Hydro Aluminium Kurri Kurri Smelter Remediation and Demolition

Ecological Assessment

Prepared for
Hydro Aluminium Kurri Kurri Pty Ltd
July 2016

DOCUMENT TRACKING

Item	Detail
Project Name	Former Hydro Aluminium Kurri Kurri Smelter Demolition and Remediation - Ecological
Project Number	765
Project Manager	David Bonjer 02 8536 8668
Prepared by	Daniel McKenzie, Vivian Tan
Reviewed by	Antony von Chrismar
Approved by	David Bonjer
Status	Final
Version Number	2
Last saved on	4 July 2016
Cover photo	Kurri Sand Swamp EEC, Squirrel Gliders investigating nest box, Forester Moth (*Pollanisus* sp.). Photos by Daniel McKenzie and remote camera.

This report should be cited as 'Eco Logical Australia 2015. *Kurri Hydro Aluminium Smelter Demolition Project - Ecological Assessment*. Prepared for Hydro.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Shaun Taylor of Ramboll Environ, Shannon Sullivan of ESS and Kerry McNaughton of Hydro.

Contents

Executive summary **1**

1 Introduction **1**

1.1 Background 1

1.2 Objectives 2

2 Project description **2**

2.1 Concurrent Activities 5

3 Existing environment **7**

4 Methods **7**

4.1 Literature review 7

4.2 Flora survey 9

4.2.1 Biometric plots and rapid vegetation assessment 9

4.2.2 Threatened flora surveys 9

4.3 Fauna survey 12

4.3.1 Hair sampling and analysis 12

4.3.2 Nest box inspection 12

4.3.3 Camera traps 12

4.3.4 Spotlight survey 12

4.3.5 Microbat echolocation call recording and identification 12

4.3.6 Call playback 12

4.3.7 Amphibian survey 13

4.3.8 Bird survey 14

5 Results **16**

5.1 Literature review 16

5.1.1 CENwest (2004) *Terrestrial Vertebrate Fauna Assessment* 16

5.1.2 Greg Richards and Associates (2004) *Bat Fauna Assessment* 17

5.1.3 FloraSearch (2004) *Flora Assessment* 17

5.1.4 CENwest (2010) – Avifauna Monitoring Survey, Hydro Aluminium Property, Kurri Kurri, November 2010 18

5.1.5 FloraSearch 2011 – 2010 Spring Survey of the Hazard Reduction Burn Area 18

5.1.6 Roderick et. al (2013) – Swift Parrots and Regent Honeyeaters in the Lower Hunter Region of NSW – An Assessment of Status, Identification of High Priority Habitats and Recommendations for Conservation 19

5.1.7 Eco Logical Australia 2013 – Lower Hunter Koala Study 19

5.1.8 DECC (2007) – The Green and Golden Bell Frog Key Population in the Middle Hunter 20
5.1.9 Database search 20
5.2 Vegetation communities 21
5.3 Flora 25
5.4 Fauna 29

6 Impact assessment 35
6.1 Impact avoidance 35
6.2 Vegetation 35
6.3 Threatened species 35
6.4 Summary of assessment under s5A of the EP&A Act 36
6.5 Summary of assessment under EPBC Act 36
6.6 SEPP 44 Koala Habitat Protection 36
6.7 Koala EPBC Act referral assessment 36

7 Biobanking assessment 38
7.1 Landscape values assessment 38
7.1.1 Assessment circles 38
7.1.2 Connectivity assessment 38
7.1.3 CMA Region and CMA Subregion 39
7.1.4 Patch Size and Mitchell Landscape 39
7.2 Assessment of threatened species 42
7.2.1 Predicted species 42
7.2.2 Threatened species habitat 42
7.3 Credit calculations 43
7.3.1 Ecosystem credits 43
7.3.2 Species credits 43

8 Conclusion and statement of commitments for biodiversity 47
8.1 Biodiversity statement of commitments 47

References 49

Appendix A : Fauna Species List for Study Area 50

Appendix B : Flora Species List 58

Appendix C : Likelihood of Occurrence Table 62

Appendix D : Assessment of Significance 88

Appendix E : Assessment of Significance under the EPBC Act 114

Appendix F : Field staff CV's and qualifications 121

List of figures

Figure 1: Location of the Study Area (Hydro land) and the project site 6
Figure 2: Biobanking and threatened flora quadrats 10
Figure 3: Area covered during searches for threatened flora within and adjacent to the Project site 11
Figure 4: Fauna survey methods and survey locations 15
Figure 5: Plant Community Types within the Project site 24
Figure 6: Recorded threatened flora locations and EEC's within Hydro land. 27
Figure 7: Threatened flora and EEC's within and surrounding the project site*. 28
Figure 8: Threatened and Migratory Fauna within and surrounding Hydro land. 34
Figure 9: Assessment circles 40
Figure 10: Connectivity 41
Figure 11: Green-thighed Frog habitat 44
Figure 12: Koala habitat 44
Figure 13: Myotis habitat 45
Figure 14: Regent Honeyeater habitat 45
Figure 15: *Eucalyptus parramattensis* habitat 46
Figure 16: Small-flowered Grevillea locations and habitat 46

List of tables

Table 1: SEARs Scenario 2 requirements and relevant section of report. 2
Table 2: Outline of the Project 2
Table 3: Type of amphibian survey, location, date and weather 13
Table 4: Threatened species recorded within the study area by CENwest (2004) 16
Table 5: Species recorded within the study area by Greg Richards and Associates (2004) 17
Table 6: Vegetation Types recorded within the study area by FloraSearch (2004) 17

Table 7: Threatened flora species recorded in the study area by FloraSearch (2004) 18

Table 8: Plant Community Types (PCTs) within the Project site 23

Table 9: Listed threatened flora species found in the study area 25

Table 10: Threatened and migratory species recorded by ELA or considered likely to utilise the Project site. 30

Table 11: Plant community types and EEC's proposed to be impacted and what is available in the Hydro land. 35

Table 12: Area of vegetation in each assessment circle before and after. 38

Table 13: Width classes before and after 39

Table 14: Condition classes before and after (PFC – Projected Foliage Cover) 39

Table 15: Predicted threatened species 42

Table 16: Threatened species credits. 43

Table 17: Ecosystem credits required 43

Table 18: Species credits required. 43

Table 19: Flora species list from biometric quadrat in Kurri Sand Swamp Woodland within the Project site 58

Table 20: Flora species list from biometric quadrat in Lower Hunter Spotted Gum/ Ironbark forest within the Project site 59

Abbreviations

Abbreviation	Description
API	Aerial Photo Interpretation
BBAM	Biobanking Assessment Methodology
BCAM	Biodiversity Certification Assessment Methodology
CBD	Central Business District
DECC	Department of Environment and Climate Change
DECCW	NSW Department of Environment, Climate Change and Water (now OEH)
DP&I	NSW Department of Planning and Infrastructure (now NSW Department of Planning and Environment)
DPE	NSW Department of Planning and Environment
DoE	Commonwealth Department of the Environment
DoP	NSW Department of Planning (now NSW Department of Planning and Environment)
DSEWPaC	Commonwealth Department of Sustainability Environment, Water, Population and Communities (now Commonwealth Department of the Environment)
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EP&A Act	*Environmental Planning and Assessment Act 1979*
GIS	Geographic Information System
GGBF	Green and Golden Bell Frog
LGA	Local Government Area
NPW Act	*National Parks and Wildlife Act 1974*
NPWS	NSW National Parks and Wildlife Service (now part of OEH)
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PFC	Projected Foliage Cover
SEARs	Secretary's Environmental Assessment Requirements
TSC Act	NSW *Threatened Species Conservation Act 1995*
TSPD	Threatened Species Profile Database

Executive summary

Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) is proposing the demolition and remediation of the Hydro Aluminium Smelter site located near Kurri Kurri NSW (the Project). The Project includes the demolition of the smelter, management of waste and remediation of the Project site.

