vegetation communities as occurring on site, of which six were determined as being commensurate with Endangered Ecological Communities (EECs) listed under the TSC Act (see **Table 5**).

Table 5 LHCCREMS Vegetation Communities (Hunter Eco 2008)

Mapped Community (LHCCREMS Map Unit name, NPWS 2000)	Listed EEC (TSC Act)
MU 1a: Coastal Warm Temperate – Subtropical Rainforest	*Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions*
MU 5: Alluvial Tall Moist Forest	*River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*
MU 37: Swamp Mahogany – Paperbark Forest	*Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*
MU 38: Redgum Rough-barked Apple Forest	*River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*
MU 42: Riparian Melaleuca Swamp Woodland	*Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*
MU 46: Freshwater Wetland Complex	*Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*

Flora

Hunter Eco (2008) recorded five species of threatened flora in the 2008 REF boundary, namely:

- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea);
- *Melaleuca biconvexa* (Biconvex Paperbark);
- *Maundia triglochinoides*;
- *Rutidosis heterogama*; and
- *Tetratheca juncea* (Black-eyed Susan).

Fauna

Hunter Eco (2008) recorded nine species of threatened fauna in the REF boundary, namely:

- Giant Barred Frog (*Mixophyes iteratus*);
- Wallum Froglet (*Crinia tinnula*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Little Bentwing-bat (*Miniopterus australis*);
- East Coast Freetail-bat (*Mormopterus norfolkensis*);
- Squirrel Glider (*Petaurus norfolcensis*);
- Yellow-bellied Glider (*Petaurus australis*);
- Powerful Owl (*Ninox strenua*); and
- Gang-gang Cockatoo (*Callocephalon fimbriatum*).

3.2.2 Hunter Eco 2009

This Hunter Eco (2009) report was prepared for Centennial Mandalong to extend their exploration drilling program in the Mandalong Southern Extension Area within EL 6317. The exploration area encompassed a new area of approximately 4,467 ha (Hunter Eco 2009) which covered an area of similar extent to the current Study Area for the Project.

Vegetation Communities

Hunter Eco (2009) identified 11 vegetation communities as occurring with five deemed commensurate with EECs listed under the TSC Act (**Table 6**).

Table 6 LHCCREMS Vegetation Communities (Hunter Eco 2009)

Mapped Community (LHCCREMS Map Unit name, NPWS 2000)	Listed EEC (TSC Act)
MU 1: Coastal Wet Gully Forest	*Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions*
MU 5: Alluvial Tall Moist Forest	*River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*
MU 17a: Lower Hunter Spotted Gum - Ironbark Forest	*Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion*
MU 41: Swamp Oak Sedge Forest	*Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions*
MU 42: Riparian Melaleuca Swamp Woodland	*Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*

Flora

Hunter Eco (2009) recorded three threatened flora species in the REF boundary. These species were:

- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea);
- *Melaleuca biconvexa* (Biconvex Paperbark); and
- *Tetratheca juncea* (Black-eyed Susan).

Fauna

Hunter Ecology (2009) recorded sixteen threatened fauna species in the REF area, namely:

- Green and Golden Bell Frog (*Litoria aurea*);
- Green-thighed Frog (*Litoria brevipalmata*);
- Stuttering Frog (*Mixophyes balbus*);
- Giant Barred Frog (*Mixophyes iterates*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Golden-tipped Bat (*Phoniscus papuensis*);
- Southern Myotis (*Myotis adversus*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Squirrel Glider (*Petaurus norfolcensis*);
- Yellow-bellied Glider (*Petaurus australis*);
- Powerful Owl (*Ninox strenua*);
- Masked Owl (*Tyto novaehollandiae*);
- Sooty Owl (*Tyto tenebricosa*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Glossy Black-Cockatoo (*Calyptorhynchus lathami*); and
- Regent Honeyeater (*Anthochaera phrygia*).

3.2.3 RPS 2013

The RPS (2013) Flora and Fauna Assessment Report was prepared for Centennial Mandalong as part of an Environmental Impact Statement to extend underground mining operations south into the area covered by Exploration Licence 6317 (EL 6317).

Vegetation Communities

Vegetation surveys and ground-truthing determined that existing mapping by Hunter Eco (2008; 2009) and NPWS (2003) was relatively accurate. Some modifications were made to the community boundaries following ground-thruthed data and API. Occasionally, areas were remapped as different communities, particularly MU1 actually occurring as MU5. In total, 11 native vegetation types and one highly modified vegetation community were mapped totalling 4,613 ha, four of which correspond with EECs as listed under the TSC Act (**Table 7**).

Table 7 Vegetation Communities Confirmed within the Study Area

Vegetation Community Name	Analogous to NPWS (2003) Map Unit	Corresponds to TSC Act EEC
Coastal Wet Gully Forest	MU 1	*Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions*
Alluvial Tall Moist Forest	MU 5	-
Coastal Narrabeen Moist Forest	MU 6	-
Coastal Ranges Open Forest	MU 9	-
Coastal Foothills Spotted Gum - Ironbark Forest	MU 15	-
Lower Hunter Spotted Gum - Ironbark Forest	MU	*Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion.*
Coastal Plains Smooth-barked Apple Woodland	MU 30	-
Coastal Plains Scribbly Gum Woodland	MU 31	-
Swamp Oak Sedge Forest	MU 41	*Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions*
Riparian Melaleuca Swamp Woodland	MU 42	*Swamp Sclerophyll Forest of the Floodplains of the North Coast, Sydney Basin and Southeast Corner Bioregions*
Wyong Paperbark Swamp Forest	MU 43	-
Cleared / Disturbed Land	none	-

Flora

RPS (2013) recorded three species of threatened flora

- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea);
- *Melaleuca biconvexa* (Biconvex Paperbark); and
- *Tetratheca juncea* (Black-eyed Susan).

Fauna

RPS (2013) recorded nine species of threatened fauna

- Glossy Black-Cockatoo (*Calyptorhynchus lathami*);

- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Powerful Owl (*Ninox strenua*);
- Varied Sittella (*Daphoenositta chrysoptera*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Yellow-bellied Glider (*Petaurus australis*);
- Little Bentwing-bat (*Miniopterus australis*); and
- Golden-tipped Bat (*Phoniscus papuensis*).

3.2.4 RPS 2016

RPS Australia East Pty Ltd (RPS) prepared a Flora and Fauna Assessment (FFA) to assess the impacts associated with the Mandalong Transmission Line (TL) 24 Relocation Project (RPS 2016).

Vegetation Communities

Vegetation surveys and ground-truthing determined that existing mapping by Hunter Eco (2008; 2009) and NPWS (2003) (LHCCREMS) was relatively accurate. Some modifications were made to the boundaries of communities in specific areas using the ground-truthed data and API. In total, three native vegetation types and one highly modified (cleared) vegetation community exist, none of which correspond with any EECs as listed under the TSC Act or EPBC Act (see **Table 8**).

LHCCREMS terminology was used to standardise the descriptions of the vegetation communities with respect to previous vegetation mapping. This standardisation enables comparison with regional data and all prior surveys. A total of 103 flora species were identified.

Table 8 Vegetation Communities confirmed within the Study Area

Vegetation Community Name	Analogous to LHCCREMS Map Unit	Corresponds to TSC Act EEC
Alluvial Tall Moist Forest	MU 5	-
Coastal Narrabeen Moist Forest	MU 6	-
Coastal Foothills Spotted Gum - Ironbark Forest	MU 15	-
Cleared / Disturbed Land	none	-

Flora

RPS (2016) did not record any threatened flora during surveys for the TL24 Transmission Line.

Fauna

RPS (2016) recorded nine species of threatened fauna, including:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Yellow Bellied Glider (*Petaurus australis*);
- Little Bentwing Bat (*Miniopterus australis*); and
- East Coast Free-tailed Bat (*Mormopterus norfolkensis*).

3.3 Weather Conditions

A breakdown of the weather conditions for every day that flora and fauna surveys were undertaken within the Study Area is provided in **Table 9**.

Table 9 Weather Conditions During Survey Period

Date	Temp Min-Max (°C)	Rain (24 hrs to 9:00am) (mm)	Sun Rise - Sun Set	Surveys Undertaken										
				BioBanking Plots	Koala SAT	Elliot Traps / Hair Tubes [1]	Targeted Flora Survey	Bird Census	Herpetofauna Search	Spotlighting	Call Playback	Camera [1]	Opportunistic Surveys	Harp Trapping
26/09/2016	84.-22.6	5.0	0608-1823		X		X							
27/09/2016	6.3-24.4	0	0607-1824		X		X							
28/09/2016	4.1-21.8	0	0605-1824		X		X							
29/09/2016	6.6-19.7	1.0	0604-1825		X		X							
5/10/2016	12.6-23.6	0	0556-1829		X		X							
6/10/2016	8.2-29.1	0	0555-1830		X		X							
9/10/2016	13.0-25.9	1.0	0551-1832	X		X			X			X	X	X
10/10/2016	10.7-33.8	0	0549-1833	X		X			X			X	X	X
11/10/2016	10.4-21,7	2.0	0548-1834	X		X		X	X	X	X	X	X	X
12/10/2016	3.4-22.4	0	0547-1834	X		X		X	X	X	X	X	X	X
13/10/2016	9.4-17.3	0	0546-1835	X		X			X			X	X	X
14/10/2016	6.3-19.9	2.0	05441836	X		X			X			X	X	X
2/02/2017	21.5-27.6	4.0	0548-1927	X										
3/02/2017	21.3-25.3	1.0	0549-1927	X										
10/02/2017	18.9-38.9	0	0556-1921	X										

Source: Geoscience Australia website:
http://www.ga.gov.au/bin/geodesy/run/sunrisenset
Bureau of Meteorology Website:
http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=2016&p_c=-753622958&p_stn_num=061385
http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=122&p_display_type=dailyDataFile&p_startYear=2016&p_c=-754283172&p_stn_num=061412
http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=123&p_display_type=dailyDataFile&p_startYear=2016&p_c=-754283368&p_stn_num=061412

3.4 Flora

3.4.1 Existing Vegetation Mapping

Vegetation types of the Study Area were previously mapped and described by NPWS (2003). Five vegetation communities were mapped within the Study Area, as listed below:

- MU 1 Coastal Wet Gully Forest;
- MU 5 Alluvial Tall Moist Forest;
- MU 12 Hunter Valley Moist Forest;
- MU 15 Coastal Foothills Spotted Gum – Ironbark Forest; and

[1] Hair tubes and cameras from 9/10/2016-6/12/2016

- MU 17 Lower Hunter Spotted Gum – Ironbark Forest.

Subsequent vegetation mapping performed by Bell (2016) resulted in additional vegetation communities being described and mapped. Those occurring within the Study Area, as delineated by this recent mapping project, have been used as the basis for stratifying field surveys in this investigation. Field validated vegetation communities using the Bell (2016) nomenclature are outlined in the following section.

3.4.2 Plant Community Types

A field validated vegetation community map based on Bell (2016) for the Study Area is provided in **Figure 4**. Vegetation communities and their corresponding area within the Study Area is provided in **Table 10**. MU 46 is here reclassified as a derived form of MU 5, which for the purpose of this report is referred to as MU 5 'XXX', as evidenced by scattered *Melaleuca biconvexa* (Biconvex Paperbark) and the likelihood this the pre-European vegetation cover was previously vegetated open forest and did not constitute a wetland complex.

Table 10 Vegetation within the Study Area

Vegetation Map Unit Number (MU) and Description	Total Area (ha)
MU 1 Coastal Wet Gully Forest	3.2
MU 5 Alluvial Tall Moist Forest	8.4
MU 5 derived Alluvial Tall Moist Forest	0.6
MU 5XXX Alluvial Tall Moist Forest	0.8
MU 12c Hunter Valley Moist Spotted Gum – Ironbark Forest	17.8
MU 15 Coastal Foothills Spotted Gum – Ironbark Forest	1.0
MU 15n Jilliby Spotted Gum – Ferguson's Ironbark – Mahogany Forest	17.4
MU 15m Jilliby Spotted Gum – Northern Ironbark Forest – Mahogany Forest	6.1
MU 46 Freshwater Wetland Complex	1.8
17o Hinterland Spotted Gum – Red Ironbark Forest	0.5
Cleared and Disturbed Lands	49.6
Dams/water bodies	0.5
Total	**107.7**

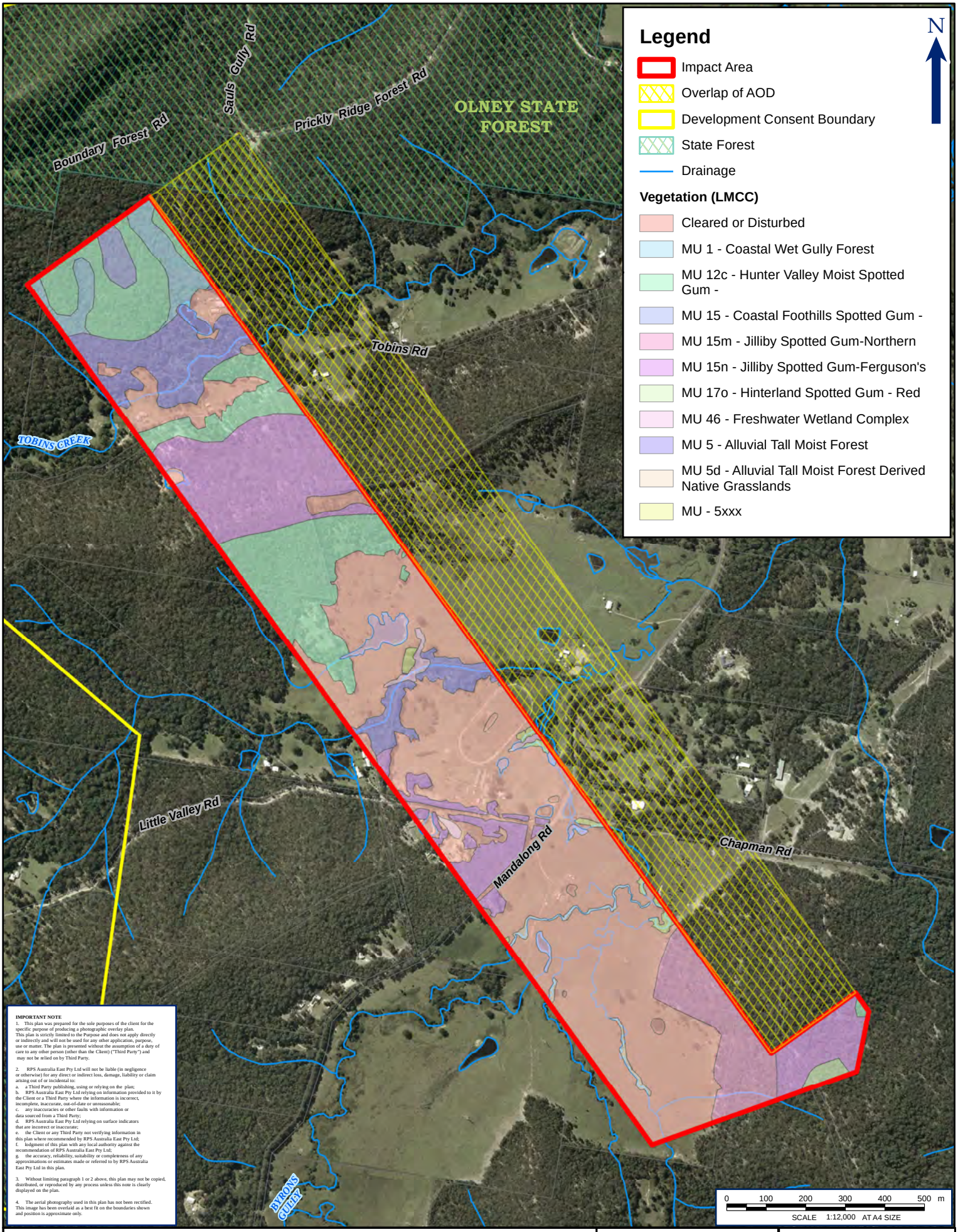
3.5 Threatened Ecological Communities

Three threatened ecological communities exist within the Study Area, one of which is present in both a natural and derived form, as indicated in **Table 11**. These communities align to sections of MU 5 (Alluvial Tall Moist Forest) which contains two separate EEC's within the Study Area, and to MU 17o (Hinterland Spotted Gum – Red Ironbark Forest).

Table 11 Threatened Ecological Communities

Vegetation Map Unit Number (MU) and Description	Corresponding EEC	Total Area (ha)
MU 5 Alluvial Tall Moist Forest	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	8.4
MU 5 derived Alluvial Tall Moist Forest	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion	0.6
MU 5XXX Alluvial Tall Moist Forest	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion	0.8
17o Hinterland Spotted Gum – Red Ironbark Forest	Lower Hunter Spotted Gum Ironbark Forest	0.5
Total		**10.3**

Profiles of all vegetation communities are provided below.



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   e. the Client or any Third Party not verifying information in this plan where recommended by RPS Australia East Pty Ltd;
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   g. the accuracy, reliability, suitability or completeness of any approximations or estimates made or referred to by RPS Australia East Pty Ltd in this plan.

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

Figure 4: Vegetation Communities

LOCATION: Mandalong Longwalls 24-24A	DATUM: GDA94 PROJECTION: MGA Zone 56
JOB NO.: **PR133215** PURPOSE: Bio Inventory Technician: kieran.marshall Date: 13/04/2017	Data Sources: RPS Client

CLIENT: Centennial Mandalong Pty Ltd

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

Path: S:\Centennial\All Jobs\133215 Mandalong LW22-23 and LW 24-24a Eco' assesssments\10 - Drafting\Arcgis Map Documents\Eco\LW24-24A\Bio Intentory Figures\133215 LW24-24a Figure 4 Veg Communities B A4 20170410.mxd

Coastal Wet Gully Forest (MU 1)

Plate 1 Coastal Wet Gully Forest

Canopy Layer: 22 to 35 m – 60 to 75% Percentage Foliage Cover (PFC). Dominant species were *Eucalyptus saligna* (Sydney Bluegum), *Syncarpia glomulifera* (Turpentine), *Angophora floribunda* (Rough-barked Apple) and *Eucalyptus acmenoides* (White Mahogany).