The Project is comprised of the following key elements:

- The Works. The Works are the activities required to make the Project site suitable for future use. The key element of the Works is the construction of a waste management facility, comprising a state of the art, modern and purpose built containment cell.

Other ancillary elements of the Works are:

  - Demolition of the remaining Smelter buildings and structures.
  - Site remediation.
  - Leachate and groundwater treatment.

- Containment Cell Management. Following completion of the Works, the containment cell would be subject to a monitoring and management program.

The removal of approximately 2.5 ha of native (intact) vegetation is required for demolition activities and construction of a containment cell in the north-western section of the Project site and dust suppression activities (vehicular access to dams and facilities for the filling of water carts) in the north east section of the Project site.

Eco Logical Australia (ELA) was commissioned by Hydro to conduct ecological investigations and provide a subsequent biodiversity assessment report for the Project.

The vegetation proposed to be removed was determined to consist of two Endangered Ecological Communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) , these being: *Kurri Sand Swamp Woodland in the Sydney Basin Bioregion* and *Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion*.

The threatened species; *Petaurus norfolcensis* (Squirrel Glider), *Glossopsitta pusilla* (Little Lorikeet) *Eucalyptus parramattensis* subsp. *decadens* (Parramatta Red Gum) and *Grevillea parviflora* subsp. *parvifora* (Small-flower Grevillea) were detected within the Project site. The threatened plant *Callistemon linearifolius* (Netted Bottlebrush) was observed to occur adjacent to the Project site but would not be impacted under the Project. Threatened species that were considered 'likely' or have 'potential' to occupy or utilise the native vegetation proposed to be removed within the Project site are provided in **Table 8**.

An assessment of impacts on those species and communities listed under the TSC Act or *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) 'known', considered 'likely' or have 'potential' to utilise the Project site was conducted. It was determined the Project was unlikely to have a significant impact on the species assessed primarily due to the relatively small area of native vegetation proposed to be impacted and it's relatively disturbed state, given it's near proximity to an aluminium smelter (**Appendix D** and **Appendix E**).

This report has been prepared to fulfil the biodiversity assessment requirements as listed in the Secretary's Environmental Assessment Requirements (SEARs). **Table 1** provides a guide indicating where each requirement of the SEARs are addressed in the report. This report provides the information necessary to address 'scenario 2' of the SEARs, whereby a traditional impact assessment on

threatened biodiversity potentially impacted by the Project has been prepared. In addition, based on consultation with the Office of Environment and Heritage (OEH), the Project was considered to require biodiversity offsets. Credit calculations using the BioBanking Assessment Methodology (BBAM) have been completed to inform the quantum of credits necessary to offset the impacts of the Project. It is proposed that the required number of ecosystem and species credits will be sourced within the broader Hydro land around the Project site and the credit transfer is to be completed subsequent to a BCAM assessment on the Hydro land.

Table 1: SEARs Scenario 2 requirements and relevant section of report.

SEAR Scenario 2 requirement	Report section
1. The EA should include a detailed biodiversity assessment, including assessment of impacts on threatened biodiversity, native vegetation and habitat. This assessment should address the matters included in the following sections	This report
2. A field survey of the site should be conducted and documented in accordance with relevant guidelines, including: • Threatened Biodiversity Survey and Assessment: Guidelines for Development and Activities – Working Draft • Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians • Threatened species survey and assessment guideline	**Section 4** and **5**
3. The EA should contain the following information as a minimum:	
a. The requirements set out in the *Guidelines for Threatened Species Assessment* (Department of Planning July 2005).	**Section 4**
b. Description and geo-referenced mapping of study area.	**Section 1.2 Figure 1**
c. Description of survey methodologies used, including timing, location and weather conditions.	**Section 4.3**
d. Details, including qualifications and experience of all staff undertaking the surveys, mapping and assessment of impacts as part of the EA.	**Appendix F**
e. Detailed description of all vegetation communities (both forested and non-woody e.g. derived grasslands), including classification and methodology used to classify) and including all plot data. Plot data should be supplied to the OEH in electronic format (e.g. MS-Excel) and organised by vegetation community. Copies of all plot data (quadrat /transect sheets should also be provided.	**Section 5.2** and **Appendix B**
f. Identification of national and state listed threatened biota known or likely to occur in the study area and their	**Appendix C**

conservation status.	
g. Description of the likely impacts of the proposal on biodiversity and wildlife corridors, including direct and indirect and construction and operation impacts. Wherever possible, quantify these impacts such as the amount of each vegetation community or species habitat to be cleared or impacted, or any fragmentation of a wildlife corridor.	**Section 6** and **Appendix D**
h. The proposal should provide an assessment of the cumulative impacts of the proposal in relation to other nearby developments.	**Section 6**
i. Identification of the avoidance, mitigation and management measures that will be put in place as part of the proposal to avoid or minimise impacts, including details about alternative options considered and how long term management arrangements will be guaranteed	**Section 6.1**
j. Description of the residual impacts of the proposal. If the proposal cannot adequately avoid or mitigate impacts on biodiversity, then a biodiversity offset package is expected (see the requirements for this at point 6 below).	**Section 6** and **7**
k. Provision of specific Statement of Commitments relating to biodiversity	**Section 8.1**
4. An assessment of the significance of direct and indirect impacts of the proposal must be undertaken for threatened biodiversity known or considered likely to occur in the study area based on the presence of suitable habitat. This assessment must take into account: a. The factors identified in s.5A of the EP&A Act, and b. The guidance provided by *The Threatened Species Assessment Guideline* – The Assessment of Significance.	**Appendix D**
5. Where an offsets package is proposed by a proponent for impacts to biodiversity (and a BioBanking Statement has not been sought) this package must be developed in accordance with the *NSW offset principles for major projects* (state significant development and infrastructure), which may be guided by the *NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects*.	**Section 7**
6. Where appropriate, likely impacts (both direct and indirect) on any adjoining and/or nearby National Parks and Wildlife Service estate or any marine and estuarine protected areas	N/A

7. With regard to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the assessment should identify any relevant Matters of National Environmental Significance and whether the proposal has been referred to the Commonwealth or already determine to be a controlled action	**Appendix E** and **referral** (ELA 2015)

1 Introduction

This Ecological Assessment has been prepared by Eco Logical Australia (ELA) on behalf of Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) to inform an Environmental Impact Statement for submission to the Department of Planning and Environment prepared to assess for the Demolition and Remediation Project (the Project) at the former Hydro Aluminium Kurri Kurri aluminium smelter at Hart Road Loxford (the Smelter).

This report has been prepared to fulfil the biodiversity assessment requirements as listed in the Secretary's Environmental Assessment Requirements (SEARs). This report provides the information necessary to address 'scenario 2' of the SEARs, whereby a traditional impact assessment on threatened biodiversity potentially impacted by the Project has been prepared. In addition, based on consultation with the Office of Environment and Heritage (OEH), the Project was considered to require biodiversity offsets. Credit calculations using the BioBanking Assessment Methodology (BBAM) have been completed to inform the quantum of credits necessary to offset the impacts of the Project. It is proposed that the required number of ecosystem and species credits will be sourced within the broader Hydro land around the Project site and the credit transfer is to be completed subsequent to a BCAM assessment on the Hydro land.

1.1 Background

The former Hydro Aluminium Kurri Kurri Smelter (the Smelter) is located on Hart Road, Loxford near Kurri Kurri in New South Wales, Australia. The area owned and managed by Hydro incorporates the former smelter area comprising approximately 60 hectares, and the surrounding Hydro owned lands, comprising approximately 1,940 hectares (the Hydro land).

Smelting activities ceased in September 2012, and in May 2014 Hydro formally announced the closure of the Smelter.

It is Hydro's strategic vision for the Hydro land to play a key role in allowing the Hunter Region to achieve the economic, employment and environmental objectives identified in the NSW Government NSW State Plan 2021 and the Hunter Regional Action Plan. Hydro aims to achieve this strategic vision by facilitating the rezoning and development of the Project site for significant employment, residential, rural and biodiversity conservation purposes.

Hydro has commenced a number of decommissioning activities to facilitate demolition and remediation of the Smelter. In addition Hydro has submitted a Development Application to Cessnock City Council for the demolition of the majority of the Smelter (Stage 1 Demolition) excluding the buildings and structures at the Smelter used to store spent potlining, the concrete stacks and the water tower.

The remaining activities that would make the Smelter suitable for future employment and industrial land uses are the following:

- The Works. The Works are the activities required to make the Project site suitable for future use. The key element of the Works is the construction of a waste management facility, comprising a state of the art, modern and purpose built containment cell.

  Other ancillary elements of the Works are:

  – Demolition of the remaining Smelter buildings and structures.

  - Site remediation.
  - Leachate and groundwater treatment.
- Containment Cell Management. Following completion of the Works, the containment cell would be subject to a monitoring and management program.

These activities form the Project, which is the subject of the Environmental Impact Statement and this Ecological Assessment.

1.2 Objectives

The purpose of the Ecological Assessment is to assist the Department of Planning and Environment in assessing the Project in accordance with Section 79(c)(1) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The objectives of this Ecological Assessment are to:

- Assess the potential ecological impacts of the Project.
- Address the project SEARs.
- Identify any additional management measures to mitigate impacts of the Project on threatened species, populations and ecological communities.

2 Project description

The Project would be located within the existing Hydro Aluminium Kurri Kurri Smelter site (the Smelter) at Hart Road Loxford. The Smelter and Project locations are shown in **Figure 1**.

Table 2 outlines the major elements of the Project and the key activities. A detailed description of the Project is provided in **Chapters 8** and **9** of the Environmental Impact Statement.

Table 2: Outline of the Project

Element	Key Activities
The Works	
Project Site Establishment	• Establishment of environmental controls (erosion and sediment controls, water quality controls). • Construction of the containment cell haul road. • Continued use of Stage 1 Demolition compounds. • Continued use of Stage 1 Demolition stockpile and storage areas.
Containment Cell Construction	• Vegetation clearance.

Element	Key Activities
	• Site preparatory works. • Establishment and implementation of environmental controls (erosion and sediment controls, water quality controls). • Construction of the containment cell base layers. • Construction of internal cell walls within the containment cell. • Transport and placement of remediation and demolition materials to the containment cell. • Leachate and stormwater management. • Construction of the final containment cell capping layers.
Stage 2 Demolition	• Completion of hazardous materials removal. • Establishment and implementation of environmental controls (dust mitigation and water quality management). • Demolition of three concrete stacks and a water tower using detonation. • Mechanical demolition of remaining buildings and structures. • Material collection, separation, processing and storage. • Transportation of recyclable metals offsite. • Transport non-recyclable demolition material to the containment cell. • Grading of former building footprints.
Demolition Material Management	• Operation of a concrete and refractory crushing plant processing of up to 140 tonnes per day. • Manage a large stockpile area in the west of the Smelter. • Ferrous (steel) and non-ferrous (predominantly aluminium and copper) metals would be sorted and sized before being transported off site for recycling. It is anticipated that there would be up to 20 truck movements per day.
Contamination Remediation	• Removal of the capped waste stockpile. • Excavation of the contaminated soils within the Smelter (including stockpiled soils sourced from other Hydro land). • Transport to the containment cell. • Filling and grading following removal of contaminated materials.

Element	Key Activities
Leachate and Groundwater Treatment	• Establish and operate water treatment plants (capped waste stockpile and containment cell). • Groundwater monitoring. • Water treatment plant, pumping well network and dam decommissioning.

Environmental Controls	• Dust controls during demolition would include:
	  ○ Accumulated fines from within the buildings would be removed where safe, reasonable and feasible to do so.
	  ○ Pre-wetting of buildings prior to undertaking the induced collapse and use of water sprays for dust suppression (as required due to wind conditions) during induced collapse.
	  ○ Ceasing activities that have the potential to generate significant dust that could have adverse impacts on sensitive receivers.
	• Watering of the demolition areas, unsealed access roads and other unsealed areas.
	• Vehicles would use (where possible) existing sealed roads.
	• Erosion and sediment controls would be installed, monitored and managed to reduce sediment run off entering the existing drainage system.
	• The existing site water management system would capture runoff.
	• Where possible, clean water would be diverted from Works areas.

Containment Cell Management	
Monitoring	• Monitoring of leachate generation within the containment cell.
Maintenance	• Maintenance of the containment cell grass cover. • Maintenance (if required) of the capping layers.

The Works component of the Project would take approximately three years to complete.

Project traffic would predominantly travel to and from the Smelter via Hart Road and the Hunter Expressway (using the Hart Road interchange). A small number of vehicles (predominantly small vehicles used by Works personnel) are likely to continue to the intersection with Sawyers Gully Road, Gingers Lane and Government Road and along one of these roads.

Works activities that could generate an audible noise at the nearest sensitive receiver would be undertaken between 7:00 am to 6:00 pm, Mondays to Fridays and 7:00 am to 1:00 pm on Saturdays. Based on the findings of the noise and vibration impact assessment there are a number of the activities listed in **Table 2** that could occur outside these standard hours that would not generate an audible noise at the nearest sensitive receiver.

2.1 Concurrent Activities

In August 2015 Hydro submitted a Development Application (supported by a Statement of Environmental Effects) to Cessnock City Council requesting approval of the following:

- Demolition of all buildings and structures at the Smelter excluding:
    - Buildings used for the storage of materials.
    - Three concrete stacks, and one concrete water tower (structures requiring the use of explosives).
    - The transformer yard and major power supply infrastructure in the north of the Smelter.
- Establishment of a contractor's compound, either within an existing building located in the south of the Smelter (the former Building 77A Pot Rebuild building), or in the car park near the main entrance to the Smelter.
- A concrete and refractory crushing plant processing up to 28,000 tonnes per year or 140 tonnes per day.
- A demolition materials stockpile area.
- The sorting of recyclable metallic demolition materials and transportation to a metal recycling facility.

The works addressed in this Development Application is known as Stage 1 Demolition.

It is proposed that the contractor's compound, the demolition materials stockpile area and the concrete and refractory crushing plant included in this Development Application would continue to be used for the Project. It is anticipated that some Stage 1 Demolition activities would occur concurrently with the early stage of the Works.