Sub-canopy Layer: 10 to 18 m – 35 to 50% Percentage Foliage Cover (PFC). Dominated by *Rhodamnia rubescens* (Brush Turpentine), *Backhousia myrtifolia* (Grey Myrtle), Callistemon *salignus* (Willow Bottlebrush), *Acmena smithii* (Lilly Pilly), *Glochidion ferdinandi* (Cheese Tree), *Melaleuca linariifolia* (Flax-leaved Paperbark) and *Allocasuarina torulosa* (Forest Oak).

Ground Layer: To 1.5 m – 15 to 20% Percentage Foliage Cover (PFC). Dominant species included *Oplismenus imbecilis* (Basket Grass), *Gahnia clarkei* (Tall Saw-sedge), *Adiantum aethiopicum* (Common Maidenhair), *Doodia aspera* (Rasp Fern) and *Dioscorea transversa* (Native Yam). Other species detected included *Lomandra longifolia* (Spiny-headed Mat-rush), *Imperata cylindrica* (Blady Grass) and *Calochlaena dubia* (False Bracken).

Classification: This community does correspond to an EEC known as *Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions*, which is listed under the TSC Act.

Alluvial Tall Moist Forest (MU 5)

Plate 2 Alluvial Tall Moist Forest

Canopy Layer: 20 to 30 m – 40% to 50% Percentage Foliage Cover (PFC). Dominant species are *Eucalyptus pilularis* (Blackbutt), *Eucalyptus acmenoides* (White Mahogany), *Syncarpia glomulifera* (Turpentine), *Eucalyptus propinqua* (Small-fruited Grey Gum), *Corymbia maculata* (Spotted Gum) and *Eucalyptus umbra* (Broad-leaved White Mahogany).

Sub-canopy Layer: 8 to 15 m – 30% to 40% PFC. Dominated by; *Glochidion ferdinandi* (Cheese Tree), *Melaleuca stypheloides* (Prickly-leaved Tea-tree), *Backhousia myrtifolia* (Grey Myrtle), *Callistemon salignus* (Willow Bottlebrush), *Acmena smithii* (Lilly Pilly), *Allocasuarina torulosa* (Forest Oak), and *Acacia longifolia* (Sydney Golden Wattle).

Ground Layer: To 1.5 m (mostly to 1.0 m) – 40% to 60% PFC. Dominant species includes *Adiantum aethiopicum* (Common Maidenhair), *Imperata cylindrica* (Blady Grass), *Entolasia stricta* (Panic), *Lomandra longifolia* (Spiky-headed Mat-rush), *Oplismenus imbecilis* (Basket Grass), *Pratia purpurascens* (Whiteroot), *Dichondra repens* (Kidney Weed), *Pteridium esculentum* (Bracken), *Doodia aspera* (Rasp Fern) and *Calochlaena dubia* (False Bracken).

Classification: Corresponds with *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* EEC listed under the TSC Act.

Derived Alluvial Tall Moist Forest, River-flat Variant (MU 5 derived)

Canopy Layer: Absent with the exception of dense aggregations of *Melaleuca biconvexa* (Biconvex Paperbark).

Ground Layer: <1 m upper height and a mean of 95% PFC. Dominant species included *Ludwigia peploides* subsp *montevidensis* (Water Primrose), *Paspalum distichum* (Knotgrass), *Eleocharis sphacelata* (Tall Spike Rush), *Juncus usitatus* (Soft Rush), *Persicaria decipiens* (Slender Knotweed), *Maundia triglochinoides*, and *Cyperus odoratus* (Flagrant Flatsedge).

Classification: Corresponds with *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion* EEC, listed under the TSC Act.

Melaleuca biconvexa Swamp Mahogany open forest (MU 5 'XXX')

Canopy Layer: 5 to 12 m –45% mean Percentage Foliage Cover (PFC). Dominant species include; *Eucalyptus tereticornis* (Forest Redgum), *Eucalyptus robusta* (Swamp Mahogany), and *Melaleuca biconvexa* (Biconvex Paperbark).

Ground Layer: <1 m upper height and a mean of 95% PFC. Dominant species included *Ludwigia peploides* subsp *montevidensis* (Water Primrose) and *Paspalum distichum* (Knotgrass), *Eleocharis sphacelata* (Tall Spike Rush), *Juncus usitatus* (Soft Rush), *Persicaria decipiens* (Slender Knotweed), *Maundia triglochinoides*, and *Cyperus odoratus* (Flagrant Flatsedge).

Classification: Corresponds with *Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion* EEC, listed under the TSC Act.

Hunter Valley Moist Spotted Gum – Ironbark Forest (MU12c)

Plate 3 Hunter Valley Moist Spotted Gum – Ironbark Forest

Canopy Layer: 18 to 25 m – 25% to 45% Percentage Foliage Cover (PFC). Dominant species are *Corymbia maculata* (Spotted Gum), *Eucalyptus punctata* (Grey Gum), *Eucalyptus siderophloia* (Northern Grey Ironbark), *Angophora floribunda* (Rough-barked Apple), *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Syncarpia glomulifera* (Turpentine).

Sub-canopy Layer: 3.2 to 13m – 15% to 35% PFC. Dominated by; *Allocasuarina torulosa* (Forest Oak), *Brachychiton populneus* (Kurrajong), *Melaleuca stypheloides* (Prickly Paperbark), *Sigesbeckia orientalis* (St Paul's-wort), *Rapanea variabilis* (Muttonwood), *Breynia oblongifolia* (Coffee Bush), and *Maytenus silvestris* (Narrow-leaved Orange Bark).

Ground Layer: To 1.5 m (mostly to 1.0 m) –20% to 80% PFC. Dominant species includes *Adiantum aethiopicum* (Common Maidenhair), *Pratia purpurascens* (White Root), *Entolasia marginata* (Margined Panic), *Dichondra repens* (Kidney Weed), *Oplismenus aemulus* (Basket Grass), *Pratia purpurascens* (Whiteroot*), Dichondra repens* (Kidney Weed), *Plectranthus parviflorus* (Little Spurflower) and *Desmodium varians* (Slender Ticktrefoil).

Classification: This community does not correspond to any EEC as listed under the TSC Act or EPBC Act.

Coastal Foothills Spotted Gum – Ironbark Forest (MU 15)

Plate 4 Coastal Foothills Spotted Gum - Ironbark Forest

Description: This is a moderately tall open forest known to be dominated by Spotted Gum (*Corymbia maculata*) and several ironbark species.

Canopy Layer: 20 m mean upper height and a mean of 60% PFC. The dominant canopy species included *Corymbia maculata* (Spotted Gum) with *Eucalyptus siderophloia* (Northern Grey Ironbark), and *Eucalyptus umbra* (Broad-leaved White Mahogany)

Sub-canopy Layer: 10 m mean upper height and a mean of 30% PFC. The dominant species was *Allocasuarina torulosa* (Forest Oak).

Shrub Layer: 2 m upper height and a mean of 60% PFC. Dominant shrub species included *Daviesia ulicifolia* (Gorse Bitter Pea), *Persoonia linearis* (Narrow-leaved Geebung), and *Podolobium ilicifolium* (Native Holly).

Ground Layer: <1 m upper height and a mean of 10% PFC. Dominant species included *Entolasia stricta* (Wiry Panic) and *Microlaena stipoides* (Weeping Rice Grass) and *Cissus hypoglauca* (Water Vine).

Classification: This community does not correspond to any EEC as listed under the TSC Act or EPBC Act.

Coastal Foothills Spotted Gum – Ironbark Forest (MU 15n)

Description: This is a moderately tall open forest known occurring in and around the Mandalong Valley. It is known to be dominated by Spotted Gum, Ferguson's Ironbark and Mahogany forests.

Canopy Layer: 20 m mean upper height and a mean of 60% PFC. The dominant canopy species included *Corymbia maculata* (Spotted Gum) with *Eucalyptus fergusonii* subsp. *fergusonii* (Ferguson's Ironbark), *Eucalyptus umbra* (Broad-leaved White Mahogany) and *Eucalyptus pilularis* (Blackbutt).

Shrub Layer: 2 m upper height and a mean of 60% PFC. Dominant shrub species included *Daviesia ulicifolia* (Gorse Bitter Pea), *Persoonia linearis* (Narrow-leaved Geebung), and *Podolobium ilicifolium* (Native Holly).

Ground Layer: <1 m upper height and a mean of 10% PFC. Dominant species included *Entolasia stricta* (Wiry Panic),*Microlaena stipoides* (Weeping Rice Grass) and *Cissus hypoglauca* (Water Vine).

Classification: This community does not correspond to any EEC as listed under the TSC Act or EPBC Act.

Coastal Foothills Spotted Gum – Ironbark Forest (MU 15m)

Canopy Layer: 20 m mean upper height and a mean of 60% PFC. The dominant canopy species included *Corymbia maculata* (Spotted Gum) with *Eucalyptus siderophloia* (Northern Grey Ironbark), *Eucalyptus umbra* (Broad-leaved White Mahogany) and *Eucalyptus microcorys* (Tallowood).

Sub-canopy Layer: 10 m mean upper height and a mean of 30% PFC. The dominant species was *Allocasuarina torulosa* (Forest Oak).

Shrub Layer: 2 m upper height and a mean of 60% PFC. Dominant shrub species included *Daviesia ulicifolia* (Gorse Bitter Pea), *Persoonia linearis* (Narrow-leaved Geebung), and *Podolobium ilicifolium* (Native Holly).

Ground Layer: <1 m upper height and a mean of 10% PFC. Dominant species included *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* (Weeping Rice Grass) and *Cissus hypoglauca* (Water Vine).

Classification: This community does not correspond to any EEC as listed under the TSC Act or EPBC Act.

Hinterland Spotted Gum – Red Ironbark Forest (MU17o)

Plate 5 Hinterland Spotted Gum – Red Ironbark Forest

Canopy Layer: 8 to 30 m – 20% to 30% Percentage Foliage Cover (PFC). Dominant species include; *Corymbia maculata* (Spotted Gum), *Eucalyptus fibrosa* (Red Ironbark), *Eucalyptus acmenoides* (White Mahogany), *Eucalyptus umbra* (Broad-leaved White Mahogany), and *Eucalyptus paniculata* (Grey Ironbark).

Shrub Layer: 3 to 10 m mean upper height and a mean of 25% PFC. The dominant species was *Daviesia ulicifolia* (Gorse Bitter Pea), *Acacia parvipinnula* (Silver-stemmed Wattle), and *Melaleuca nodosa* (Prickly-leaved Paperbark).

Ground Layer: <1 m upper height and a mean of 40% PFC. Dominant species included *Cheilanthes sieberi* subsp *sieberi* (Poison Rock Fern),*Entolasia stricta* (Wiry Panic), *Themeda triandra* (Kangaroo Grass), *Dianella revoluta* (Blue Flax-lily) and *Pratia purpurascens* (White Root).

Classification: This community does not correspond to any EEC as listed under the TSC Act or EPBC Act.

Cleared/Disturbed Lands

Plate 6 Disturbed habitat associated with powerline easement

3.5.1 Native Plant Species Richness

A total of 231 native flora species were recorded within the Study Area in the field surveys undertaken for this report. A full list of the species collected by RPS during field surveys is provided in **Appendix 1**. A summary of the mean native plant species richness per 'MU' for comparison against NPWS (2003) mean values is provided in **Table 12**.

Table 12 Mean Native Plant Species Richness for each MU

MU	# Plots	Mean Native Plant Species	Mean Native Plant Species (NPWS 2003)
1	3	21.3	53.25
12c	4	31.6	50.54
15	5	32	39.7
15m	4	36	39.7
15n	2	30.3	39.7
17o	2	27	40.2
cd	0	7.5	-

Mean native plant species richness was lower in all MUs sampled within the Study Area when compared to those published by NPWS (2003). This difference was most marked in MU1 (Wet Gully Forest) for which NPS were on average 30 species less than expected. Obvious lower plant species richness was also observed within cleared and disturbed habitat compared to the other MU habitats.

3.5.2 Threatened species

Two threatened flora species were observed within the Study Area these being *Melaleuca biconvexa* and *Maundia triglochinoides*. Locations where these species were found are shown in **Figure 5**. A brief description of these species preferred habitat are provided below.

- *Melaleuca biconvexa* (Biconvex paperbark) is endemic to NSW and is listed as Vulnerable under both the TSC Act and EPBC Act. It grows in damp areas, often on low-lying alluvial souls or sheltered slopes. Sometimes grows in dense stands on moist soils, flooded areas or adjacent to water courses.
- *Maundia triglochinoides* a perennial herb, restricted to NSW and Qld along the coastal zone. Grows in shallow freshwater water bodies such as swamps, ponds or drainage lines. Ideal habitat is between 30 and 60 cm deep water over low nutrient heavy clays. It is listed as Vulnerable under the TSC Act

3.5.3 Exotic species

A total of 28 exotic species were recorded within the Study Area. Weed species diversity was greatest in that of more disturbed areas. Two weeds of national significance were recorded, specifically, *Lantana camara* (Lantana) and *Senecio madagascariensis* (Fireweed).

- Lantana is highly invasive, forming dense thickets overtaking bushland and pastures. It has negative economic impacts including being poisonous to stocks, reducing productivity of pasture or forestry and increasing bushfire risk.
- Fireweed is a weed that mainly effects disturbed areas such as pasture in eastern NSW. Fireweed is toxic to livestock leading to potential economic damage.

3.6 Fauna

99 native fauna species were found in the study area: 70 bird species, 15 mammal species, nine reptile species and 5 amphibian species.

3.6.1 Birds

A total of 70 native bird species were recorded in the study area through systematic censuses and opportunistic visual and aural identification. Frequently recorded species during diurnal bird censuses included the Eastern Koel, White-throated Tree-creeper, Olive-backed Oriole and a diversity of Honeyeaters. Of the birds recorded five are listed as vulnerable under the TSC Act, including:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*); was detected only in Sclerophyll Forest (Shrubby) during this survey.
- Glossy Black Cockatoo (*Calyptorhynchus lathami*); was detected only in Dry Sclerophyll Forest (Shrubby) during this survey.
- Little Lorikeet (*Glossopsitta pusilla*); was detected in all three surveyed habitat types over the survey period.
- Powerful Owl (*Ninox strenua*); was detected only in Dry Sclerophyll Forest (Shrubby) during this survey.
- Sooty Owl (*Tyto tenebricosa*); was detected only in Dry Sclerophyll Forest (Shrubby) during this survey.

All threatened fauna locations are displayed in **Figure 6**.

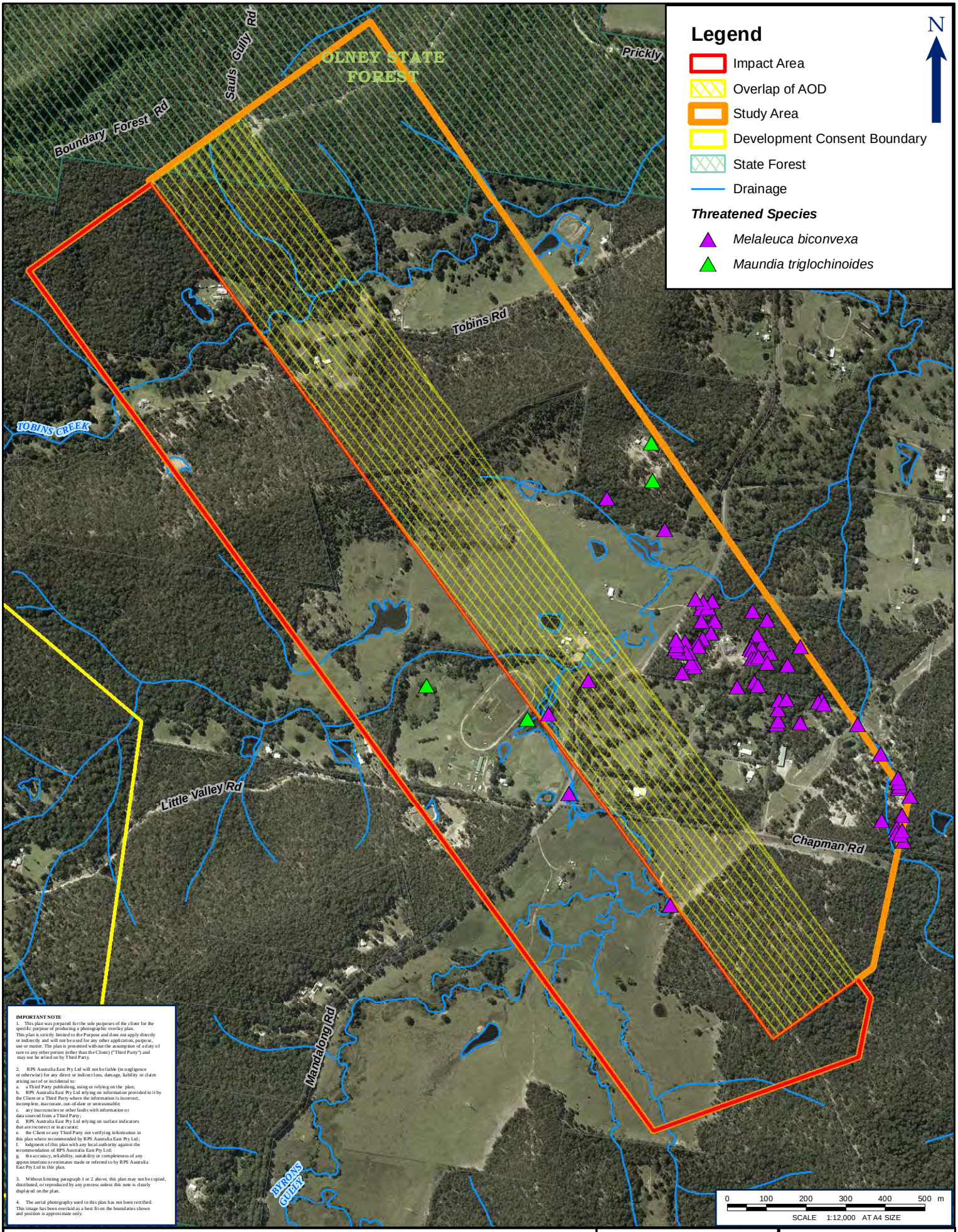

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Figure 5: Threatened Flora Locations

LOCATION: Mandalong Longwalls 24-24A	DATUM: GDA94 PROJECTION: MGA Zone 56
JOB NO.: **PR133215** PURPOSE: Bio Inventory Technician: Natalie.Wood Date: 10/04/2017	Data Sources: RPS Client

CLIENT: Centennial Mandalong Pty Ltd

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)
241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303
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The two species of large forest owl, the Powerful Owl and Sooty Owl are subject to planning and management guidelines within the LMCC area. Powerful owls and Sooty owls are both recognised as preferring to roost and nest in dense forest along creeks and gullies, with Sooty Owls especially preferring wetter areas. Both species require large hollow bearing trees including *Angophora costata* and Eucalyptus species. Within our survey, both species were recorded in Hunter-Macleay Dry Sclerophyll forest, which represents a foraging habitat for the species. It is likely that roosting and nesting habitat of the species would be present in areas of North Coast Wet Sclerophyll forest where large hollow bearing trees were present. The foraging habitats of the two species differ with the Sooty Owl being a more generalist predator of mammals, while the Powerful Owl specifically targets arboreal mammal species. Prey items of both species were recorded during the survey including: Bush Rat, Sugar Glider, Brush-tailed Possum and the Yellow-bellied Glider.

Both the Glossy Black Cockatoo and the Gang Gang Cockatoo are listed as Vulnerable and were detected in the study area. Both of these Cockatoo species are highly mobile, and utilise different habitats for foraging or nesting, or at different times of the year. Both species require large hollows in Eucalypt species for nesting sites; however Gang Gang Cockatoos nest mainly at high altitude and are unlikely to utilise the study area for this purpose. Glossy Black Cockatoos are a dietary specialist with a marked preference of *Allocasuarina torulosa* and *Allocasuarina littoralis*. Gang Gang Cockatoos are more varied in their diet including seeds of trees and shrubs, frequently of Eucalyptus and Acacia. Feeding potential for both species exist across the site, with *Allocasuarina torulosa* being abundant in several areas, and a variety of Eucalyptus and Acacia species present. It is likely that both species utilise the study area as a feeding habitat.

3.6.2 Ground Mammals

Ten ground mammal species were recorded in the Study Area. Of these, one is listed as Vulnerable under the TSC Act, specifically the Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*) and one is a non-native species, the Red Fox (*Vulpes vulpes*). Elliott traps and a trail camera detected seven terrestrial mammal species. All seven species detected are considered common native species, with the exception of one being a non-native species. They include:

- Red Fox (*Vulpes vulpes*);
- Brown Antechinus (*Antechinus stuartii*);
- Common Dunnart (*Sminthopsis murina*);
- Red-necked Wallaby (*Macropus rufogriseus*);
- Swamp Wallaby (*Wallabia bicolor*);
- Long-nosed Bandicoot (*Perameles nasuta*) (refer to **Plate 7**); and
- Short-beaked Echidna (*Tachyglossus aculeatus*).

Trapping within North-Coast Wet Sclerophyll Forest detected three native mammal species. Both the Eastern Chestnut Mouse (vulnerable) and the Bush Rat were detected only within this habitat during the survey. Within NSW the Eastern Chestnut Mouse is most abundant in dense wet heathland and heath swamps, especially heathland that is vigorously regenerating from burning. Across its geographic range it is also recorded in a range of habitats including open grassland or rainforest habitats. Detection of the Eastern Chestnut Mouse in the North-Coast Wet Sclerophyll Forest habitat is outside its reported ideal habitat setting, but within the geographic variation the species is known to inhabit.

The Brown Antechinus occur in higher numbers where there is thick leaf litter, abundant logs and thick ground cover (Van der Ree 2003). This species is able to cross gaps between patches of suitable habitat, such as tracks, bitumen roads and cleared farmland. Across the Study Area the Brown Antechinus was detected in each of the surveyed habitat types and was the only ground mammal detected in Coastal Swamp Forest during the survey period.

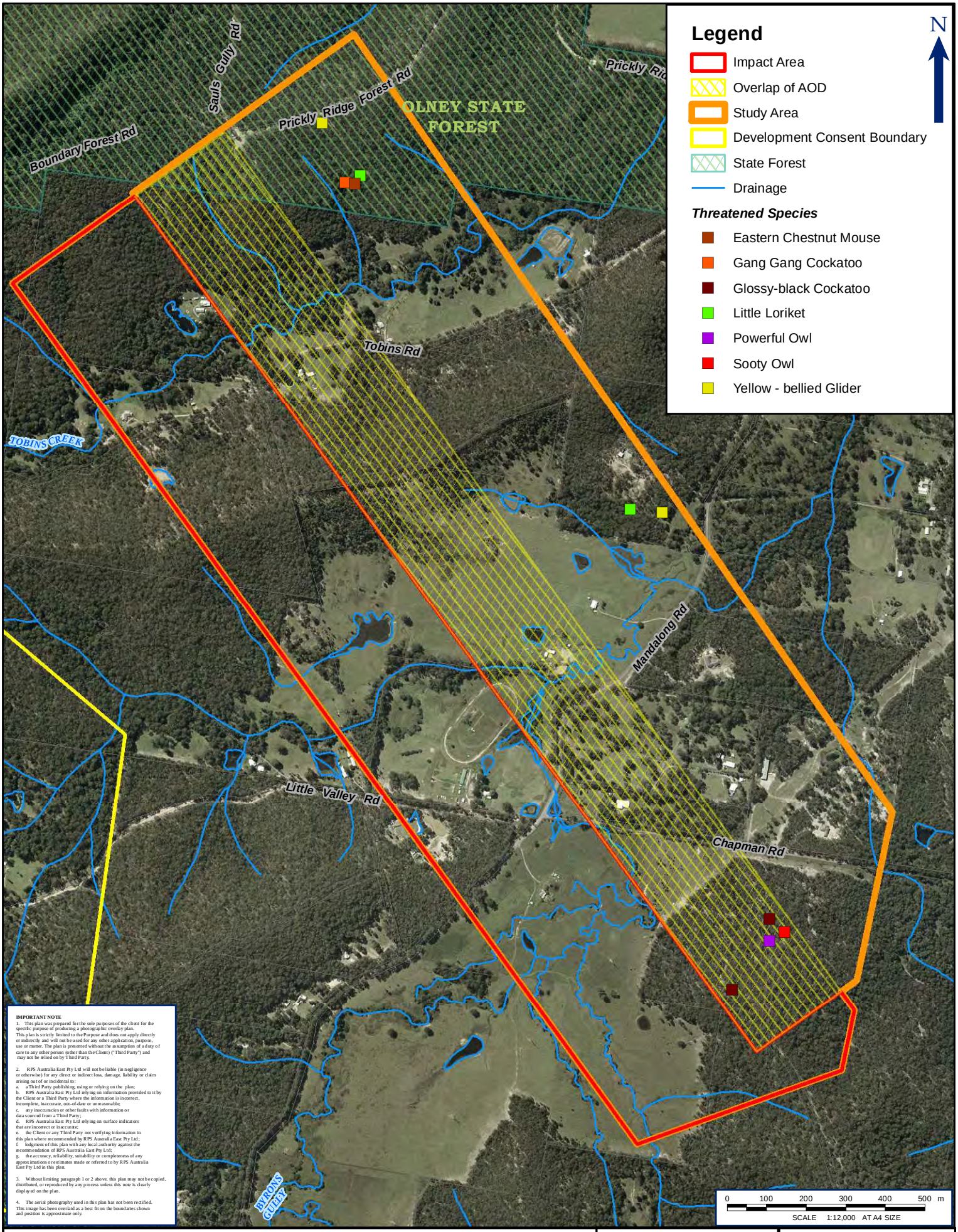

Figure 6: Threatened Fauna Locations

LOCATION: Mandalong Longwalls 24-24A
DATUM: GDA94
PROJECTION: MGA Zone 56
JOB NO.: **PR133215**
PURPOSE: Bio Inventory
Technician: Natalie.Wood Date: 10/04/2017
Data Sources: RPS Client

CLIENT: Centennial Mandalong Pty Ltd

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Macropods were observed feeding throughout the day within the Study Area. The Eastern Grey Kangaroo was observed feeding on grasses and forbs in cleared areas of the Study Area, and was not often recorded in woodland or forest communities. Red-necked Wallabies also occurred in cleared patches, but favoured areas where nearby forest and woodland provides shelter.

Plate 7 Long-nosed Bandicoot (*Parameles nasuta*) detected using a trail camera

3.6.3 Arboreal Mammals

Three arboreal mammals were recorded in the Study Area. One common mammal, namely the Common Brushtail Possum (*Trichosurus vulpecula*) was identified through camera trap images, while another common species the Sugar Glider (*Petaurus breviceps*) was captured in an arboreal trap. One threatened arboreal mammal was identified during spotlighting, and call playback, namely the Yellow-bellied Glider (*Petaurus australis*), which is listed as Vulnerable under the TSC Act.

The Yellow-bellied Glider inhabits a range of habitat types but typically occurs in tall, mature eucalypt forest in regions of high rainfall (NPWS 2003b). Habitats rich in resources are preferred by Yellow-bellied gliders, including trees with hollows and a variety of tree species that provide year round foraging resources. Within this survey call playback identified the species in Hunter-Macleay Dry Sclerophyll Forest and on the boundary of Hunter-Macleay Dry Sclerophyll Forest and Coastal Swamp Forest. The presence of Coastal Swamp Forests abutting taller eucalypt forest likely provides an extra foraging habitat for the Yellow-bellied Glider in this area.

Plate 8 Adult and juvenile Brush-tailed Possum (*Trichosurus vulpecula*) trail camera

3.6.4 Bats

Two microchiropteran bat (microbat) species were captured using harp traps in the study area (**Table 12**). Both species are regarded as common.

Both species recorded are insectivorous and hunt for flying insects such as moths, bugs, beetles, flies, cicadas, crickets and wasps. Some microbat species are able to take prey from the ground or from the surface of vegetation, including spiders, ants and termites (Churchill 2008).

Table 13 Microbats Recorded in the Study Area

Species	Roosting Habitat (Churchill 2008)	Foraging behaviour (Churchill 2008)
Vespadelus vulturnus	Roosting in hollows of dead branches or in dead trees or in buildings. Roosts are often near water, in large trees along creeks and rivers.	Forage within the upper levels of the forest understory, or in the spaces between trees. They can range up to 1.5km from their roost site.
Vespadelus darlingtoni	Groups of 4/5 up to colonies of 80, utilising hollows in large living smooth-barked trees.	Mainly foraging in the space between trees and between the canopy and understory. They can utilise foraging areas of 10-300ha, ranging up to 6km a night.

3.6.5 Herpetofauna

Nine common reptile species were detected opportunistically diurnally active across the Study Area, or through opportunistic search of cover habitat.

The Eastern Water Dragon (*Intellegama lesueurii* prev. *Physignathus*), Eastern Water Skink (*Eulamprus quoyii*) and Red-bellied Black Snake (*Pseudechis porphyriacus*) (refer to **Plate 9**) are common in a variety of wetter habitats such as streams, dams or temporary water bodies. They are most abundant when these habitats have associated cover habitat such as fallen logs. The majority of suitable habitat for these species occurs within the Coastal Swamp Forest and North Coast Wet Sclerophyll Forest habitats of the Study Area. However, they are not totally dependent on water and at least one Red-bellied Black Snake was detected in the Hunter-Macleay Dry Sclerophyll Forest, where dams or other water bodies can provide areas of habitat.

Other reptiles detected include the Common Tree Snake (*Dendrelaphis punctulatus*), Common Sun-skink (*Lampropholis delicata*), Jacky Dragon (*Amphibolurus muricatus*) and Lace Monitor (*Varanus varius*), which

all occupy a wide range habitats, especially sclerophyll forests with an abundance of trees, logs and plenty of leaf-litter. Hunter-Macleay Dry Sclerophyll Forest would provide the majority of habitat for these species across the Study Area; however they are likely to be present in other habitats, including disturbed areas.

Five amphibian species were detected opportunistically or during auditory surveys. The species detected are all considered common and represent species usually associated with dams, ponds or wetland areas. Of the Hylidae (Tree Frogs) two species Peron's Tree Frog (*Litoria peronii*) and Tyler's Tree Frog (*Litoria tyleri*) frequently call from and shelter in trees or logs near water. The remaining Hylid, the Eastern Sedge Frog (*Litoria fallax*) mainly calls from and inhabits sedges and other vegetation within the water body, and is not as reliant on trees.

Both Myobatrachids (Ground Frogs) detected, the Common Eastern Froglet (*Crinia signifera*) and Dusky Toadlet (*Uperoleia fusca*), inhabit a wide range of open or heavily vegetated water bodies, in a variety of ground covers including sedges, reeds, leaf-litter, fallen logs, or other cover. The Coastal Swamp Forest and North Coast Wet Sclerophyll Forest contained an abundance of ponds, creeks, and low-lying areas likely providing habitat to frog species.

Within the Hunter-Macleay Dry Sclerophyll Forest there was a relatively low proportion of suitable habitat for frogs, but several species were recorded around one dam surveyed.

Plate 9 Red Bellied Black Snake (*Pseudechis porphyriacus*) detected using a trail camera

3.7 Fauna Habitat

3.7.1 Terrestrial Habitat Condition

BioBanking plot data provided in Appendix 1 is summarised in **Table 13** (mean data), which also includes comparison with benchmark datasets for comparable plant community types (OEH 2017). Values in bold indicate a 'within benchmark' state.

Table 14 Mean Vegetation Values

MU	Vegetation Description	NPSR	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL
1	Coastal Wet Gully Forest	24.3	**38.2**	64.2	**14.7**	**9.3**	70.0	**0.0**	0.0	**1.0**	**17.3**
	Benchmark	>=50	24.0 - 55.0	10.0 - 55.0	5.0 to 20.0	1.0 - 15.0	5.0 - 40.0	0.0	>=1	1.0	>=10
5	Alluvial Tall Moist Forest	**29.2**	**26.5**	**36.0**	50.7	3.3	**29.0**	31.3	**0.3**	**1.0**	**16.4**
	Benchmark	>=24	15.0 - 70.0	10.0 - 60.0	5.0 - 50.0	5.0 - 30.0	5.0 - 40.0	0.0	>=0	1.0	>=5
12c	Hunter Valley Moist Spotted Gum - Ironbark Forest	34.0	**50.4**	**16.6**	46.0	0.5	**9.5**	0.5	0.8	**1.0**	8.5
	Benchmark	>=50	24.0 - 55.0	10.0 - 55.0	5.0 - 20.0	1.0 - 15.0	5.0 - 40.0	0.0	>=1	1.0	>=10
15n	Jilliby Spotted Gum - Ferguson's Ironbark - Mahogany Forest	36.0	40.5	**29.0**	28.0	**6.0**	6.0	**0.0**	2.0	**1.0**	**23.0**
	Benchmark	>=38	15.0 - 40.0	4.0 - 40.0	30.0 - 60.0	3.0 - 15.0	10.0 - 25.0	0.0	>=1	1.0	>=10
15m	Jilliby Spotted Gum - Northern Ironbark Forest - Mahogany Forest	29.5	48.3	**4.0**	23.0	**11.0**	1.0	**0.0**	**1.5**	**1.0**	**39.8**
	Benchmark	>=38	15.0 - 40.0	4.0 - 40.0	30.0 - 60.0	3.0 - 15.0	10.0 - 25.0	0.0	>=1	1.0	>=10
17o	Hinterland Spotted Gum - Red Ironbark Forest	26.3	**39.1**	**18.0**	**46.0**	**11.5**	0.5	**0.0**	**1.0**	**1.0**	**33.1**
	Benchmark	>=38	15.0 - 40.0	4.0 - 40.0	30.0 - 60.0	3.0 - 15.0	10.0- 25.0	0.0	>=1	1.0	>=10

A discussion on the habitat condition prevailing thought the study area is provided below.

Native Plant Species Richness (NPSR)

Native plant species abundance was lower than benchmark across the Study Area habitats with the exception of MU 5 (Alluvial Tall Moist Forest). Despite this a variety of flowering plants such as eucalypts, banksias and acacias were still present across the Study Area. These species offer foraging resources to a diversity of highly mobile nectar-feeding birds including Eastern Spinebill (*Acanthorhynchus tenuirostris*), a diversity of honeyeaters and Noisy Friarbird (*Philemon corniculatus*).

Native Overstorey Canopy

Native overstorey canopy cover was across the Study Area either within benchmark levels or above benchmark levels. The composition of overstorey was mainly that of eucalypts and corymbias across the Study Area. Some of these species offer foraging resources including nectar, pollen and eucalypt sap to arboreal mammals such as the Yellow-bellied Glider (*Petaurus australis*) which was detected in MU 12c (Hunter Valley Moist Spotted Gum – Ironbark Forest) and 15 (Coastal Foothills Spotted Gum – Ironbark Forest) and Sugar Glider (*Petaurus breviceps*).

Native Midstorey Canopy

Allocasuarina littoralis and *Allocasuarina torulosa,* preferred food resources of the Glossy Black Cockatoo (*Calyptorhynchus lathami*) (Higgins 1999), were densely distributed within sections of MU 5 (Alluvial Tall Moist Forest) across he Study Area. *Acacia* species which are readily eaten were distributed in several habitats across the Study Area, especially within MU 5 (Alluvial Tall Moist Forest).

Native Groundcover (grass/ shrubs/ other)

A mixed picture of groundcover is evident, suggestive of past land uses that may have involved forestry or grazing within forests. It's uncertain as to why the condition across the Study Area is as variable as indicated.