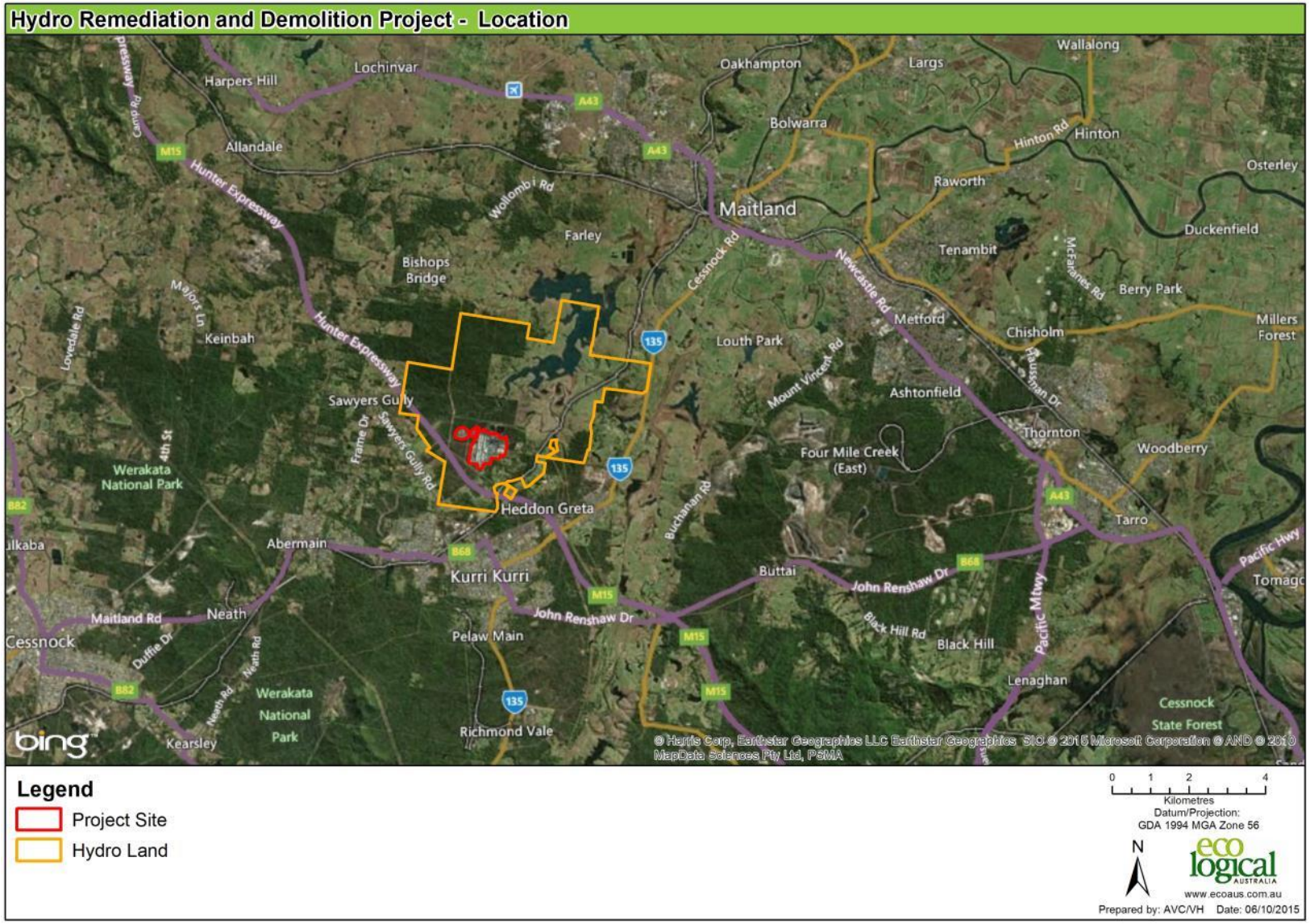

Figure 1: Location of the Study Area (Hydro land) and the Project site

3 Existing environment

As shown in Figure 1, the Project would impact the fenced Smelter footprint and the area currently known as the clay borrow pit to the immediate west.

Land uses in the vicinity of the Project include:

- Native vegetation: native ecological communities (with some cleared or disturbed areas) generally surround the Smelter and are within the Hydro land. Security fencing separates the Smelter from the vegetation. Further details are provided in Chapter 5.
- Electricity infrastructure: overhead power lines are located within easements to the north, west, southwest and northwest of the Smelter.
- Recreation: the Kurri Kurri Speedway and the Kurri Kurri Junior Motorcycle Club facility are approximately 500 metres to the east of the Project.
- Roads: The key roads in the vicinity of the Project are:
    - Hart Road is used to access the Smelter and is immediately adjacent to the western section of the Project.
    - Dickson Road intersects with Hart Road approximately 120 metres south of the Smelter security gate and immediately adjacent to the western section of the Project.
    - The Hunter Expressway is approximately 380 metres southwest of the Project.
- Residential: the Project is approximately 410 metres to the north of the nearest sensitive receiver, which is a rural residence owned by Hydro. The nearest rural residence not owned by Hydro is approximately 500 metres to the southeast, and the next nearest is approximately 750 metres to the southeast. There are approximately 24 rural residences within 1000 metres of the Project, of which 15 are on Hydro land.
- The nearest residential area to the Project is Weston, which is approximately 1800 metres to the southwest.
- Education: The Kurri Kurri TAFE is located approximately 1500 metres to the southeast of the Project and Kurri Kurri High School is approximately 1900 metres to the southeast of the Project.

4 Methods

Ecological investigations for the Project were conducted between October 2014 and March 2015 in conjunction with investigations intended for a Planning Proposal on the Hydro land.

4.1 Literature review

The Hydro land has been the subject of a number of previous studies that have investigated the biodiversity values of the area and surrounding lands. Database searches of the *Atlas of NSW Wildlife*

and *EPBC Protected Matters Search Tool* were also conducted. These documents were reviewed to assist the identification and assessment of biodiversity values within the study area.

Reviewed documents are listed below:

- FloraSearch 2004 – *Hydro Aluminium Kurri Kurri Flora Assessment*
- Greg Richards and Associates 2004 – *Hydro Aluminium Kurri Kurri Bat Fauna Assessment*
- Cenwest Environmental Services 200*4* – *Hydro Aluminium Kurri Kurri Terrestrial Vertebrate Fauna Assessment*
- Hydro Aluminium 2006 – *Hydro Aluminium Kurri Kurri Property Management Plan*
- Western Research Institute Ltd 2006 – *Avifauna Monitoring Survey, Hydro Aluminium Property, Kurri Kurri*
- Hydro Aluminium 2007 – *Hydro Aluminium Kurri Kurri Property Management Plan Annual Report*
- Western Research Institute Ltd 2007 – *Avifauna Monitoring Survey, Hydro Aluminium Property, Kurri Kurri*
- FloraSearch 2007 – *Hydro Aluminium Kurri Kurri Long term vegetation monitoring of the Hydro Aluminium property Spring*
- FloraSearch 2008 – *Hydro Aluminium Kurri Kurri vegetation monitoring of the Hydro Aluminium property Baseline wetland vegetation survey*
- Hydro Aluminium 2008 – *Hydro Aluminium Kurri Kurri Property Management Plan Annual Report.*
- Cenwest Environment Services 2008 – *Avifauna Monitoring Survey, Hydro Aluminium Property, Kurri Kurri*
- AECOM 2009 – *Hydro Aluminium Kurri Kurri Pty Ltd Property Management Plan – Annual report*
- Cenwest Environmental Services 2009 – *Avifauna Monitoring Survey, Hydro Aluminium Property, Kurri Kurri*
- AECOM 2010 – *Property Management Plan Annual report*
- Cenwest Environmental Services 2010 – *Avifauna Monitoring Survey, Hydro Aluminium Property, Kurri Kurri, November 2010*
- AECOM 2011 – *Property Management Plan – Annual report*
- FloraSearch 2011 – *Wetland Vegetation Monitoring Report*