Hollow-bearing Trees

Hollow-bearing trees were common in MU 15 (Coastal Foothills Spotted Gum – Ironbark Forest), and include a diversity of eucalypt species of various ages. Hollows were less common in other MU habitats, but still present in some larger eucalypts or as smaller trunk and branch hollows in other tree species. Forest communities, particularly those occurring in sheltered gullies, supported some very large trees, some up to 1.2 metres DBH. Some of these tall, wide trees contained several large tree and branch hollows. Such tree hollows, especially where they occur in riparian zones or sheltered slopes are potentially important roosting or nesting sites for Sooty Owls (*Tyto tenebricosa*) and Powerful Owls (*Ninox strenua*) which were detected within the Study Area.

Overstorey regeneration

There is clear evidence of regeneration of the overstorey canopy in line with benchmark figures, indicating a healthy condition status of the current vegetation.

Fallen Logs

Large woody debris was common across the Study Area, above benchmark levels in all habitats excepting MU 12c (Hunter Valley Moist Spotted Gum – Ironbark Forest). The abundance of hollow logs offers potential sheltering and breeding habitat for small terrestrial mammals, reptiles and birds.

Summary

Habitat conditions evident throughout the Study Area are generally consistent with landscapes subject past forestry and agricultural activity. In particular plant species richness was lower than expected and in some communities old growth hollow baring trees were scarcer than should be expected. However, evidence of condition recovery is apparent in parts of the Study Area, particularly where there is an absence of active anthropogenic land use (i.e. lands owned by Centennial Coal and Olney State Forest).

3.7.2 Aquatic Habitats

Surface watercourses draining the Study Area are ephemeral to permanent and are characterised by fast flows during rainfall events and low flows throughout the remainder of the year. When flowing, creeks are known to offer important habitat for frogs and reptiles. A variety of ponds and dams exist across the Study Area, especially in the lower areas such as MU 5 (Alluvial Tall Moist Forest) and provide habitat for pond breeding frogs and reptiles that inhabit wetter areas.

Depressions and low lying areas that are inundated following rain are scattered across the Study Area and may offer temporary breeding habitat for colonising frog species. Habitat suitable for the threatened Green Thighed-frog (*Litoria brevipalmata*) was detected; however surveys for the species were unable to be conducted without appropriate weather conditions occurring during the survey season.

3.7.3 Vegetation Corridors and Linkages

The Lake Macquarie Native Vegetation & Corridor Map (Lake Macquarie City Council 2011) maps the Study Area as a Corridor of Remnant Native Vegetation with the area cleared for the easement mapped as a Corridor of Partially Cleared Remnant Native Vegetation.

The Study Area is located on the eastern side of Olney State Forest, of which it is connected via multiple vegetated lots. This huge expanse of continuous habitat facilitates the movement of many fauna species across the landscape. Animals move through habitats to obtain food, shelter and breeding resources, in

response to seasonal resource availability and habitat conditions. Large tracts of habitat are generally required for successful dispersal away from natal areas or seasonal migrations (Van der Ree et al 2007).

In the wider locality, the landscape to the north and south east of the Study Area is characterised by a mosaic of cleared agricultural land and rural residential properties. Many of these remnants are linked by remnant vegetation that has been retained in association with drainage lines or vegetated properties; others are linked by narrow corridors of native vegetation. Some remnants do not maintain connectivity with any other patches of vegetation in the landscape and are completely isolated amongst cleared land.

There are no significant barriers to fauna movement surrounding the Study Area.

3.8 Koala Habitat

The Study Area supports Koala feed trees and 'Potential Koala Habitat', but not 'Core Koala Habitat' as defined in SEPP 44.

SEPP 44 applies to Lake Macquarie LGA. Schedule 2 of SEPP No. 44 – 'Koala Habitat Protection' lists 10 tree species that are considered indicators of 'Potential Koala Habitat'. The presence of any of the species listed on a site proposed for development triggers the requirement for an assessment for 'Potential Koala Habitat'. SEPP 44 defines potential Koala Habitat as:

> *"areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component".*

Four feed tree species listed under Schedule 2 of SEPP 44 occur in the Study Area, including:

- *Eucalyptus microcorys* (Tallowwood)
- *Eucalyptus punctata* (Grey Gum)
- *Eucalyptus tereticornis* (Forest Red Gum)
- *Eucalyptus robusta* (Swamp Mahogany)

The density of these koala feed tree species did in part equate to at least 15% of the total number of trees within the Study Area. Therefore, Potential Koala Habitat does occur within the Study Area.

To then determine if the Study Area consists of Core Koala Habitat, habitat would need to correspond with the definition of Core Koala Habitat. SEPP 44 defines Core Koala Habitat as:

> *"an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that, is females with young) and recent sightings of and historical records of a populations."*

Surveys within the Study Area failed to detect any Koalas or signs of Koalas including scats or scratches on trees. There are eight records within a 10 km radius of the Study Area only one of which is recent. This record is located east of the Study Area adjacent to Wyee Rd. Given the paucity of recent sightings, and the lack of Koala presence within the Study Area, habitats are not considered to be classified as Core Koala Habitat in line with the SEPP 44 definition.

4.0 Summary

4.1 Biodiversity Values

This Biodiversity Inventory Report has detailed the methods and results of ecological surveys conducted for the Project. Surveys were conducted in accordance with the FBA and considered species populations and EECs listed under the NSW TSC Act and Commonwealth EPBC Act. Flora surveys detected two threatened flora species, including:

- *Melaleuca biconvexa* (Biconvex Paperbark); and
- *Maundia triglochinoides*.

Three EECs were detected including:

- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (i.e. MU 5 - Alluvial Tall Moist Forest);
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion (i.e. MU 5 'XXX' and MU 5 - derived Alluvial Tall Moist Forest); and
- Lower Hunter Spotted Gum Ironbark Forest (i.e. MU 17o).

Seven threatened fauna species listed under the TSC Act and/or EPBC Act were detected during RPS surveys:

- Gang Gang Cockatoo (*Callocephalon fimbriatum*)
- Powerful Owl (*Ninox strenua*)
- Sooty Owl (*Tyto tenebricosa*)
- Glossy Black Cockatoo (*Calyptorhynchus lathami*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Yellow-bellied Glider (*Petaurus australis*)
- Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*)

4.2 EPBC Act Assessment

A total of 75 nationally threatened species have been recorded, or have potentially suitable habitat, within the 10 km search area (EPBC Protected Matters Search Tool 2012). It has been determined that, based on habitats present, eight nationally threatened flora species and 13 nationally threatened fauna species occur or have potential to occur within the site. These species are:

Threatened Flora

- *Cryptostylis hunteriana (*Leafless-tongue Orchid), listed as vulnerable;
- *Melaleuca biconvexa (*Biconvex Paperbark), listed as vulnerable;
- *Tetratheca juncea* (Black-eyed Susan), listed as vulnerable.
- *Rutidosis heterogama* (Heath Wrinklewort) listed as vulnerable,
- *Syzygium paniculatum* (Magenta Lilly Pilly) listed as vulnerable,
- *Caladenia tessellate* (Thick-lipped Spider Orchid) listed as vulnerable,
- *Rhizanthella slateri* (Underground Orchid) listed as endangered,
- *Persicaria elatior* (Tall Knotweed) listed as vulnerable,

One species of nationally threatened flora, Melaleuca biconvexa (Biconvex Paperbark) was found within the study area during surveys. It was distributed in dense patches within the Bell vegetation community MU 5.

Threatened Fauna

- Green and Golden Bell Frog *(Litoria aurea)* listed as vulnerable;
- Giant Burrowing Frog *(Heleioporus australiacus)* listed as vulnerable,
- Stuttering Frog *(Muixophyes balbus)* listed as vulnerable,
- Giant Barred Frog *(Mixophyes iteratus)* listed as endangered,
- Regent Honeyeater *(Anthochaera phrygia),* listed as endangered;
- Swift Parrot *(Lathamus discolor),* listed as endangered;
- Australasia Bittern *(Botaurus poiciloptilus)* listed as vulnerable,
- Australian Painted Snipe *(Rostratula australis)* listed as endangered,
- Koala *(Phascolarctos cinereus)* listed as vulnerable,
- Greater Glider *(Petauroides Volans)* listed as vulnerable,
- Grey-headed Flying-fox *(Pteropus poliocephalus),* listed as vulnerable*;*
- Large-eared Pied Bat *(Chalinolobus dwyeri),* listed as vulnerable and,
- Spotted-tail Quoll *(Dasyurus maculatus maculatus),* listed as endangered*.*

None of the nationally threatened species of significance were detected during surveys of the site. There are no threatened vegetation communities identified within the site listed under the EPBC Act.

Under the EPBC Act significant impact guidelines, a population of a vulnerable species must be considered to be an 'important population' to require further assessment of impact. An important population is defined as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

Whilst it is likely that a number of the vulnerable species listed above would not be considered an 'important population', a precautionary approach has been undertaken in this instance. Therefore, all species have been afforded a Significance Assessment, in line with the EPBC Act in **Appendix 5**. The potential for impact upon the endangered species listed above are assessed on an individual basis in **Appendix 5**.

These assessments determine if the proposed action will have any significant impact on any MNES. If it is determined that there is a significant impact to any MNES then a referral of the matter to DoE would be recommended.

5.0 References

Bell, S. and Driscoll, C. (2015) Vegetation Mapping of Lake Macquarie LGA: Stages 1-6.

Briggs and Leigh (1996)

Churchill S (2008) *Australian Bats*. Reed New Holland, Frenchs Forest.

Debus, S. (1995) Surveys of Large Forest Owls in Northern New South Wales: Methodology, Calling Behaviour and Owl Responses. *Corella* 19: 38-50.

Department of Environment & Climate Change (2007) *Threatened Species Assessment Guidelines: The Assessment of Significance.* Department of Environment and Climate Change, Sydney south.

Department of Environment & Climate Change (2009) *Draft Operational Manual for using the BioBanking Credit Calculator* v2.0.

Department of the Environment and Energy (DoEE) (2017) Protected Matters Search tool. Accessed online February 2017.

Department of Land & Water Conservation [DLWC] (2002) *The NSW State Groundwater Dependent Ecosystems Policy*. Prepared by the Department of Land & Water Conservation, Sydney NSW.

DEWHA (2010b) *Survey guidelines for Australia's threatened birds*. Commonwealth of Australia, Canberra.

DEWHA (2010c) *Survey guidelines for Australia's threatened bats*. Commonwealth of Australia, Canberra.

DEWHA (2011a) *Survey guidelines for Australia's threatened mammals*. Commonwealth of Australia, Canberra.

DEWHA (2011b) *Survey guidelines for Australia's threatened reptiles*. Commonwealth of Australia, Canberra.

Eamus, D. (2009) *Identifying groundwater dependent ecosystems*, *A guide for land and water managers.* Australian Government – Land and Water Australia.

Hollis, C.J., Robertshaw, J.D., Harden, R.H., (1986) Ecology of the Swamp Wallaby (Wallabia bicolor) in Northeastern New South Wales. *Australian Wildlife Research* Vol. 13. p.355-365.

Hunter Eco (2008) *Awaba East Exploratory Drilling Program REF Stage 1 – Ecology*. A Report for Centennial Coal.

Hunter Eco (2009) *Flora and Fauna Assessment for the Mandalong Mine Longwalls 11 to 14 Subsidence Management Plan.* Prepared for Centennial Coal, June 2009.

Lake Macquarie City Council (2015) Lake Macquarie Native Vegetation and Corridors Mapping. Accessed online February 2017 from: http://www.lakemac.com.au/downloads/native_veg_corridor_map_2012.pdf

NSW National Parks and Wildlife Services (NPWS) (2003) Lower Hunter and Central Coast Regional Environmental Mapping Strategy (LHCCREMS).

NSW National Parks and Wildlife Services (NPWS) (2003b) *Recovery Plan for the Yellow-bellied Glider (Petaurus australis)*. NSW National Parks and Wildlife Services, Hurstville.

OEH (2017) NSW Bionet Atlas of NSW Wildlife. Accessed February 2017. http://www.bionet.nsw.gov.au/

Pennay, M., Law, B. and Reinhold, L. (2004) Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats. New South Wales Department of Environment and Conservation, Hurstville.

RPS (2013) Mandalong South Extension Project Flora and Fauna Assessment. Report to Centennial Coal.

RPS (2016) Mandalong Transmission Line TL24 Relocation Project Flora and Fauna Assessment. Report to Centennial Coal.

Serov P, Kuginis L, Williams J.P.,(2012) *Risk assessment guidelines for groundwater dependent ecosystems, Volume 1 – The conceptual framework*. NSW Department of Primary Industries, Office of Water, Sydney.

Simpson, K. and Day, N. (2010). *Field Guide to the Birds of Australia*. Penguin Group, Australia.

Strahan R. (ed). (1995) *The Mammals of Australia*. Australian Museum/Reed Books, Chatswood.

Tyler, M. J. and Knight. F. (2011) *Field Guide to the Frogs of Australia*; Revised Edition. CSIRO Publishing, Victoria.

Van der Ree R., Grift E., Gulle N., Holland K., Mata C., Suarez F., (2007) Overcoming the barrier effects of roads- how effective are mitigation measures? An International review of the use and effectiveness of underpasses and overpasses designed to increase the permeability of roads for wildlife. UC Davis: Road Ecology Centre.

Wilson, S. and Swan, G. (2010). *A Complete Guide to Reptiles of Australia*. CSIRO Publishing, Australia.

Appendix 1

Flora Species Inventory

Scientific Name	Common Name	Form	TSC Act	EPBC Act	BB01	BB02	BB03	BB04	BB05	BB06	BB07	BB08	BB09	BB10	BB11	BB13	BB14	ABB01	ABB02	ABB03	ABB04	ABB05	ABB06	ABB07	ABB08	ABB09	ABB10	ABB11	ABB12	Swan1	Swan2	Swan3	Swan4	Swan5	Swan8	Besant	Pencil page	General
Acianthus fornicatus	Pixie Caps	g	P												X																							
Adiantum aethiopicum	Common Maidenhair	g	P									X								X	X						X											
Adiantum formosum	Giant Maidenhair	g																X		X																		
Adiantum spp.			P												X																							
Persoonia spp.			P					X																														
Maundia triglochinoides	-	w	V	-																																		X
Melaleuca biconvexa	Biconvex Paperbark	t	V	V																				X														
Acacia floribunda	White Sally	s					X								X																							
Acacia implexa	Hickory Wattle	s										X																										
Acacia irrorata	Green Wattle										X										X		X	X			X					X				X		
Acacia linearifolia	Narrow-leaved Wattle							X																														
Acmena smithii	Lillypilly	t														X		X	X	X											X					X	
Acrotriche spp.												X	X	X		X																						
Allocasuarina littoralis	Black She-oak	t																	X																		
Allocasuarina torulosa	Forest Oak	t			X	X	X	X		X		X	X	X	X	X																						
Alphitonia excelsa	Red Ash	t													X																					X		
Amyema spp.	Mistletoe					X								X																								
*Andropogon virginicus**	Whisky Grass	g																							X													
Angophora floribunda	Rough-barked Apple	t																					X															
Archontophoenix cunninghamiana	Bangalow Palm	t																		X																		
Aristida ramosa	Purple Wiregrass	g			X	X			X																													
Aristida vagans	Three-awn Speargrass	g								X													X															
Asplenium australasicum	Birds Nest Fern	e																			X																	
Austromyrtus spp.																																				X		
*Axonopus fissifolius**	Narrow-leaved Carpet Grass	g																			X														X			
Azolla spp.																																		X				
Backhousia myrtifolia	Grey Myrtle	t																X	X	X							X											
Billardiera scandens	Hairy Appleberry	v				X	X			X			X	X		X																						
Blechnum spp.																		X																				
Brachyscome ciliaris	Variable Daisy											X																										
Breynia oblongifolia	Coffee Bush	s								X					X						X						X		X									
Breynia spp.												X																										
*Briza maxima**	Quaking Grass	g																																		X		
Brunoniella australis	Blue Trumpet	g								X			X	X	X	X																						
Bursaria spinosa	Native Blackthorn								X																													
Bursaria spp.																X																						
Caesia parviflora var. parviflora	Pale Grass Lily	g												X																								
Callistemon salignus	Willow Bottlebrush	s									X									X	X			X	X		X											
Callistemon spp.												X																										

Scientific Name	Common Name	Form	TSC Act	EPBC Act	BB01	BB02	BB03	BB04	BB05	BB06	BB07	BB08	BB09	BB10	BB11	BB13	BB14	ABB01	ABB02	ABB03	ABB04	ABB05	ABB06	ABB07	ABB08	ABB09	ABB10	ABB11	ABB12	Swan1	Swan2	Swan3	Swan4	Swan5	Swan8	Besant	Pencil page	General
Calochilus robertsonii	Purplish Beard Orchid	g						X																													
Calochlaena dubia	Rainbow Fern	g																		X																	
Carex appressa	Tall Sedge	g									X	X												X			X		X			X	X				
*Centaurium spp.**																											X										
Centella asiatica	Swamp Pennywort	g																		X			X	X													
Cheilanthes sieberi	Rock Fern							X																													
*Cinnamomum camphora**	Camphor Laurel	t																												X							
Cissus antarctica	Kangaroo Vine	v															X			X																	
Cissus hypoglauca	Water Vine	v																X	X	X																	
Claoxylon australe	Brittlewood	t																																		X	
Clematis aristata	Old Man's Beard	v												X							X						X										
Commelina cyanea	Scurvy Weed, Native Wandering Jew	g									X													X			X										
*Convolvulus spp.**	A Bindweed										X																										
*Conyza bonariensis**	Flax-leaf Fleabane	g																					X														
*Conyza spp.**	A Fleabane																									X		X									
Cordyline stricta	Narrow-leaf Palm Lily	s																																		X	
Corymbia maculata	Spotted Gum	t			X	X	X	X	X	X		X	X	X	X	X		X		X																	
Cryptocarya microneura	Murrogun	t																						X													
Cryptocarya spp.																				X	X																
Cymbidium suave	Snake Orchid	e																			X																
Cymbopogon refractus	Barbwire Grass	g			X	X											X						X		X												
Cynodon dactylon	Common Couch	g										X											X	X		X	X	X	X								
*Cyperus congestus**	-	g																					X		X												
Cyperus laevis	-	w									X																										
Daviesia spp.						X																															
Daviesia squarrosa	-	s			X		X		X								X																				
Daviesia ulicifolia	Gorse Bitter Pea	s			X		X	X		X			X												X												
Desmodium brachypodum	Large Tick-trefoil	v													X																						
Desmodium gunii	Slender Tick-trefoil	v						X																													
Desmodium rhytidophyllum	-	v											X				X																				
Desmodium varians	Slender Tick-trefoil	v									X	X			X									X	X				X								
Dianella caerulea	Blue Flax-lily					X	X	X		X		X	X	X		X	X		X		X								X								
Dianella revoluta	Blueberry Lily															X																					
Dichelachne micrantha	Short-hair Plume Grass	g																		X			X	X			X		X								
Dichondra repens	Kidney Weed	g									X																										
Dietes spp.												X																									
Digitaria parviflora	Small-flowered Finger Grass	g			X	X	X	X	X	X			X			X							X	X		X	X	X	X								
*Digitaria sanguinalis**	Crab Grass	g																							X												
*Digitaria spp.**	A Finger Grass									X																											