A number of studies and reports have also been completed in the broader locality (within 10km of the Project site), including:

- DECC NSW 2007 – *Management Plan – The Green and Golden Bell Frog Key Population in the Middle Hunter*
- Bell and Driscoll 2007 – *Vegetation of the Cessnock-Kurri region, Cessnock LGA, NSW* which included both rapid assessments and full floristic surveys within the Hydro site
- Birdlife Australia 2013 – *Swift Parrots and Regent Honeyeaters in the Lower Hunter Region of NSW – An assessment of Status, Identification of High priority Habitats and Recommendations for Conservation* (prepared for prepared for the Commonwealth Department of Sustainability Environment, Water, Population and Communities (DSEWPaC))
- Eco Logical Australia 2013 – *Lower Hunter Koala Study* prepared for DSEWPAC

4.2 Flora survey

4.2.1 Biometric plots and rapid vegetation assessment

Investigation of vegetation within the study area was conducted between August 2014 and March 2015 by ELA botanists Antony von Chrismar, Gordon Patrick, and ecologists Emily Mowat and Daniel McKenzie. Forty-three 20 x 50 m vegetation quadrats were investigated in accordance with the Biobanking Assessment Methodology (BBAM). Two plots were conducted in the Project site each sampling a different vegetation type. Measurements of native canopy and midstory cover, structure of groundcover, soil type, number of hollow-bearing trees and logs and a count of native flora species present were completed.

Vegetation plots were supplemented with rapid data points (RDPs) which recorded dominant species in the canopy, midstorey and ground layers. RDPs are less comprehensive than full floristic vegetation plots, however they allowed for rapid identification of Plant Community Types (PCTs) and identification of boundaries between vegetation communities, which could then be interpreted through aerial photographic interpretation (API).

Vegetation mapping was undertaken using a 'heads-up' on screen digitising approach in ArcGIS10.2 at a scale of 1:10,000. Spatial data was loaded into a Geographic Information System (GIS) and RDPs were combined with full floristic vegetation plots to form a combined dataset which was overlain on high resolution (50 cm) ADS40 imagery. RDPs were used as an initial guide to identifying vegetation community boundaries. API was then used to identify distinct patterns in the imagery representing potential vegetation community boundaries.

Supplementary datasets such as contours, drainage layers and soil types were used to help inform the API and to delineate boundaries between vegetation communities.

PCTs were assigned based on a quantitative comparison of vegetation plot and RDP data with the vegetation descriptions, characteristic species in the upper, mid and ground structural layers, vegetation structure, soils, landform and other relevant data contained within the VIS Classification database (OEH, 2015b).

4.2.2 Threatened flora surveys

The survey for threatened flora consisted of walking parallel transects 5 – 10 m apart through both the native vegetation proposed to be removed for the Project and in surrounding lands. Surveys within the Project site were conducted on 9 and 10 of December 2014. Surveys of surrounding lands within the study area were completed during February and March 2015. Twenty four additional threatened species quadrats were completed throughout the study area with the aim of estimating the number of *Eucalyptus parramattensis subsp. decadens* (Parramatta Red Gum) and *Grevillea parviflora* subsp. *parviflora* (Small-flowered Grevillea) throughout intact Kurri Sand Swamp vegetation within the study area. Patches of *G. parviflora* subsp. *parviflora* within regularly slashed power easements were mapped and counts of stem density completed to enable an estimation of total number of stems.

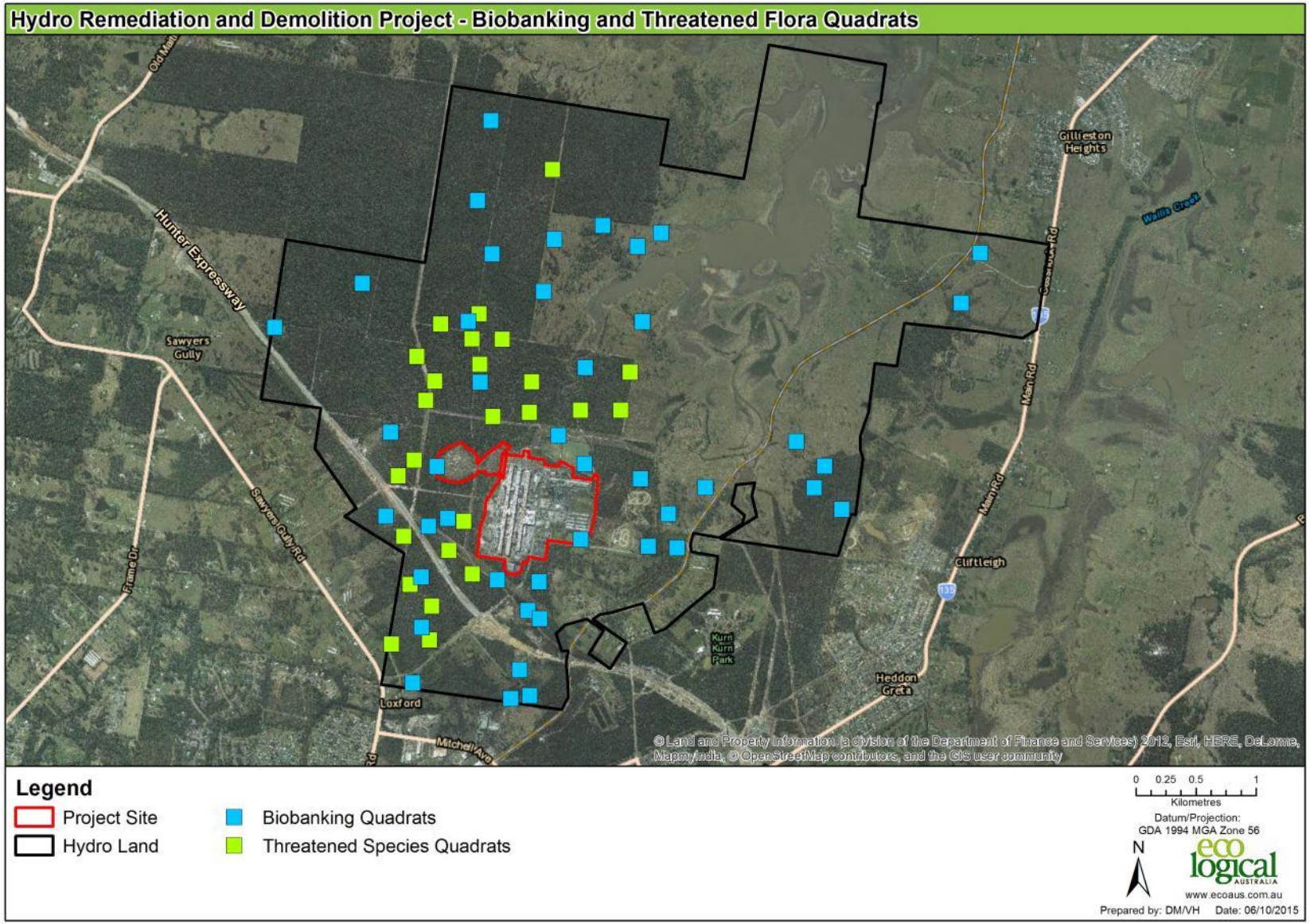

Figure 2: Biobanking and threatened flora quadrats

Figure 3: Area covered during searches for threatened flora within and adjacent to the Project site

4.3 Fauna survey

4.3.1 Hair sampling and analysis

Baited sections of 50 and 80 mm PVC hairtube lined with double sided tape were used to sample mammalian diversity within the study area over spring and summer 2014/15.