Scientific Name	Common Name	Form	TSC Act	EPBC Act	BB01	BB02	BB03	BB04	BB05	BB06	BB07	BB08	BB09	BB10	BB11	BB13	BB14	ABB01	ABB02	ABB03	ABB04	ABB05	ABB06	ABB07	ABB08	ABB09	ABB10	ABB11	ABB12	Swan1	Swan2	Swan3	Swan4	Swan5	Swan8	Besant	Pencil page	General
Dioscorea transversa	Native Yam	v										X																										
Dipodium variegatum	Blotched Hyacinth Orchid	g												X																								
Doodia aspera	Prickly Rasp Fern	g															X	X	X	X																X		
Doodia spp.												X																										
Doryphora sassafras	Sassafras	t																																			X	
Drosera peltata	Sundew	g																																	X			
Echinopogon caespitosus	Bushy Hedgehog-grass				X																							X									
Eleocharis spp.	Spike-rush, Spike-sedge																												X								
Entolasia marginata	Bordered Panic	g									X	X												X			X		X									
Entolasia spp.										X				X																								
Entolasia stricta	Wiry Panic	g			X	X	X	X	X				X		X	X			X		X						X		X									
Epacris pulchella	Wallum Heath	s				X																																
Eragrostis brownii	Brown's Lovegrass	g				X																																
Eragrostis lacunaria	Purple Lovegrass	g																							X													
Eragrostis leptostachya	Paddock Lovegrass	g																					X		X			X	X									
Eucalyptus acmenoides	White Mahogany	t				X	X											X																				
Eucalyptus deanei	Mountain Blue Gum	t																	X	X							X											
Eucalyptus fergusonii		t					X																															
Eucalyptus fibrosa	Broad Leaved Ironbark	t			X	X			X	X																												
Eucalyptus microcarpa	Western Grey Box	t													X																							
Eucalyptus microcorys	Tallowwood	t			X			X	X	X	X	X		X		X	X	X	X	X	X						X		X									
Eucalyptus pilularis	Blackbutt	t				X									X						X																	
Eucalyptus punctata	Grey Gum	t											X	X				X	X																			
Eucalyptus resinifera	Red Mahogany	t													X																							
Eucalyptus robusta	Swamp Mahogany	t																			X																	
Eucalyptus saligna	Sydney Blue Gum	t									X				X																							
Eucalyptus siderophloia	Northern Grey Ironbark	t								X	X	X	X	X	X	X											X		X									
Eucalyptus tereticornis	Forest Red Gum	t																			X																	
Eucalyptus umbra	Broad-leaved White Mahogany	t			X		X	X		X			X	X		X				X																		
Euchiton sphaericus	-	g																							X													
Eustrephus latifolius	Wombat Berry	v															X																					
Exocarpos cupressiformis	Native Cherry	t						X		X				X																								
Ficus coronata	Sandpaper Fig	t																																		X	X	
Gahnia melanocarpa	Black-fruit Saw-sedge	w g				X																																
Gahnia spp.																			X	X																		
Galium binifolium	-	g										X																										
Geitonoplesium cymosum	Scrambling Lily	v									X	X			X			X		X	X						X		X									
Geranium homeanum	Northern Cranesbill	g									X													X														
Glochidion ferdinandii	Cheese Tree	t										X			X			X	X	X									X									

Scientific Name	Common Name	Form	TSC Act	EPBC Act	BB01	BB02	BB03	BB04	BB05	BB06	BB07	BB08	BB09	BB10	BB11	BB13	BB14	ABB01	ABB02	ABB03	ABB04	ABB05	ABB06	ABB07	ABB08	ABB09	ABB10	ABB11	ABB12	Swan1	Swan2	Swan3	Swan4	Swan5	Swan8	Besant	Pencil page	General
Glochidion spp.																																				X		
Glycine clandestina	Twining Glycine	v										X		X	X								X															
Glycine microphylla	Small-leaf Glycine	v					X																														
Glycine tabacina	Twining Glycine	v					X				X		X																								
Gompholobium latifolium	Broad-leaf Wedge-pea	s						X																													
*Gomphrena celosioides**	Gomphrena Weed																						X		X	X		X										
Gonocarpus spp.	Raspwort					X		X		X						X																						
Goodenia heterophylla						X				X			X			X									X													
Guioa semiglauca	Guioa	t																																			X	
Gymnostachys anceps	Settlers Flax	g																X	X	X																		
Hardenbergia spp.						X			X				X	X		X																						
Hardenbergia violacea	False Sarsparilla	v					X	X																														
Hibbertia dentata	Twining Guinea Flower	v										X																										
Hibbertia scandens	Climbing Guinea Flower	v				X	X	X		X	X	X	X	X	X	X	X											X						X				
Hibiscus heterophyllus subsp. heterophyllus	Native Rosella	s																																		X		
Hybanthus stellarioides							X	X																														
Hydrocotyle hirta	Hairy Pennywort							X																														
Hydrocotyle peduncularis	Pennywort	g									X																											
Hypericum gramineum	Small St Johns Wort	g																					X															
*Hypochaeris radicata**	Flatweed	g																					X		X				X						X			
Imperata cylindrica	Blady Grass	g			X	X	X	X													X		X		X													
Imperata spp.										X			X	X																								
Joycea pallida	Silvertop Wallaby Grass	g				X	X	X	X	X			X	X		X																						
*Juncus microcephalus**																							X															
Juncus sp.	-	w g																																X				
Juncus usitatus	Common Rush	g																						X														
*Juniperus spp.**	Juniper																							X														
Kennedia rubicunda	Dusky Coral Pea	v					X																															
Kunzea ambigua	Tick Bush	s																																	X			
Lagenifera stipitata	Blue Bottle-daisy								X																													
Lagenophora gracilis	Slender Lagenophora									X																												
Lagerstroemia indica (Cultivar)*	Crepe Myrtle	t				X																																
*Lantana camara**	Lantana	s										X								X	X					X			X									
Lepidosperma laterale	Variable Sword-sedge	g				X	X	X	X	X			X	X	X	X																						
Leptospermum polygalifolium	Tantoon					X																														X		
Leucopogon ericoides	Pink Beard-heath	s			X		X	X					X																									
Leucopogon juniperinus	Prickly Beard-heath	s																							X													
Leucopogon lanceolatus	Lance-leaf Beard-heath	s						X				X																										
Linum marginale	Native Flax														X																							

Scientific Name	Common Name	Form	TSC Act	EPBC Act	BB01	BB02	BB03	BB04	BB05	BB06	BB07	BB08	BB09	BB10	BB11	BB13	BB14	ABB01	ABB02	ABB03	ABB04	ABB05	ABB06	ABB07	ABB08	ABB09	ABB10	ABB11	ABB12	Swan1	Swan2	Swan3	Swan4	Swan5	Swan8	Besant	Pencil page	General
Livistona australis	Cabbage Tree Palm	t																			X																	
Lomandra confertifolia	Mat-rush	g													X																							
Lomandra cylindrica	-	g				X				X																												
Lomandra filiformis	Wattle Matt-rush												X																									
Lomandra filiformis subsp. coriacea	Wattle Mat-rush	g				X			X	X																												
Lomandra filiformis subsp. filiformis	Wattle Mat-rush	g										X		X																								
Lomandra longifolia	Spiky-headed Mat-rush	g				X	X	X	X	X			X	X	X	X			X		X			X			X											
Lomandra multiflora subsp. multiflora	Many-flowered Mat-rush	g			X	X	X	X	X	X			X	X		X							X															
*Ludwigia spp.**																																		X				
Maytenus silvestris	Orange Bush	s						X		X					X	X											X											
Melaleuca linariifolia	Snow in Summer	t									X										X											X					
Melaleuca stypheloides	Prickly-leaved Tea Tree	t				X					X										X				X		X			X		X	X			X		
Melicope micrococca	White Euodia, Hairy-leaved Doughwood	t																X																				
Microlaena stipoides	Weeping Grass							X			X	X		X	X								X	X			X		X										
Morinda jasminoides	Sweet Morinda	v									X																											
Myriophyllum spp.																																	X					
Myrsine variabilis	Muttonwood	s										X			X		X																					
Neofuscelia spp.																	X																					
Nicotiana glauca	Tree Tobacco	s																					X															
Notelaea longifolia	Mock Olive, Large Mock-olive	t													X		X																					
Notelaea venosa	Veined Mock Olive	t														X																						
*Ochna serrulata**	Mickey Mouse Plant	s																X	X	X																		
Opercularia diphylla	-	s						X					X																									
Opercularia spp.						X	X		X	X			X			X																						
Oplismenus aemulus	Basket Grass	g									X	X																										
Oplismenus imbecillis	-	g									X				X			X	X	X	X			X														
*Oryza sativa**	Rice																							X	X													
Oxalis perrenans	Yellow-flowered Wood Sorrel	g										X												X		X			X									
Oxylobium ilicifolium (now Podolobium ilicifolium)	Native Holly, Wiry Shaggy Pea	s			X	X	X	X					X			X																					
Pandorea pandorana	Wonga Vine	v					X					X		X																						X		
Panicum simile	Two Colour Panic	g																					X														
Parmotrema spp.																X																					
Parsonsia brownii	Mountain Silkpod																X																					
Parsonsia straminea	Common Silkpod	v						X		X	X			X				X		X	X					X												
*Paspalum dilatatum**	Paspalum	g																							X													
Paspalum distichum	Water Couch	w																												X								
Persicaria decipiens	Slender Knotweed	g																						X		X	X			X								
Persicaria hydropiper	Water Pepper	g									X																			X	X							

Scientific Name	Common Name	Form	TSC Act	EPBC Act	BB01	BB02	BB03	BB04	BB05	BB06	BB07	BB08	BB09	BB10	BB11	BB13	BB14	ABB01	ABB02	ABB03	ABB04	ABB05	ABB06	ABB07	ABB08	ABB09	ABB10	ABB11	ABB12	Swan1	Swan2	Swan3	Swan4	Swan5	Swan8	Besant	Pencil page	General
Persicaria strigosa	-	g																											X	X							
Persoonia linearis	Narrow-leaved Geebung	s			X		X			X			X	X	X														X								
Pittosporum multiflorum	Orange Thorn	s									X																										
Pittosporum revolutum	Yellow Pittosporum	s															X																				
Pittosporum spinescens (was Citriobatus pauciflorus)	Orange Thorn	s																X	X		X			X			X										
*Plantago lanceolata**	Ribwort	g																					X		X		X		X								
Platysace lanceolata	Lance-leaf Platysace	s			X	X		X																													
Plectranthus spp.											X																										
Poa labillardierei var. labillardierei	Tussock Grass	g																											X								
Polyscias sambucifolia	Elderberry Panax	s					X				X	X																									
Pomax umbellata	Pomax	g						X							X																						
Pratia purpurascens	Whiteroot	g						X		X	X	X												X			X										
Pratia spp.																X																					
Pseudanthus spp.													X		X																						
Pseuderanthemum variabile	Pastel Flower	g							X		X	X		X										X			X										
Pteridium esculentum	Bracken	g						X													X			X			X				X	X					
*Ranunculus repens**	Creeping Buttercup	g																									X										
Rapanea variabilis (now Myrsine variabilis)	Muttonwood	t									X																										
Rhodamnia rubescens	Scrub Turpentine	s																		X																	
Rubus moluccanus var. trilobus	Native Raspberry	s									X																										
Rubus parvifolius	Native Raspberry	s										X								X	X																
Rumex brownii	Swamp Dock	g									X																										
Rytidosperma longifolium						X																															
Sarcopetalum harveyanum	Pearl Vine	v									X									X	X																
*Senecio madagascariensis**	Fireweed	g																						X	X										X		
*Setaria pumila**	Pale Pigeon Grass	g																						X													
*Sida rhombifolia**	Paddy's Lucerne	g																						X			X	X									
Sigesbeckia orientalis subsp. orientalis	Indian Weed	g									X																										
Smilax australis	Lawyer Vine	v										X			X		X		X	X	X																
Smilax glyciphylla	Sarsaparilla	v					X			X						X																					
*Solanum spp.**											X																										
*Sonchus spp.**	Sowthistle																							X													
Sporobolus creber	Slender Rat's Tail Grass	g																							X			X									
Stephania japonica	Snake vine																				X						X										
Sticherus flabellatus var. flabellatus	Umbrella Fern	g																X	X																		
Stypandra glauca	Nodding Blue Lily	g																			X																
Syncarpia glomulifera	Turpentine	t																X	X	X																	
Syncarpia spp.														X																							
Synoum glandulosum subsp. glandulosum	Scentless Rosewood	t									X			X				X			X																

Scientific Name	Common Name	Form	TSC Act	EPBC Act	BB01	BB02	BB03	BB04	BB05	BB06	BB07	BB08	BB09	BB10	BB11	BB13	BB14	ABB01	ABB02	ABB03	ABB04	ABB05	ABB06	ABB07	ABB08	ABB09	ABB10	ABB11	ABB12	Swan1	Swan2	Swan3	Swan4	Swan5	Swan8	Besant	Pencil page	General
Themeda triandra	Kangaroo Grass	g				X																			X			X							X			
Trochocarpa laurina	Tree Heath	s																X	X																			
Vernonia cinerea									X																													
Veronica plebeia	Creeping Speedwell	g										X												X			X											
Viola hederacea	Ivy-leaved Violet	g																						X			X											
*Viola spp.**																																	X					
Xanthorrhoea macronema	-	g				X																																

Appendix 2

Fauna Species Inventory

Family	Common Name	Scientific Name	NSW Status	Comm Status
Myobatrachidae	Common Eastern Froglet	*Crinia signifera*	P	
Hylidae	Eastern Dwarf Tree Frog	*Litoria fallax*	P	
Hylidae	Peron's Tree Frog	*Litoria peronii*	P	
Hylidae	Tyler's Tree Frog	*Litoria tyleri*	P	
Myobatrachidae	Dusky Toadlet	*Uperoleia fusca*	P	
Columbidae	Wonga Pigeon	*Leucosarcia picata*	P	
Columbidae	Brown Cuckoo-Dove	*Macropygia amboinensis*	P	
Columbidae	Crested Pigeon	*Ocyphaps lophotes*	P	
Columbidae	Common Bronzewing	*Phaps chalcoptera*	P	
Phalacrocoracidae	Unidentified Cormorant	*Phalacrocorax sp.*	P	
Ardeidae	White-faced Heron	*Egretta novaehollandiae*	P	
Rallidae	Purple Swamphen	*Porphyrio porphyrio*	P	
Cacatuidae	Little Corella	*Cacatua sanguinea*	P	
Cacatuidae	Gang-gang Cockatoo	*Callocephalon fimbriatum*	V,P,3	
Cacatuidae	Galah	*Eolophus roseicapillus*	P	
Psittacidae	Australian King-Parrot	*Alisterus scapularis*	P	
Psittacidae	Little Lorikeet	*Glossopsitta pusilla*	V,P	
Psittacidae	Crimson Rosella	*Platycercus elegans*	P	
Psittacidae	Eastern Rosella	*Platycercus eximius*	P	
Psittacidae	Rainbow Lorikeet	*Trichoglossus haematodus*	P	
Centropodidae	Pheasant Coucal	*Centropus phasianinus*	P	
Cuculidae	Fan-tailed Cuckoo	*Cacomantis flabelliformis*	P	
Cuculidae	Pallid Cuckoo	*Cacomantis pallidus*	P	
Cuculidae	Eastern Koel	*Eudynamys orientalis*	P	
Cuculidae	Channel-billed Cuckoo	*Scythrops novaehollandiae*	P	
Strigidae	Powerful Owl	*Ninox strenua*	V,P,3	
Tytonidae	Sooty Owl	*Tyto tenebricosa*	V,P,3	
Alcedinidae	Azure Kingfisher	*Ceyx azureus*	P	
Alcedinidae	Laughing Kookaburra	*Dacelo novaeguineae*	P	
Alcedinidae	Sacred Kingfisher	*Todiramphus sanctus*	P	
Climacteridae	White-throated Treecreeper	*Cormobates leucophaea*	P	
Ptilonorhynchidae	Green Catbird	*Ailuroedus crassirostris*	P	
Ptilonorhynchidae	Satin Bowerbird	*Ptilonorhynchus violaceus*	P	
Maluridae	Superb Fairy-wren	*Malurus cyaneus*	P	
Acanthizidae	Striated Thornbill	*Acanthiza lineata*	P	
Acanthizidae	Yellow Thornbill	*Acanthiza nana*	P	
Acanthizidae	Brown Thornbill	*Acanthiza pusilla*	P	

Family	Common Name	Scientific Name	NSW Status	Comm Status
Acanthizidae	White-throated Gerygone	*Gerygone olivacea*	P	
Acanthizidae	Weebill	*Smicrornis brevirostris*	P	
Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*	P	
Pardalotidae	Striated Pardalote	*Pardalotus striatus*	P	
Meliphagidae	Eastern Spinebill	*Acanthorhynchus tenuirostris*	P	
Meliphagidae	Red Wattlebird	*Anthochaera carunculata*	P	
Meliphagidae	Yellow-faced Honeyeater	*Lichenostomus chrysops*	P	
Meliphagidae	Noisy Miner	*Manorina melanocephala*	P	
Meliphagidae	Bell Miner	*Manorina melanophrys*	P	
Meliphagidae	Lewin's Honeyeater	*Meliphaga lewinii*	P	
Meliphagidae	White-naped Honeyeater	*Melithreptus lunatus*	P	
Meliphagidae	Scarlet Honeyeater	*Myzomela sanguinolenta*	P	
Meliphagidae	Noisy Friarbird	*Philemon corniculatus*	P	
Psophodidae	Spotted Quail-thrush	*Cinclosoma punctatum*	P	
Campephagidae	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	P	
Campephagidae	Cicadabird	*Coracina tenuirostris*	P	
Pachycephalidae	Grey Shrike-thrush	*Colluricincla harmonica*	P	
Pachycephalidae	Golden Whistler	*Pachycephala pectoralis*	P	
Pachycephalidae	Rufous Whistler	*Pachycephala rufiventris*	P	
Oriolidae	Olive-backed Oriole	*Oriolus sagittatus*	P	
Artamidae	Pied Butcherbird	*Cracticus nigrogularis*	P	
Artamidae	Australian Magpie	*Cracticus tibicen*	P	
Artamidae	Grey Butcherbird	*Cracticus torquatus*	P	
Artamidae	Pied Currawong	*Strepera graculina*	P	
Rhipiduridae	Grey Fantail	*Rhipidura albiscapa*	P	
Rhipiduridae	Willie Wagtail	*Rhipidura leucophrys*	P	
Corvidae	Australian Raven	*Corvus coronoides*	P	
Monarchidae	Restless Flycatcher	*Myiagra inquieta*	P	
Monarchidae	Leaden Flycatcher	*Myiagra rubecula*	P	
Petroicidae	Eastern Yellow Robin	*Eopsaltria australis*	P	
Hirundinidae	Welcome Swallow	*Hirundo neoxena*	P	
Turdidae	Bassian Thrush	*Zoothera lunulata*	P	
Estrildidae	Red-browed Finch	*Neochmia temporalis*	P	
Tachyglossidae	Short-beaked Echidna	*Tachyglossus aculeatus*	P	
Dasyuridae	Brown Antechinus	*Antechinus stuartii*	P	
Dasyuridae	Common Dunnart	*Sminthopsis murina*	P	
Peramelidae	Long-nosed Bandicoot	*Perameles nasuta*	P	

Family	Common Name	Scientific Name	NSW Status	Comm Status
Petauridae	Yellow-bellied Glider	*Petaurus australis*	V,P	
Petauridae	Sugar Glider	*Petaurus breviceps*	P	
Phalangeridae	Common Brushtail Possum	*Trichosurus vulpecula*	P	
Macropodidae	Eastern Grey Kangaroo	*Macropus giganteus*	P	
Macropodidae	Red-necked Wallaby	*Macropus rufogriseus*	P	
Macropodidae	Swamp Wallaby	*Wallabia bicolor*	P	
Vespertilionidae	Large Forest Bat	*Vespadelus darlingtoni*	P	
Vespertilionidae	Little Forest Bat	*Vespadelus vulturnus*	P	
Muridae	Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*	V,P	
Muridae	Bush Rat	*Rattus fuscipes*	P	
Canidae	Fox	*Vulpes vulpes**		
Scincidae	Eastern Water-skink	*Eulamprus quoyii*	P	
Scincidae	Weasel Skink	*Saproscincus mustelinus*	P	
Agamidae	Jacky Lizard	*Amphibolurus muricatus*	P	
Agamidae	Eastern Water Dragon	*Physignathus lesueurii*	P	
Varanidae	Lace Monitor	*Varanus varius*	P	
Elapidae	Red-bellied Black Snake	*Pseudechis porphyriacus*	P	
Scincidae	Dark-flecked Garden Sunskink	*Lampropholis delicata*	P	
Scincidae	Three-toed Skink	*Saiphos equalis*	P	
Colubridae	Common Tree Snake	*Dendrelaphis punctulatus*	P	

Appendix 3

Likelihood of Occurrence Analysis

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Litoria aurea (Green and Golden Bell Frog)	E	V	Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available.	1	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (ie. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Litoria brevipalmata (Green-thighed Frog)	V	-	This species is distributed from south-east Queensland to the NSW Central Coast. It occurs in a range of habitat types including rainforest, moist eucalypt forest, dry eucalypt forest and heath, but is most closely associated with wetter forest types in the southern part of its range. Calling and breeding is highly correlated with heavy rainfalls that lead to the formation of large ephemeral pools in a range of sites, but always in association with some native vegetation. Calling occurring only for one or two nights at a time anywhere between September and May.	12	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Litoria littlejohni (Littlejohn's Tree Frog)	V	V	Occurs in wet and dry sclerophyll forests and heathland associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range from the Central Coast down into Victoria. Individuals have been collected from a wide range of water bodies that includes semi-permanent dams, permanent ponds, temporary pools and permanent streams, with calling occurring from fringing vegetation or on the banks. Individuals have been observed sheltering under rocks on high exposed ridges during summer and within deep leaf litter adjacent to the breeding site. Calling occurs in all months of the year, often in association with heavy rains. The tadpoles are distinctive, being large and very dark in colouration.	31	None. Suitable habitat is absent from the study area.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Heleioporus australiacus (Giant Burrowing Frog)	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with more sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis.	4	Low. It is unlikely that the species inhabits the study area and has not been recorded in the locality (10km) within the last five years. It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for breeding or important life cycle periods). Specific habitat is not present in the study area.
Mixophyes balbus (Stuttering Frog)	E	V	Associated with streams in dry sclerophyll and wet sclerophyll forests and rainforests of more upland areas of the Great Dividing Range of NSW and down into Victoria. Breeding occurs along forest streams with permanent water where eggs are deposited within nests excavated in riffle zones by the females and the tadpoles swim free into the stream when large enough to do so. Outside of breeding, individuals range widely across the forest floor and can be found hundreds of metres from water	92	Low. It is unlikely that the species inhabits the study area despite being recorded in the locality (10km) within the last five years. It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods) on available habitat. Specific habitat is not present in the study area or the species.
Mixophyes iteratus (Giant Barred Frog)	E	E	This species is found along larger streams of the coast and adjacent ranges of NSW and SE QLD. It inhabits rainforest and wet sclerophyll forest, but is also found within cleared farmland where fringing vegetation is retained, including lantana beds. Many sites where the Giant Barred Frog is known to occur are the lower reaches of streams which have been affected by major disturbances such as clearing, timber harvesting and urban development in their headwaters.	38	Low. It is unlikely that the species inhabits the study area despite being recorded in the locality (10km) within the last five years. It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods) on available habitat. Specific habitat is not present in the study area or the species.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Pseudophryne australis (Red-crowned Toadlet)	V	-	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger semi-perennial streams. After rain these creeks are characterised by a series of shallow pools lined by dense grasses, ferns and low shrubs and usually contain leaf litter for shelter. Eggs are terrestrial and laid under litter, vegetation or rocks where the tadpoles inside will reach a relatively late stage of development before waiting for flooding waters before hatching will occur.	56	None. Suitable habitat is absent from the study area.
Hoplocephalus bungaroides (Broad-headed Snake)	E	V	Occurs almost exclusively in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they spend most of the year sheltering in and under rock crevices and exfoliating rock. However, some individuals will migrate to tree hollows to find shelter during hotter parts of summer.	0	None. Suitable habitat is absent from the study area.
Hoplocephalus stephensii (Stephens' Banded Snake)	V	-	The Stephens Banded Snake is found through the coast and adjacent ranges of NSW from the Central Coast northwards and into SE Queensland. It is most commonly found living in wet sclerophyll and rainforest areas, but can be found in taller dry forest areas and even in some areas of dry forest where there is significant rock outcropping. They spend the majority of the time in tree tops, either in large hollows or in dense vegetation, coming to the ground for forage for a range of vertebrates.	10	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (ie. for breeding or important life cycle periods), or habitat is in a modified or degraded state.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Haliaeetus leucogaster (White-bellied Sea-Eagle)	V	M	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.	1	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Lophoictinia isura (Square-tailed Kite)	V	-	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata or E. smithii. Individuals appear to occupy large hunting ranges of more than 100km^2. They require large living trees for breeding, particularly near water with surrounding woodland -forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	2	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration. Has not been recorded in the locality (10km) within the last five years.
Botaurus poiciloptilus (Australasian Bittern)	E	E	The Australasian Bitterns is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.	0	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Artamus cyanopterus cyanopterus (Dusky Woodswallow)	V	-	The Dusky Woodswallow is widespread in eastern, southern and southwestern Australia. In New South Wales it is widespread from coast to inland, including the western slopes of the Great Dividing Range and farther west. It is sparsely scattered in, or largely absent from, much of the Upper Western region. The Dusky Woodswallow is often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests. At sites where Dusky Woodswallows are recorded the understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, including heath. The ground cover may consist of grasses, sedges or open ground, often with coarse woody debris (Higgins and Peter 2002). Birds are also often observed in farm land, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber.	3	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Burhinus grallarius (Bush Stone-curlew)	E	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights.	4	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration. Has not been recorded in the locality (10km) within the last five years.
Callocephalon fimbriatum (Gang-gang Cockatoo)	V	-	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine snow gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	55	Known. The species was observed in the study area during the current survey.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Calyptorhynchus lathami (Glossy Black-Cockatoo)	V	-	Inhabits forest with low nutrients, characteristically with key Allocasuarina spp. Tends to prefer drier forest types with a middle stratum of Allocasuarina below Eucalyptus or Angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina.	99	Known. The species was observed in the study area during the current survey.
Ephippiorhynchus asiaticus (Black-necked Stork)	E	-	Mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation.	16	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Climacteris picumnus victoriae (Brown Treecreeper (eastern subspecies))	V	-	Found in eucalypt woodlands (including box-gum woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and river red gum forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	3	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Irediparra gallinacea (Comb-crested Jacana)	V	-	Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies.	2	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Anthochaera phrygia (Regent Honeyeater)	CE	E,M	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. The distribution of the species has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	3	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Grantiella picta (Painted Honeyeater)	V	-	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests.	0	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Daphoenositta chrysoptera (Varied Sittella)	V	-	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.	16	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Dasyornis brachypterus (Eastern Bristlebird)	E	E	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.	0	None. Suitable habitat is absent from the study area.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Pachyptila turtur subantarctica (Fairy Prion)	-	V	The fairy prion is the smallest prion and it measures between 23 and 28 cm (9.1–11.0 in) long.[2] Its plumage is blue-grey on its upperparts, and white underneath. They have a dark "M" on their upperparts extending to their wingtips, and their tail is wedge-shaped with a dark tip. They have a blue bill and feet. The diet consists mainly of planktonic crustaceans and other tiny sea animals, which they feed at night from the water's surface. They breed colonially and prefer small islands. The nest is situated in soil, hidden by vegetation and is dug with the bill or feet, or it is in a hollow in a crevice. When coming back to their nest at night, they will coo softly and listen for their mate. The fairy prion is found throughout oceans and coastal areas in the Southern Hemisphere. Their colonies can be found on Chatham, Snares and Antipodes Islands of New Zealand, Bass Strait Islands of Australia, Falkland Islands, Marion Island, the Crozet Islands and Macquarie Island.	0	None. Suitable habitat is absent from the study area.
Glossopsitta pusilla (Little Lorikeet)	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	11	Known. The species was observed in the study area during the current survey.
Lathamus discolor (Swift Parrot)	E	CE	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects . The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW . This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	0	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration. Has not been recorded in the locality (10km) within the last five years.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Rostratula australis (Australian Painted Snipe)	E	E, M	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	0	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Limosa lapponica (Bar-tailed Godwit)	-	M	Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. It is rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips, although it is commonly recorded in paddocks at some locations overseas.	0	None. Suitable habitat is absent from the study area.
Numenius madagascariensis (Eastern Curlew)	-	CE	The Eastern curlew spends its breeding season in northeastern Asia, including Siberia to Kamchatka, and Mongolia. Its breeding habitat is composed of marshy and swampy wetlands and lakeshores. Most individuals winter in coastal Australia, with a few heading to South Korea, Thailand, Philippines and New Zealand, where they stay at estuaries, beaches, and salt marshes. It uses its long, decurved bill to probe for invertebrates in the mud. It may feed in solitary but it generally congregates in large flocks to migrate or roost. Its call is a sharp, clear whistle, cuuue-reee, often repeated.	0	None. Suitable habitat is absent from the study area.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Calidris ferruginea (Curlew Sandpiper)	E	-	The Curlew Sandpiper is distributed around most of the coastline of Australia. It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland	0	None. Suitable habitat is absent from the study area.
Ninox strenua (Powerful Owl)	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	38	Known. The species was observed in the study area during the current survey.
Tyto novaehollandiae (Masked Owl)	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.	7	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration. Has not been recorded in the locality (10km) within the last five years.
Tyto tenebricosa (Sooty Owl)	V	-	Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude less than 500 metres. Nests and roosts in hollows of tall emergent trees, mainly eucalypts often located in gullies. Nests have been located in trees 125 to 161 centimetres in diameter.	72	Known. The species was observed in the study area during the current survey.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Neophema pulchella (Turquoise Parrot)	V	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	3	Low. It is unlikely that the species inhabits the study area and has not been recorded in the locality (10km) within the last five years. It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for breeding or important life cycle periods). Specific habitat is not present in the study area.
Dasyurus maculatus maculatus (Spotted-tailed Quoll)	V	E	Spotted-tailed Quoll are found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	20	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Phascogale tapoatafa (Brush-tailed Phascogale)	V	-	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west to the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	2	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	1	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (ie. for breeding or important life cycle periods), or habitat is in a modified or degraded state.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Macropus parma (Parma Wallaby)	V	-	Once occurred from north-eastern NSW to the Bega area in the southeast. Their range is now confined to the coast and ranges of central and northern NSW from the Gosford district to the Queensland border. Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.	7	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Petrogale penicillata (Brush-tailed Rock-wallaby)	E	V	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices.	7	None. Suitable habitat is absent from the study area.
Mormopterus norfolkensis (Eastern Freetail-bat)	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	14	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Pseudomys novaehollandiae (New Holland Mouse)	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	2	Low. It is unlikely that the species inhabits the study area and has not been recorded in the locality (10km) within the last five years. It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for breeding or important life cycle periods). Specific habitat is not present in the study area.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Petaurus australis (Yellow-bellied Glider)	V	-	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	381	Known. The species was observed in the study area during the current survey.
Petaurus norfolcensis (Squirrel Glider)	V	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias. There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.	7	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (i.e. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Phascolarctos cinereus (Koala)	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall .	10	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration. Has not been recorded in the locality (10km) within the last five years.
Potorous tridactylus tridactylus (Long-nosed Potoroo)	V	V	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy.	4	Low. It is unlikely that the species inhabits the study area and has not been recorded in the locality (10km) within the last five years. It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for breeding or important life cycle periods). Specific habitat is not present in the study area.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Petauroides volans (Greater Glider)	-	V	The Greater Glider occurs in eucalypt forests and woodlands. Utilise tree hollows	126	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	58	Known. The species was observed in the study area during the current survey.
Chalinolobus dwyeri (Large-eared Pied Bat)	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	3	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (ie. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	V	-	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor . This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites .	7	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Kerivoula papuensis (Golden-tipped Bat)	V	-	Distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to Bega in southern NSW. Found in rainforest and adjacent sclerophyll forest. Roost in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests located in rainforest gullies on small first- and second-order streams.	33	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Miniopterus australis (Little Bentwing-bat)	V	-	Coastal north-eastern NSW and eastern Queensland. Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites. Little Bent-wing Bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	19	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Miniopterus schreibersii oceanensis (Eastern Bentwing-bat)	V	-	Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	31	Moderate. Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent on habitat within the study area (ie. for breeding or important life cycle periods), or habitat is in a modified or degraded state.
Myotis macropus (Southern Myotis)	V	-	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	18	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Scoteanax rueppellii (Greater Broad-nosed Bat)	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	14	High. It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods), has been recorded in the locality (10km) within the last five years and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Rutidosis heterogama	V	V	Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	6	Moderate. Potential habitat is present in the study area. The species is unlikely to be dependent on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were seasonally targeted by surveys and were not recorded. Not recorded win the locality (10km) within the last five years.
Acacia bynoeana (Bynoe's Wattle)	E	V	Grows mainly in heath and dry sclerophyll forest in sandy soils. Mainly south of Dora Creek-Morisset area to Berrima and the Illawarra region, west to the Blue Mountains, also recorded from near Kurri Kurri in the Hunter Valley and from Morton National Park.	0	None. Suitable habitat is absent from the study area.
Senna acclinis	E	-	Grows in or on the edges of subtropical and dry rainforest.	13	Moderate. Potential habitat is present in the study area. The species is unlikely to be dependent on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were seasonally targeted by surveys and were not recorded. Not recorded win the locality (10km) within the last five years.
Pelargonium sp. Striatellum (Omeo's Stork's-bill)	-	E	Flowering occurs from October to March. Occurs in habitat usually located just above the high water level of irregularly inundated or ephemeral lakes. During dry periods, the species is known to colonise exposed lake beds. The species is known to form clonal colonies by rhizomatous propagation.	0	None. Suitable habitat is absent from the study area.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Maundia triglochinoides	V	-	Grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Flowering occurs during warmer months. Diaspore is the seed and root tubers, which are probably dispersed by water.	5	Known. The species was observed in the study area during the current survey.
Angophora inopina	V	V	Endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset. Occurs most frequently in red bloodwood – scribbly gum woodland, wet heath, red mahogany – paperbark sedge woodland and stringybark – red bloodwood forest.	197	Low. It is unlikely that the species inhabits the study area despite being recorded in the locality (10km) within the last five years. Habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for important life cycle processes). Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Eucalyptus camfieldii	V	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas.	0	Low. It is unlikely that the species inhabits the study area and has not been recorded in the locality (10km) with the last five years. Habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for important life cycle processes). Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Melaleuca biconvexa (Biconvex Paperbark)	V	V	Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	206	Known. The species was observed in the study area during the current survey.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Syzygium paniculatum (Magenta Lilly Pilly)	E	V	Found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State forest. On the south coast the species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities	2	Moderate. Potential habitat is present in the study area. The species is unlikely to be dependent on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were seasonally targeted by surveys and were not recorded. Not recorded win the locality (10km) within the last five years.
Caladenia tessellata (Thick-lip Spider Orchid)	E	V	The Tessellated Spider Orchid is found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct.	0	Moderate. Potential habitat is present in the study area. The species is unlikely to be dependent on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were seasonally targeted by surveys and were not recorded. Not recorded win the locality (10km) within the last five years.
Cryptostylis hunteriana (Leafless Tongue-orchid)	V	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (Eucalyptus sclerophylla), Silvertop Ash (E. sieberi), Red Bloodwood (Corymbia gummifera) and Black Sheoak (Allocasuarina littoralis); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (C. subulata) and the Tartan Tongue Orchid (C. erecta).	0	Low. It is unlikely that the species inhabits the study area and has not been recorded in the locality (10km) with the last five years. Habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for important life cycle processes). Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Genoplesium baueri (Bauer's Midge Orchid)	E	E	Grows in dry sclerophyll forest and moss gardens over sandstone. Flowers February to March. Has been recorded between Ulladulla and Port Stephens. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded in Berowra Valley Regional Park, Royal National Park and Lane Cove National Park and may also occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments.	0	Low. It is unlikely that the species inhabits the study area and has not been recorded in the locality (10km) with the last five years. Habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for important life cycle processes). Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Genoplesium insigne (Variable Midge Orchid)	E	-	Grows in patches of kangaroo grass amongst shrubs and sedges in heathland and forest. Associated vegetation at Chain Valley Bay is described as dry sclerophyll woodland dominated by scribbly gum, red bloodwood, smooth-barked apple and black she-oak.	0	Low. It is unlikely that the species inhabits the study area despite being recorded in the locality (10km) within the last five years. Habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for important life cycle processes). Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Pterostylis gibbosa (Illawarra Greenhood)	E	E	Grows in open forest or woodland, on flat or gently sloping land with poor drainage. Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra).	0	None. Suitable habitat is absent from the study area.
Rhizanthella slateri (Underground Orchid)	V	E	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.	0	Moderate. Potential habitat is present in the study area. The species is unlikely to be dependent on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were seasonally targeted by surveys and were not recorded. Not recorded win the locality (10km) within the last five years.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Thelymitra adorata (Wyong Sun Orchid)	CE	-	Occurs from 10-40 m a.s.l. in grassy woodland or occasionally derived grassland in well-drained clay loam or shale derived soils. The vegetation type in which the majority of populations occur (including the largest colony) is a spotted gum - ironbark forest with a diverse grassy understorey and occasional scattered shrubs.	0	Low. It is unlikely that the species inhabits the study area despite being recorded in the locality (10km) within the last five years. Habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for important life cycle processes). Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Persicaria elatior	V	V	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	1	Moderate. Potential habitat is present in the study area. The species is unlikely to be dependent on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were seasonally targeted by surveys and were not recorded. Not recorded win the locality (10km) within the last five years.
Grevillea parviflora subsp. parviflora (Small-flowered Grevillea)	V	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	10	Low. It is unlikely that the species inhabits the study area despite being recorded in the locality (10km) within the last five years. Habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for important life cycle processes). Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.