Five lines of 10 arboreal 80 mm hairtubes baited with universal bait (peanut butter, oats and honey) were placed throughout the study area. Each tube was spaced approximately 20 m apart. A meat baited (tinned catfood) hair tube was placed at the end of each line. Four lines of 10 terrestrial hairtubes (50 mm diameter) also baited with universal bait were placed throughout the study area.

Hair tubes were left in place from 26 November 2014 – 17 December (three weeks). Hair samples were analysed by a hair analysis expert, Hans Brunner. Hair identified as belonging to *Petaurus breviceps* (Sugar Glider) was re-attributed to *Petaurus* spp. (due to the difficulty in separating Sugar Glider and *Petaurus norfolcensis* (Squirrel Glider) based on hair samples and the predominance of Squirrel Glider recorded during spotlight survey and captured on remote camera images).

4.3.2 Nest box inspection

Ten nesting boxes specifically designed for *Petaurus norfolcensis* (Squirrel Glider) and 10 designed *Cercartetus nanus* (Eastern Pygmy Possum) were placed both in the Project site and surrounding study area. Nest boxes were inspected after a four month period for occupation or evidence of occupation in conjunction with remote camera photos.

4.3.3 Camera traps

Infrared remote cameras were used in conjunction with baited hair tubes over a three week period and also nestboxes to identify mammalian fauna utilising the Project site and surrounding lands. Eight cameras were placed facing either arboreal hairtubes baited with universal bait (peanut butter, oats and honey) or terrestrial hairtubes baited with tinned cat food. Fifteen remote cameras were placed facing nestboxes designed for Squirrel Glider and Pygmy Possum over a three month period (December to February)

4.3.4 Spotlight survey

Eight nocturnal walking transects with hand held spotlights and headtorches, were completed within the study area. Each survey lasted for at least two person hours and covered a distance of approximately 2 km. Spotlight fauna surveys were completed on the nights of 27 November, 16 and 17 December 2014 and 29 January, 17, 18, 19 and 23 of February 2015.

4.3.5 Microbat echolocation call recording and identification

Four anabat ultrasonic recording devices were deployed within the study area between 26 November and 2 December 2014 at six different locations and set to record all night. A total of 21 recording nights were completed. Calls were analysed and identified by Peter Knock of Fauna Sonics.

4.3.6 Call playback

The vocalisations of Koala, Masked Owl, Powerful Owl and Barking Owl were broadcast using a loudhailer from seven different locations within the study area following spotlight surveys (**Figure 4).** Each species call was played for two minutes followed by two minutes quiet listening and then repeated.

4.3.7 Amphibian survey

Amphibian surveys were conducted in summer during a period of rainfall, targeting water storage areas within and adjacent to the Project site and also natural wetland areas to the north of the smelter. A nocturnal spotlight survey of lentic habitats and associated vegetation within the study area was combined with call playback for *Litoria aurea* (Green and Golden Bell Frog) (GGBF) over six separate nights. Calls of the GGBF were played at each location for two minutes followed by two minutes quiet listening and then repeated twice. Aquatic vegetation and bank areas of wetlands were then searched by torchlight over approximately one hour.

A nocturnal driving transect aiming to detect amphibian and reptile species foraging on or crossing roads was conducted through the study area on the night of 16 December 2014.

Table 3: Type of amphibian survey, location, date and weather

Survey	Location	Date	Rainfall (Cessnock Airport)	Max and Min Temp (ºC) (Cessnock Airport)
Call playback for GGBF and search of bank and aquatic vegetation	Section of Wentworth Swamp directly north of smelter and water storage area to the east of smelter	26 November 2014	No rainfall on night. 15.2 mm fell prior to survey on 24th	22.7, 17.7
	Dams in far north-east of study area	27 November 2014		23.5, 19.4
	Water storage areas within and adjacent to smelter	9 December 2014	Heavy rainfall week previous. No rain on night	25.1, 17.2
		10 December 2014	18.4 mm	22.8, 17.7
		11 December 2014	14.6 mm	22.8, 20.0
	Southern section of Wentworth Swamp to east of smelter	29 January 2015	3.6 mm. 22.2 mm recorded in previous 24 hours	26.6, 15.1
Nocturnal driving transect	Starting adjacent to a section of Wentworth Swamp directly north of smelter and through bushland to north west of smelter	16 December 2014	Rainfall 3 days prior to survey. No rainfall on night	26.3,13.4

4.3.8 Bird survey

Five separate waterbird surveys were conducted using a spotting scope and binoculars over a 1 hour period on separate days during summer 2014. An afternoon/dusk waterbird survey was conducted within the water storage areas to the north of the Project site on 9 December 2014.

Opportunistic bird observations were also recorded when conducting fieldwork. Birds were identified based on either direct observation or knowledge of calls.