Scientific Name (Common Name)	TSC Act	EPBC Act	Habitat	Number of Records (OEH 2016)	Likelihood of Occurrence
Asterolasia elegans	E	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Known from only seven populations, only one of which is wholly within a conservation reserve. Occurs on Hawkesbury sandstone in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest.	0	None. Suitable habitat is absent from the study area.
Thesium australe (Austral Toadflax)	V	V	Grows in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass.	0	None. Suitable habitat is absent from the study area.
Tetratheca juncea (Black-eyed Susan)	V	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest-woodland with a mixed shrub understorey and grassy groundcover. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. Cryptic species that requires survey in September-October.	170	Low. It is unlikely that the species inhabits the study area despite being recorded in the locality (10km) within the last five years. Habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent on available habitat (i.e. for important life cycle processes). Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.

Appendix 4

BioBanking Plot Data

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone	MU	PCT
ABB01	22	50.5	59.5	4	14	64	0	0	1	29	351460	6333232.49	56	1	HU782
ABB02	21	24.5	78	18	10	88	0	0	1	11	351482.2	6333103.9	56	1	HU 507
ABB03	30	39.5	55	22	4	58	0	0	1	12	351383.8	6333018.96	56	1	HU782
MBB14	12	38	50.5	26	0	12	0	0	1	36	351816.4	6333276.14	56	1	HU782
ABB04	31	18	80	40	6	68	0	0	1	4	351501.9	6332894.21	56	5	HU507
ABB05	33	55	38.5	68	2	42	0	2	1	5	352384.8	6331985.17	56	5	HU507
ABB06	21	3.5	4	44	0	0	92	0	1	0	352681.8	6331607.41	56	5	HU937D
ABB07	31	68.5	22.5	60	10	44	0	0	1	6	352604.8	6331451.83	56	5	HU937
ABB08	22	0	8	40	0	0	96	0	1	0	352583.4	6331338.33	56	5	HU937D
ABB10	35	46	30.5	60	0	38	2	0	1	2	352771.1	6332233.88	56	5	HU507
MBB07	37	14	63	52	2	20	0	0	1	83.5	352030.6	6332039.82	56	5	HU937
MBB13	32	43.5	7.5	60	4	0	0	11	1	50	351589	6333488	56	15	HU803
ABB12	22	72.5	10.5	74	0	16	28	0	1	0	352590.4	6332419.89	56	12c	HU798
ABT3	34	67	45	50	0	8	2	0	1	26	351359.4	6333310.14	56	12c	HU798
ABT4	31	52	7	20	2	14	0	3	1	8	351384.1	6333201.55	56	12c	HU798
MBB08	38	37.5	11	32	0	8	0	0	1	0	351784	6332450	56	12c	HU798
MBB11	33	45	3.5	82	0	8	0	0	1	0	351879.9	6332847.52	56	12c	HU798
MBB04	36	40.5	29	28	6	6	0	2	1	23	352825	6331083	56	15m	HU803
MBB03	30	52.5	4	20	12	0	0	0	1	36.5	352935	6331133	56	15n	HU803
MBB09	29	44	4	26	10	2	0	3	1	43	351942	6332572	56	15n	HU803
MBB10	32	40.5	7	40	8	0	0	2	1	46.5	352198	6332715	56	15n	HU803
MBB01	21	34.5	11	28	2	0	0	0	1	22.5	352940	6331451	56	17o	HU806
MBB02	36	35.2	1.5	38	12	0	0	1	1	20	352710	6331423	56	17o	HU806

PlotName	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	Easting	Northing	Zone	MU	PCT
MBB05	18	53	43	30	26	0	0	2	1	38	353030.1	6330965.46	56	17o	HU806
MBB06	33	33.5	16.5	88	6	2	0	1	1	52	352748	6331341	56	17o	HU806
ABB09	7	0	0	0	4	2	96	0	1	0	353191.8	6332227.86	56	cd	
ABB11	8	0	0	6	0	0	50	0	1	0	352759.6	6332071.56	56	cd	

Appendix 5

EPBC Act Assessments

Assessment of Significance for Vulnerable Flora Species

Significant Impacts	*Melaleuca biconvexa*	*Persicaria elatior*
Lead to a long-term decrease in the size of an important population.	Unlikely. This species was detected within the Study Area. However if a population was in an area of clearing it would not experience an impact such that it would experience a decrease in important population size.	Unlikely. This species was not detected within the Study Area. However if a population was in an area of clearing it would not experience an impact such that it would experience a decrease in important population size.
Reduce the area of occupancy of the species.	Unlikely. This species was detected within the site. Impacts modelling indicate an unlikely scenario resulting in a reduced area of occupancy within the Study Area.	Unlikely. This species was not detected within the site so it is unlikely that its area of occupancy within the Study Area will be reduced as a result of the associated clearing for the Project.
Fragment an existing important population into two or more populations.	Unlikely. It is considered that the proposed action with its associated subsidence impacts is unlikely to fragment any populations as a result of this Project.	Unlikely. No existing populations are known within the Study Area, however there is suitable habitat throughout the locality. It is considered that the proposed action with its associated clearing is unlikely to fragment any populations as a result of this Project.
Adversely affect habitat critical to the survival of a species.	No. Critical habitat has not been declared for this species. The expected clearing impacts involved in this Project will not affect critical habitat for this species.	No. Critical habitat has not been declared for this species. The expected clearing impacts involved in this Project will not affect critical habitat for this species.
Disrupt the breeding cycle of a population.	Unlikely. The Project would result in a small area of potential habitat removal. The Project will not result in the disruption of the breeding cycle of a population.	Unlikely. This species was not observed within the Study Area. The Project would result in a small area of potential habitat removal. The Project will not result in the disruption of the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. The maximum expected vegetation removal is not expected to destroy and/or modify habitat so that the species is likely to decline.	Unlikely. The maximum expected vegetation removal is not expected to destroy and/or modify habitat so that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.
Introduce disease that may cause the species to decline.	Unlikely. The Project is unlikely to lead to an introduced disease to the area.	Unlikely. The Project is unlikely to lead to an introduced disease to the area.
Interfere substantially with the recovery of the species.	Unlikely. The small area of clearing is not expected to impact on this species. Therefore it will not interfere substantially with the recovery of this species.	Unlikely. The small area of clearing is not expected to impact on this species therefore it will not interfere substantially with the recovery of this species.

Significant Impacts	*Rutidosis heterogama*	*Syzygium paniculatum*	*Tetratheca juncea*
Lead to a long-term decrease in the size of an important population.	Unlikely. This species was not detected within the Study Area. However if a population was in an area of clearing it would not experience an impact such that it would experience a decrease in important population size.	Unlikely. This species was not detected within the Study Area. However if a population was in an area of clearing it would not experience an impact such that it would experience a decrease in important population size.	Unlikely. This species was observed within the Study Area. No specimens of this species are required to be removed. The impacts of clearing of some small areas of low potential habitat are not expected to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of the species.	Unlikely. This species was not detected within the site so it is unlikely that its area of occupancy within the site will be reduced as a result of the associated clearing for the Project.	Unlikely. This species was not detected within the site so it is unlikely that its area of occupancy within the site will be reduced as a result of the associated clearing for the Project.	Unlikely. This species was observed within the Study Area. No specimens of this species are required to be removed. The Project will not result in the reduction in the area of occupancy of this species.
Fragment an existing important population into two or more populations.	Unlikely. No existing populations are known within the Study Area, however there is suitable habitat throughout the locality. It is considered that the proposed action with its associated clearing is unlikely to fragment any populations as a result of this Project.	Unlikely. No existing populations are known within the Study Area, however there is suitable habitat throughout the locality. It is considered that the proposed action with its associated clearing is unlikely to fragment any populations as a result of this Project.	Unlikely. It is considered that the proposed action with its associated subsidence impacts is unlikely to fragment any populations as a result of this Project.
Adversely affect habitat critical to the survival of a species.	No. Critical habitat has not been declared for this species. The expected clearing impacts involved in this Project will not affect critical habitat for this species.	No. Critical habitat has not been declared for this species. The expected clearing impacts involved in this Project will not affect critical habitat for this species.	No. Critical habitat has not been declared for this species. The expected clearing impacts involved in this Project will not affect critical habitat for this species.
Disrupt the breeding cycle of a population.	Unlikely. This species was not observed within the Study Area. The Project would result in a small area of potential habitat removal. The Project will not result in the disruption of the breeding cycle of a population.	Unlikely. This species was not observed within the Study Area. The Project would result in a small area of potential habitat removal. The Project will not result in the disruption of the breeding cycle of a population.	Unlikely. This species was not observed within the Study Area. The Project is not likely to result in a small area of potential habitat removal. The Project will not result in the disruption of the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. The maximum expected vegetation removal is not expected to destroy and/or modify habitat so that the species is likely to decline.	Unlikely. The maximum expected vegetation removal is not expected to destroy and/or modify habitat so that the species is likely to decline.	Unlikely. The maximum expected vegetation removal is not expected to destroy and/or modify habitat so that the species is likely to decline.

Significant Impacts	*Rutidosis heterogama*	*Syzygium paniculatum*	*Tetratheca juncea*
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.
Introduce disease that may cause the species to decline.	Unlikely. The Project is unlikely to lead to an introduced disease to the area.	Unlikely. The Project is unlikely to lead to an introduced disease to the area.	Unlikely. The Project is unlikely to lead to an introduced disease to the area.
Interfere substantially with the recovery of the species.	Unlikely. The small area of clearing is not expected to impact on this species therefore it will not interfere substantially with the recovery of this species.	Unlikely. The small area of clearing is not expected to impact on this species. Therefore it will not interfere substantially with the recovery of this species.	Unlikely. The small area of clearing is not expected to impact on this species therefore it will not interfere substantially with the recovery of this species.

Significant Impacts	*Caladenia tessellata*	*Cryptostylis hunteriana*
Lead to a long-term decrease in the size of an important population.	Unlikely. This species was observed within the Study Area. No specimens of this species are required to be removed. The impacts of clearing of some small areas of low potential habitat are not expected to lead to a long-term decrease in the size of an important population.	Unlikely. This species was not detected within the Study Area. However if a population was in an area of clearing it would not experience an impact such that it would experience a decrease in important population size.
Reduce the area of occupancy of the species.	Unlikely. This species was observed within the site. No specimens of this species are required to be removed. The Project will not result in the reduction in the area of occupancy of this species.	Unlikely. This species was not detected within the Study Area so it is unlikely that its area of occupancy within the site will be reduced as a result of the associated clearing for the Project.
Fragment an existing important population into two or more populations.	Unlikely. At least one population is known within the Study Area. It is considered unlikely that any populations will be fragmented as a result of the expected clearing associated with this Project.	Unlikely. It is considered that the proposed action with its associated subsidence impacts is unlikely to fragment any populations as a result of this Project.
Adversely affect habitat critical to the survival of a species.	No. Critical habitat has not been declared for this species. The expected clearing impacts involved in this Project will not affect critical habitat for this species.	No. Critical habitat has not been declared for this species. The expected clearing impacts involved in this Project will not affect critical habitat for this species.
Disrupt the breeding cycle of a population.	Unlikely. This species was observed within the Study Area. No specimens of this species are required to be removed. The Project will not result in the disruption of the breeding cycle of a population.	Unlikely. This species was not observed within the Study Area. The Project is not likely to result in a small area of potential habitat removal. The Project will not result in the disruption of the breeding cycle of a population.

Significant Impacts	*Caladenia tessellata*	*Cryptostylis hunteriana*
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. The maximum expected vegetation removal is not expected to destroy and/or modify habitat so that the species is likely to decline.	Unlikely. The maximum expected vegetation removal is not expected to destroy and/or modify habitat so that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.
Introduce disease that may cause the species to decline.	Unlikely. The Project is unlikely to lead to an introduced disease to the area.	Unlikely. The Project is unlikely to lead to an introduced disease to the area.
Interfere substantially with the recovery of the species.	Unlikely. The small area of clearing is not expected to impact on this species therefore it will not interfere substantially with the recovery of this species.	Unlikely. The small area of clearing is not expected to impact on this species therefore it will not interfere substantially with the recovery of this species.

Assessment of Significance for Vulnerable Fauna Species

Significant Impacts	Koala	Grey-headed Flying-fox
Lead to a long-term decrease in the size of an important population.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present. This species will not be losing any significant habitat due to the Project and associated clearing within the Study Area. Therefore no long-term decrease in population size will occur.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present throughout the Study Area. This species is highly mobile and will not be losing any significant habitat due to the Project and associated clearing within the site. Therefore no long-term decrease in population size will occur.
Reduce the area of occupancy of the species.	Unlikely. This species was not detected within the Study Area so it is unlikely that its area of occupancy within the Study Area will be reduced as a result of the Project.	Unlikely. This species was not detected within the site so it is unlikely that its area of occupancy within the site will be reduced as a result of the Project.
Fragment an existing important population into two or more populations.	Unlikely. No existing populations are known within the Study Area so it is unlikely that any populations will be fragmented as a result of this Project.	Unlikely. No existing populations are known within the site so it is unlikely that any populations will be fragmented as a result of this Project.
Adversely affect habitat critical to the survival of a species.	Unlikely. Critical habitat for this species survival does not exist within the Study Area.	Unlikely. This species is highly mobile and critical habitat for this species survival does not exist within the Study Area.
Disrupt the breeding cycle of a population.	Unlikely. The Study Area is potentially used for foraging however no breeding activity is likely. No Koala activity is known in the area. On this basis it is considered that the Project would not disrupt the breeding cycle of a population.	Unlikely. No Camps or breeding sites were observed within the site. The Study Area is potentially used for foraging not breeding and this species is capable of moving to other nearby areas easily if required.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. The removal of potential foraging habitat within the Study Area is not likely to cause the species to decline.	Unlikely. The removal of potential foraging habitat within the Study Area is not likely to cause the species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.
Introduce disease that may cause the species to decline.	Unlikely. The Project is not expected to introduce any diseases that may cause this species to decline.	Unlikely. The Project is not expected to introduce any diseases that may cause this species to decline.
Interfere substantially with the recovery of the species.	Unlikely. The Koala is not known to occur within the Study Area or locality. If occurring, presence would be rare and transient. Habitat loss would not substantially interfere with the recovery of the species.	Unlikely. The Grey-headed Flying Fox is known to occur within the locality. If occurring, presence would be limited to foraging. Retained high value habitat to be avoided. Habitat loss would not substantially interfere with the recovery of the species.