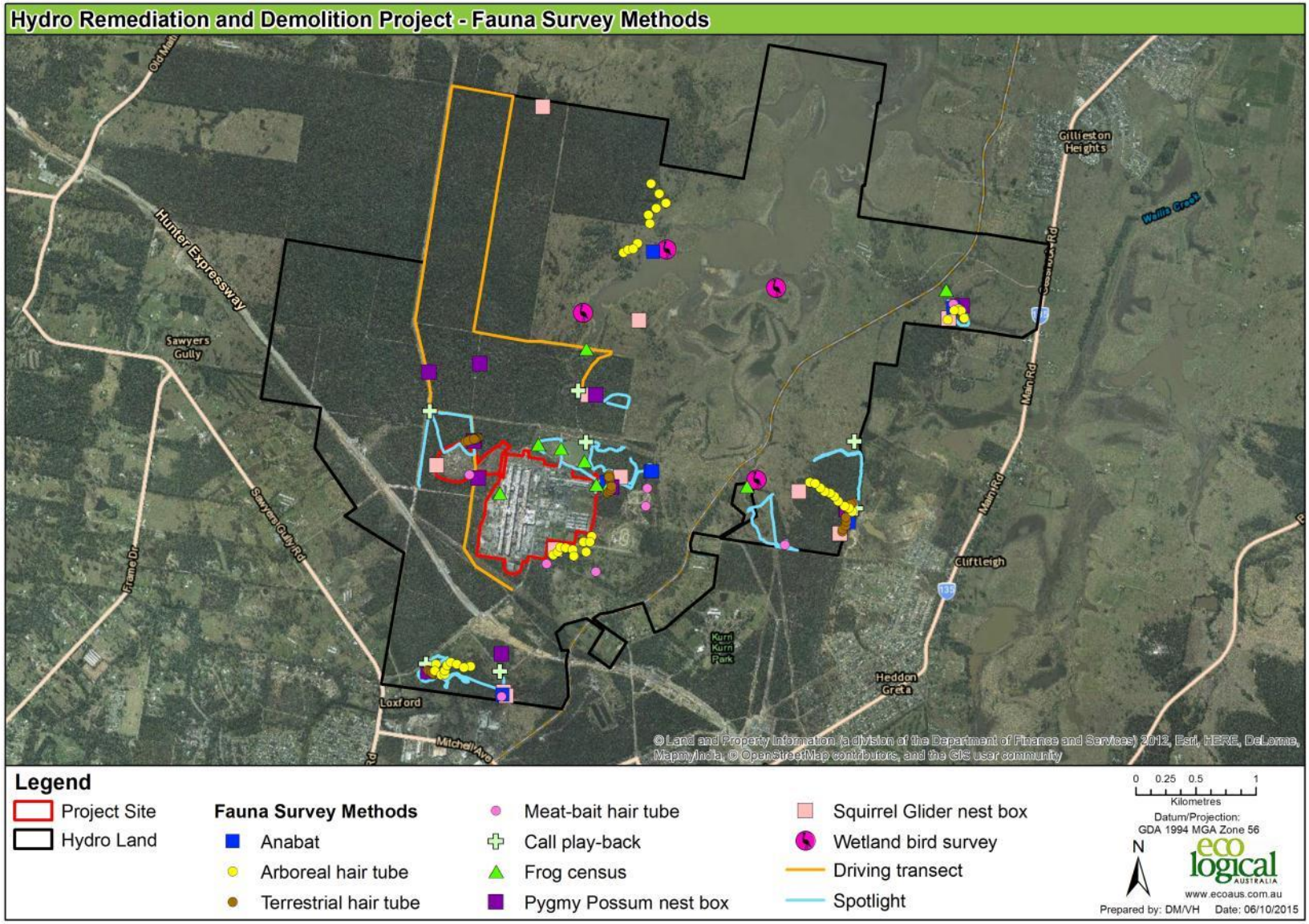

Figure 4: Fauna survey methods and survey locations

5 Results

5.1 Literature review

5.1.1 CENwest (2004) *Terrestrial Vertebrate Fauna Assessment*

CENwest (2004) conducted a range of terrestrial vertebrate fauna surveys within the Hydro land during autumn and spring 2003. These included terrestrial and arboreal elliot trapping for small mammals, cage trapping for medium sized mammals, terrestrial and arboreal hair tubes, pitfall trapping and spotlight surveys. CENwest recorded 166 native terrestrial vertebrate fauna of which 11 were listed as threatened species (**Table 4**).

Table 4: Threatened species recorded within the study area by CENwest (2004)

Common Name	Scientific name	Status TSC Act	Status EPBC Act
Black-tailed Godwit	*Limosa limosa*	Vulnerable	Migratory
Brown Treecreeper	*Climacteris picumnus victoriae*	Vulnerable	-
Speckled Warbler	*Pyrrholaemus sagittata*	Vulnerable	-
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*	Vulnerable	-
Hooded Robin	*Melanodryas cucullata cucullata*	Vulnerable	-
Diamond Firetail	*Stagonopleura guttata*	Vulnerable	-
Squirrel Glider	*Petaurus norfolcensis*	Vulnerable	-
Green-thighed Frog	*Litoria brevipalmata*	Vulnerable	-
Heath Monitor	*Varanus rosenbergi*	Vulnerable	-
Spotted-tailed Quoll	*Dasyurus maculatus*	Vulnerable	Endangered
Southern Brown Bandicoot	*Isoodon obesulus*	Endangered	Endangered

Records of *Isoodon obesulus* (Southern Brown Bandicoot) and *Varanus rosenbergi* (Heath Monitor) both represent northern range extensions for these species. The observation of Heath Monitor is described in CENwest (2004) as moving "*rapidly up the nearest tree*". This lends doubt to the accuracy of this identification as this species is regarded as being more likely to flee along the ground (as opposed to the widespread *Varanus varius* (Lace Monitor), which readily climbs trees). Southern Brown Bandicoot was recorded via hair and faeces analysis only and identification was uncertain.

CENwest (2004) also concluded that the study area did not constitute potential or core *Phascolarctos cinereus* (Koala) habitat and did not have a resident Koala population. The Migratory species, Baird's Sandpiper was also recorded.

5.1.2 Greg Richards and Associates (2004) *Bat Fauna Assessment*

Bat Fauna Assessment by Greg Richards and Associates 2004 sampled bat fauna using Anabat ultrasonic bat call recorders during spring and autumn 2004. Eleven species of bats, including two threatened species were recorded. These are listed in **Table 5**:

Table 5: Species recorded within the study area by Greg Richards and Associates (2004)

Common Name	Scientific Name	Status TSC Act	Status EPBC Act
Gould's Wattled Bat	*Chalinolobus gouldii*	Not listed	Not listed
Chocolate Wattled Bat	*Chalinolobus morio*	Not listed	Not listed
Little Bentwing Bat	*Miniopterus australis*	Vulnerable	Not listed
Undescribed Freetail Bat	*Mormopterus sp.*	Not listed	Not listed
Southern Myotis	*Myotis macropus*	Vulnerable	Not listed
Long-eared Bats	*Nyctophilus spp.*	-	-
Eastern Broadnosed Bat	*Scotorepens orion*	Not listed	Not listed
White-striped Freetail Bat	*Tadarida australis*	Not listed	Not listed
Large Forest Bat	*Vespadelus darlingtoni*	Not listed	Not listed
Southern Forest Bat	*Vespadelus regulus*	Not listed	Not listed
Little Forest Bat	*Vespadelus vulturnus*	Not listed	Not listed

The threatened Little Bentwing Bat was one of the most recorded species and was found in a range of habitat types, while the Southern Myotis was only recorded adjacent to Wentworth Swamp reflecting the tendency for this species to forage over water.

5.1.3 FloraSearch (2004) *Flora Assessment*

FloraSearch (2004) identified six vegetation types as occurring within the Hydro land, of which two (Vegetation types 2 and 3) were regarded as endangered ecological communities (**Table 6**).

Table 6: Vegetation Types recorded within the study area by FloraSearch (2004)

Number	Vegetation Type (FloraSearch, 2004)
1	Wetland
2	Lowland Redgum Forest: *Eucalyptus tereticornis* (Forest Redgum) / *Eucalyptus amplifolia* (Cabbage Gum) / *Angophora floribunda* (Rough-barked Apple)
3	Kurri Sand Swamp Woodland: *E. parramattensis* ssp. *decadens* (Parramatta Redgum) / *Angophora*

	bakeri (Narrow-leaved Apple) / *E. capitellata* (Brown Stringybark)
4	Broad-leaved Ironbark / Spotted Gum Forest: *E. fibrosa (*Broad-leaved Ironbark) / *Corymbia maculata* (Spotted Gum)
5	Grey Box Forest (*Eucalyptus moluccana*)
6	Disturbed areas

Four hundred and twenty one (421) vascular plant species were identified of which 304 were locally native. Four species listed as threatened under the NSW *Threatened Species Conservation Act, 1995* or Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* were found in the study area (**Table 7**).

Table 7: Threatened flora species recorded in the study area by FloraSearch (2004)

Common Name	Scientific Name	Comments (FloraSearch 2004)
Bottlebrush	*Callistemon linearifolius*	Widespread but uncommon
Slaty Redgum	*Eucalyptus glaucina*	Scattered throughout study area, mainly near watercourses
Parramatta Redgum	*Eucalyptus parramattensis* ssp. *decadens*	Common in Kurri Sand Swamp Woodland throughout the study area
Small-flowered Grevillea	*Grevillea parviflora* ssp. *parviflora*	Common in drier, open grassy parts of Kurri Sand Swamp Woodland and adjoining Spotted Gum / Ironbark Forest

5.1.4 CENwest (2010) – Avifauna Monitoring Survey, Hydro Aluminium Property, Kurri Kurri, November 2010

Avifauna surveys were conducted annually between 2006-2010. During 2010, 11 monitoring sites were surveyed consisting of one hour surveys of 200m transects spread throughout the study area and a wetland bird survey. Seventy nine species of avifauna were detected during 2010; including the threatened species *Hieraaetus morphnoides* (Little Eagle) and *Pomatostomus temporalis* (Grey-crowned Babbler). The EPBC listed migratory species; *Ardea ibis* (Cattle Egret) was also observed.