Significant Impacts	Greater Glider	Large-eared Pied Bat
Lead to a long-term decrease in the size of an important population.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present throughout the Study Area. This species will remain able to forage and breed despite the Project going ahead. . Therefore no long-term decrease in population size will occur.	Unlikely. No known roosting sites for this species are located within the Study Area. This species has not been detected foraging within the Study Area. Therefore, it is considered that the Project will not lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of the species.	Unlikely. This species was not detected within the Study Area so it is unlikely that its area of occupancy within the Study Area will be reduced as a result of the Project.	Unlikely. No known roosting sites for this species are located within the Study Area. This species has not been detected foraging within the Study Area. Large areas of potential foraging habitat will be retained in the locality. Therefore, it is considered that the Project will not reduce the area of occupancy of the species.
Fragment an existing important population into two or more populations.	Unlikely. No existing populations are known within the Study Area so it is unlikely that any populations will be fragmented as a result of this Project.	Unlikely. A small area of potential foraging habitat for this species is required to be removed. The Project will not result in the fragmentation of an existing population.
Adversely affect habitat critical to the survival of a species.	Unlikely. Critical habitat for this species survival does not exist within the Study Area.	No. Critical habitat has not been declared for this species. The expected clearing involved in this Project will not affect critical habitat for this species.
Disrupt the breeding cycle of a population.	Unlikely. The Study Area is potentially used for foraging and breeding however despite the Projects proposal; this species will remain able to breed within the Study Area. Additionally, this species is capable of moving to other nearby areas easily if required.	Unlikely. A small area of potential foraging habitat for this species is required to be removed. No breeding habitats such as maternity caves or mineshafts are to be disturbed. Therefore, the Project should not interfere with the breeding cycle of this species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. The potential modification of habitats from ponding is not expected to contribute to a decline in this species.	Unlikely. The removal of potential foraging habitat within the Study Area is not likely to cause the species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.
Introduce disease that may cause the species to decline.	Unlikely. The Project is not expected to introduce any diseases that may cause this species to decline.	Unlikely. The Project is not expected to introduce any diseases that may cause this species to decline.
Interfere substantially with the recovery of the species.	Unlikely. Given the minor impacts associated with ponding, the Project is not expected to interfere substantially with the recovery of this species.	Unlikely. Roost habitat for the Large-eared Pied Bat is not known to occur within the Study Area. Species presence would be rare and transient. Retained high value habitat to be avoided. Habitat loss would not substantially interfere with the recovery of the species.

Significant Impacts	Green and Golden Bell Frog	Giant Burrowing Frog	Stuttering Frog
Lead to a long-term decrease in the size of an important population.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present. This species will not be losing any significant habitat due to the Project and associated clearing within the Study Area. Therefore no long-term decrease in population size will occur.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present throughout the Study Area. Therefore no long-term decrease in population size will occur.	Unlikely. This species has not been detected foraging within the Study Area. Therefore, it is considered that the Project will not lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of the species.	Unlikely. This species was not detected within the Study Area so it is unlikely that its area of occupancy within the Study Area will be reduced as a result of the Project.	Unlikely. This highly mobile species was detected within the Study Area. The Study Area is used by this species for foraging only. Therefore, it is unlikely that its area of occupancy within the Study Area will be reduced as a result of the Project.	Unlikely. This species has not been detected foraging within the Study Area. No habitat is being removed for the Project. Therefore, it is considered that the Project will not reduce the area of occupancy of the species.
Fragment an existing important population into two or more populations.	Unlikely. No existing populations are known within the Study Area so it is unlikely that any populations will be fragmented as a result of this Project.	Unlikely. No existing populations are known within the Study Area so it is unlikely that any populations will be fragmented as a result of this Project.	Unlikely. The Project will not result in the fragmentation of an existing population.
Adversely affect habitat critical to the survival of a species.	Unlikely. Critical habitat for this species survival does not exist within the Study Area.	Unlikely. Critical habitat has not been declared for this species. The expected clearing involved in this Project will not affect critical habitat for this species.	No. Critical habitat has not been declared for this species. The expected clearing involved in this Project will not affect critical habitat for this species.
Disrupt the breeding cycle of a population.	Unlikely. The Study Area is unlikely to be used for breeding purposes.	Unlikely. The Study Area is unlikely to be used for breeding purposes.	Unlikely. Foraging habitat only exists on site. Therefore, the Project should not interfere with the breeding cycle of this species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. The removal of potential foraging habitat within the Study Area is not likely to cause the species to decline.	Unlikely. The removal of potential foraging habitat within the site is not likely to cause the species to decline.	Unlikely. The removal of potential foraging habitat within the site is not likely to cause the species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.

Significant Impacts	Green and Golden Bell Frog	Giant Burrowing Frog	Stuttering Frog
Introduce disease that may cause the species to decline.	Unlikely. The Project is not expected to introduce any diseases that may cause this species to decline.	Unlikely. The Project is not expected to introduce any diseases that may cause this species to decline.	Unlikely. The Project is not expected to introduce any diseases that may cause this species to decline.
Interfere substantially with the recovery of the species.	Unlikely. The Green and Golden Bell Frog is not known to occur within the Study Area. If occurring, its presence would be rare and transient. The Project is unlikely to interfere with the recovery of this species.	Unlikely. The Giant Burrowing Frog is known to occur within the Study Area. If occurring, its presence would be limited to foraging. The Project is unlikely to interfere with the recovery of this species.	Unlikely. Habitat for the Stuttering Frog is not known to occur within the Study Area. The Project is unlikely to interfere with the recovery of this species.

Assessment of Significance for Endangered Species

Significant Impacts	Regent Honeyeater	Swift Parrot
Lead to a long-term decrease in the size of a population.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present. High value habitat has been avoided. Therefore no long-term decrease in population size will occur.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present. High value habitat has been avoided. Therefore no long-term decrease in population size will occur.
Reduce the area of occupancy of the species.	Unlikely. The Project is not likely to reduce the area of occupancy of the species.	Unlikely. The Project is not likely to reduce the area of occupancy of the species.
Fragment an existing important population into two or more populations.	Unlikely. The Project is unlikely to result in the fragmentation of an existing population into two or more populations.	Unlikely. The Project is unlikely to result in the fragmentation of an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species.	Unlikely. Habitat critical to the survival of this species includes Swamp Mahogany, which is to be avoided by the Project.	Unlikely. Habitat critical to the survival of this species includes Swamp Mahogany, which is to be avoided by the Project.
Disrupt the breeding cycle of a population.	Unlikely. The Study Area is potentially used for foraging not breeding. The Project is not likely to disrupt breeding activity.	Unlikely. The Study Area is potentially used for foraging not breeding. The Project is not likely to disrupt breeding activity.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. Habitat availability and quality will not be reduced by the Project. The Project is not likely to cause the species to decline.	Unlikely. Habitat availability and quality will not be reduced by the Project. The Project is not likely to cause the species to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	Unlikely. It is unlikely that the Project will increase in invasive species harmful to this species.	Unlikely. It is unlikely that the Project will increase in invasive species harmful to this species.
Introduce disease that may cause the species to decline.	Unlikely. There are no diseases which have been associated with the decline of this species. As a consequence the Project is not expected to introduce any diseases that may cause this species to decline.	Unlikely. There are no diseases which have been associated with the decline of this species. As a consequence the Project is not expected to introduce any diseases that may cause this species to decline.
Interfere with the recovery of the species.	Unlikely. The Regent Honeyeater is not known to occur within the Study Area. If occurring, presence would be rare and transient. The Project is unlikely to substantially interfere with the recovery of the species	Unlikely. The Swift Parrot is not known to occur within the Study Area. If occurring, presence would be rare and transient. The Project is unlikely to substantially interfere with the recovery of the species.

Significant Impacts	Australasian Bittern	Australian Painted Snipe
Lead to a long-term decrease in the size of a population.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present. This species will remain able to forage despite the Project going ahead. Therefore no long-term decrease in population size will occur.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present. High value habitat has been avoided. Therefore no long-term decrease in population size is likely occur.
Reduce the area of occupancy of the species.	Unlikely. This species was not detected within the Study Area so it is unlikely that its area of occupancy within the Study Area will be reduced as a result of the Project.	Unlikely. The Project is not likely to reduce the area of occupancy of the species, considering it was not detected during surveys.
Fragment an existing important population into two or more populations.	Unlikely. No existing populations are known within the Study Area so it is unlikely that any populations will be fragmented as a result of this Project.	Unlikely. The Project is not likely to result in the fragmentation of an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species.	Unlikely. Critical habitat for this species survival does not exist within the Study Area.	Unlikely. No critical habitat has been described for this species.
Disrupt the breeding cycle of a population.	Unlikely. The Study Area is potentially used for foraging however no breeding activity is likely. On this basis it is considered that the Project would not disrupt the breeding cycle of a population.	Unlikely. The Study Area is potentially used for foraging not breeding. The Project is not likely to disrupt breeding activity.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. The potential modification of habitats from ponding is not expected to contribute to a decline in this species.	Unlikely. Habitat predicted to be minimally impacted by ponding is not expected to be altered such that it would cause a decline in this species.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	Unlikely. It is unlikely that the affected area will experience an increase in invasive species due to the Project.	Unlikely. It is unlikely that the Project will increase in invasive species harmful to this species.
Introduce disease that may cause the species to decline.	Unlikely. The Project is not expected to introduce any diseases that may cause this species to decline.	Unlikely. There are no diseases which have been associated with the decline of this species. As a consequence the Project is not expected to introduce any diseases that may cause this species to decline.
Interfere with the recovery of the species.	Unlikely. Given the minor impacts associated with ponding, the Project is not expected to interfere substantially with the recovery of this species.	Unlikely. Given the minor impacts associated with ponding, the Project is not expected to interfere substantially with the recovery of this species.

Significant Impacts	Spotted-tail Quoll	Giant Barred Frog
Lead to a long-term decrease in the size of a population.	Unlikely. This species was not detected within the Study Area, however suitable foraging habitat is present. High value habitat has been avoided. Therefore no long-term decrease in population size will occur.	Unlikely. This species was not detected within the Study Area, however suitable foraging and breeding habitat is present. High value habitat has been avoided. Therefore no long-term decrease in population size is likely occur.
Reduce the area of occupancy of the species.	Unlikely. The Project is not likely to reduce the area of occupancy of the species.	Unlikely. The Project is not likely to reduce the area of occupancy of the species, considering it was not detected during surveys.
Fragment an existing important population into two or more populations.	Unlikely. The Project is unlikely to result in the fragmentation of an existing population into two or more populations.	Unlikely. The Project is not likely to result in the fragmentation of an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species.	Unlikely. The area affected is not considered critical habitat and is unlikely to affect the survival of this species.	Unlikely. No critical habitat has been described for this species.
Disrupt the breeding cycle of a population.	Unlikely. The Study Area is potentially used for foraging and breeding. Predicted ponding impacts are not expected to impact on habitats relied upon by this species. The Project is not likely to disrupt breeding activity.	Unlikely. The Study Area is potentially used for foraging and breeding however despite the Projects proposal; this species will remain able to breed within the Study Area. Additionally, this species is capable of moving to other nearby areas easily if required.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. Habitat availability and quality will not be reduced by the Project. The Project is not likely to cause the species to decline.	Unlikely. Habitat predicted to be minimally impacted by ponding is not expected to be altered such that it would cause a decline in this species.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	Unlikely. It is unlikely that the Project will increase in invasive species harmful to this species.	Unlikely. It is unlikely that the Project will increase in invasive species harmful to this species.
Introduce disease that may cause the species to decline.	Unlikely. There are no diseases which have been associated with the decline of this species. As a consequence the Project is not expected to introduce any diseases that may cause this species to decline.	Unlikely. There are no diseases which have been associated with the decline of this species. As a consequence the Project is not expected to introduce any diseases that may cause this species to decline.
Interfere with the recovery of the species.	Unlikely. The Spotted-tailed Quoll is not known to occur within the Study Area. If occurring, presence would be rare and transient. The Project is unlikely to substantially interfere with the recovery of the species.	Unlikely. Given the minor impacts associated with ponding, the Project is not expected to interfere substantially with the recovery of this species.

Significant Impacts	Rhizanthella slateri
Lead to a long-term decrease in the size of a population.	Unlikely. This species was not detected during surveys, and only potential habitat exists for this species. Therefore no long-term decrease in population size is likely occur.
Reduce the area of occupancy of the species.	Unlikely. The Project is not likely to reduce the area of occupancy of the species, considering it was not detected during surveys.
Fragment an existing important population into two or more populations.	Unlikely. The Project is not likely to result in the fragmentation of an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species.	Unlikely. No critical habitat has been described for this species.
Disrupt the breeding cycle of a population.	Unlikely. Despite the Projects proposed activities, this species' ability to breed would remain viable if it went ahead.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	Unlikely. Habitat predicted to be minimally impacted by ponding is not expected to be altered such that it would cause a decline in this species.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	Unlikely. It is unlikely that the Project will increase in invasive species harmful to this species.
Introduce disease that may cause the species to decline.	Unlikely. There are no diseases which have been associated with the decline of this species. As a consequence the Project is not expected to introduce any diseases that may cause this species to decline.
Interfere with the recovery of the species.	Unlikely. Given the minor impacts associated with ponding, the Project is not expected to interfere substantially with the recovery of this species.

Appendix 2

BioBanking Credit Report

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 24/04/2017 Time: 2:44:35PM Calculator version: v4.0

Major Project details

Proposal ID:	161/2017/4211MP
Proposal name:	Mandalong Modification - Longwalls 24-24a
Proposal address:	Mandalong Coal Mine Mandalong NSW 2264
Proponent name:	Centennial Mandalong Pty Ltd
Proponent address:	Mandalong Road Mandalong NSW NSW 2264
Proponent phone:	(0) 2 4935 8901
Assessor name:	Arne Bishop
Assessor address:	PO Box 428 Hamilton NSW 2303
Assessor phone:	02 4940 4200
Assessor accreditation:	161

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion	8.36	47.00
Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast	3.16	17.00
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	1.82	10.00
Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast	1.42	19.46
Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast	24.41	132.00
Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter	0.49	3.00
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	17.82	96.00
Total	57.48	324

Credit profiles

1. White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley, (HU798)

Number of ecosystem credits created	96
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley, (HU798) Tallowwood - Small-fruited Grey Gum - Kangaroo Grass grassy tall open forest on foothills of the lower North Coast, (HU762) Tallowwood - Smooth-barked Apple - Blackbutt grass tall open forest of the Central and lower North Coast, (HU770) Pink Bloodwood - Thin-leaved Stringybark - Grey Ironbark shrub - grass open forest on ranges of the lower North Coast, (HU772)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion, (HU507)

Number of ecosystem credits created	47
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
Blackbutt - Narrow-leaved White Mahogany shrubby tall open forest of coastal ranges, northern Sydney Basin Bioregion, (HU507) Sweet Pittosporum - Forest Oak - Rough-barked Apple depauparate gully rainforest on the Liverpool Range, (HU724) New England Blackbutt moist very tall open forest on the southern escarpment of the Liverpool Range to Barrington Tops region, southern Brigalow Belt South Bioregion to NSW North Coast Bioregion, (HU705) Large-fruited Grey Gum - White Mahogany shrub - grass open forest on the slopes of Barrington Tops and lower North Coast, (HU775) Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast, (HU782) Flooded Gum - Brush Box - Tallowwood mesic tall open forest on ranges of the lower North Coast, (HU783) Messmate - Forest Ribbon Gum - New England Blackbutt shrub - grass tall open forest of Barrington Tops and Northern Tablelands escarpment, (HU789)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast, (HU782)

Number of ecosystem credits created	17
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast, (HU782) Flooded Gum - Brush Box - Tallowwood mesic tall open forest on ranges of the lower North Coast, (HU783)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

4. Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803)

Number of ecosystem credits created	132
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

5. Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806)

Number of ecosystem credits created	3
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
Spotted Gum - Red Ironbark - Grey Gum shrub - grass open forest of the Lower Hunter, (HU806) Melaleuca decora low forest of the central Hunter Valley, Sydney Basin Bioregion, (HU564) Slaty Red Gum grassy woodland on hinterland foothills of the southern North Coast, (HU619) Grey Ironbark - Broad-leaved Mahogany - Forest Red Gum shrubby open forest on Coastal Lowlands of the Central Coast, (HU802) Spotted Gum - Broad-leaved Mahogany - Grey Gum grass - shrub open forest on Coastal Lowlands of the Central Coast, (HU803) Spotted Gum - Broad-leaved Mahogany - Red Ironbark shrubby open forest, (HU804) Red Ironbark - Spotted Gum - Prickly-leaved Paperbark shrubby open forest of the Lower Hunter, (HU807) Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter, (HU814) Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter, (HU815) Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest of the central and lower Hunter, (HU816) Grey Box - Grey Gum - Rough-barked Apple - Blakely's Red Gum grassy open forest of the central Hunter, (HU822)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

6. Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, (HU533)

Number of ecosystem credits created	10
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, (HU533) Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion, (HU673) Cladium procerum coastal freshwater wetland, (HU949) Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter, (HU950) Typha rushland, (HU951) Tall Spike Rush freshwater wetland, (HU954) Lepironia articulata sedgeland, (HU955) Jointed Twig-rush sedgeland, (HU956)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

7. Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast, (HU937)

Number of ecosystem credits created	14
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast, (HU937)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

8. Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast, (HU937)

Number of ecosystem credits created	5
IBRA sub-region	Wyong

Offset options - Plant Community types	Offset options - IBRA sub-regions
Melaleuca biconvexa - Swamp Mahogany - Cabbage Palm swamp forest of the Central Coast, (HU937)	Wyong and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Maundia triglochinoides	Maundia triglochinoides	20.00	520
Biconvex Paperbark	Melaleuca biconvexa	5.00	65