Previous monitoring surveys also detected the threatened *Glossopsitta pusilla* (Little Lorikeet), *Lophoictinia isura* (Square-tailed Kite) and migratory *Calidris acuminata* (Sharp-tailed Sandpiper) and *Merops ornatus* (Rainbow Bee-eater).

5.1.5 FloraSearch 2011 – 2010 Spring Survey of the Hazard Reduction Burn Area

An investigation of the impacts to threatened plant species as a result of a hazard reduction burn was conducted. A review of previous work determined that *Callistemon linearifolius* (Netted Bottlebrush) *was* misidentified by FloraSearch in previous reports and was actually *C. rigidus.* The listed Endangered Ecological Communities*; Lower Hunter Spotted Gum Ironbark Forest* and *Kurri Sand Swamp Woodland* were identified in the study area.

5.1.6 Roderick et. al (2013) – Swift Parrots and Regent Honeyeaters in the Lower Hunter Region of NSW – An Assessment of Status, Identification of High Priority Habitats and Recommendations for Conservation

The Lower Hunter Region of NSW is regarded by Roderick et al. (2013) as a critically important area for the Endangered *Lathamus discolour* (Swift Parrot) and Critically Endangered *Anthochaera phrygia* (Regent Honeyeater). The Hunter Region, with its coastal rainfall influence, provides a key refuge for these species when drought reduces resource availability (e.g. flowering of key Eucalypts) in other parts of their range(s). Habitats regularly used by both Swift Parrot and Regent Honeyeater are under considerable threat in the Lower Hunter from urban, industrial and infrastructure projects and other threatening processes.

A feature of many sites that support Swift Parrots and Regent Honeyeaters in the Lower Hunter is the high level of tree species diversity. *Corymbia maculata* (Spotted Gum) was the dominant overstory species at 60.2% of habitat assessment sites where Swift Parrots and Regent Honeyeaters had been previously recorded.

Broad scale habitat modelling within the Lower Hunter suggested the Hydro land is likely to be important habitat for Swift Parrot and Regent Honeyeater. However it is recommended that the modelling be used a 'guide' to identifying the broad-scale priority areas of habitat only and that for specific area assessments that it be combined with fine-scale vegetation mapping and ground-truthing.

5.1.7 Eco Logical Australia 2013 – Lower Hunter Koala Study

The study focussed on the Local Government Areas (LGAs) of Cessnock, Lake Macquarie, Maitland, Newcastle, and Port Stephens. The study utilised existing data available in the public domain and consulted with stakeholders to inform specific key information gaps regarding conservation planning needs of the state and federally listed vulnerable species, Koala in the Lower Hunter.

The landscape of the Lower Hunter has been dramatically altered over the past 200 years. This has resulted in considerable loss and fragmentation of koala habitat and the inevitable reduction in abundance and distribution of koalas. As early as 1900 Koalas are thought to have disappeared from several areas in the Lower Hunter Region such as; Maitland, Morpeth, Bolwarra, Phoenix Park, Woodville, Wallalong, Miller's Forest, Nelson's Plains and Hinton. These areas are now extensively cleared for agriculture and expanding urbanisation.

The level of knowledge of the Koala within LGA's other than Port Stephens in the study area is poor, with little information available for the study. A number of koala sightings have been recorded in the Cessnock LGA, but population size is unknown. Workshop discussions noted *Eucalyptus parramattensis* subsp. *decadens* (Parramatta Red Gum) is used by koala in the Tomago Sands area of Port Stephens LGA and is regarded as an important species for Koala in that area. *Eucalyptus parramattensis* subsp. *decadens* is also a dominant or co-dominant canopy species in the *Kurri Sand Swamp Woodland EEC* which occurs widely within the Hydro land.

Priority koala habitat was modelled at a 1:25,000 scale based on stakeholder and expert consultation, available literature and a range of spatial data such as:

- Feed trees (preferred / supplementary)
- Soil landscape (high soil fertility)
- Vegetation types
- Proximity to water
- Large patch sizes not intersected by major infrastructure
- Recorded koala sightings
- Linear barriers defined as major roads and railway corridors.

A number of areas of priority koala habitat were identified around Kurri Kurri.

5.1.8 DECC (2007) – The Green and Golden Bell Frog Key Population in the Middle Hunter

The Green and Golden Bell Frog was once common throughout the Hunter Valley Region and was once known to occur in large numbers in swamps around Maitland. Since the 1970's the Green and Gold Bell Frog population in the locality is known from only a small number of verified locations on the periphery of the nearby Wentworth Swamp.

The Middle Hunter population of the Green and Gold Bell Frog is thought to consist of one main diffuse population in or around Wentworth Swamp (DECC, 2007). Wentworth Swamp is a large complex of wetlands to the north-east of the Smelter and extends to within 0.5 km of the Project site. This wetland complex is mostly privately owned and has been subject to historical land clearing and invasion of aquatic weeds and exotic fish species. The wetland is also currently subject to pressure from grazing and reduced water quality.

The closest records of Green and Gold Bell Frog are located 4 km to the north-east of the Project site in a disused quarry and adjacent farm dams adjacent to Cartwright Street, Gillieston Heights. Fourteen adult and sub-adult frogs were recorded in the quarry pond in 1998. Tadpoles were observed during this period in the quarry water body along with calling adult males and adult females in an adjacent paddock pond. Extensive damage to this habitat occurred in the summer of 2001/02 involving excavation of the quarry pond, creek line and removal of aquatic and riparian vegetation. No Green and Golden Bell Frogs have been observed in the area since this time.

The most recent and last record of the Green and Gold Bell Frog population in the locality is also from an abandoned quarry approximately 5km to the north of the Project site in the year 2000.

5.1.9 Database search

A database search of the BioNet Atlas of NSW Wildlife website for all valid records of threatened (listed on TSC Act 1995),Commonwealth listed ,CAMBA listed, JAMBA listed or ROKAMBA listed entities with a 10 x 10 km area (centred on the Project site) returned 1,561 records of 55 species.

The EPBC Protected Matters Search Tool (10 km buffer from the Smelter) returned 31 Commonwealth listed threatened species, 12 listed migratory species and 14 listed marine species.

5.2 Vegetation communities

Four different plant community types (PCT's) were recorded by ELA within the study area (**Figure 5**). These were:

- Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area
- Cabbage Gum-Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter
- Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin Bioregion
- Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter

Two additional vegetation categories were also mapped:

- Water/Swamp
- Cleared/disturbed areas

Two different PCT's occur within the demolition footprint (**Table 8**). The vegetation for both these PCT's occur in an intact condition. These correspond to the state listed Endangered Ecological Communities (EEC's) *Kurri Sand Swamp Woodland in the Sydney Basin Bioregion* and *Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion.*

Plate 1: Kurri Sand Swamp Woodland EEC within the study area. The threatened species *Eucalyptus parramattensis* subsp*. decadens* is shown on the left of the plate.

Lower Hunter Spotted Gum - Ironbark Forest in the demolition footprint has a canopy dominated by *Eucalyptus fibrosa* (Red Ironbark) with *Corymbia maculata* (Spotted Gum) being absent from this area. The midstorey of this community is dominated by *Melaleuca nodosa* (Prickly-leaved Paperbark) and *Bursaria spinosa* (Blackthorn)*,* with a diverse native ground layer also present. This community appears to have a history of timber harvesting, with few large or hollow-bearing trees present in the area.

Plate 2: Lower Hunter Spotted Gum - Ironbark Forest EEC within the study area

Table 8: Plant Community Types (PCTs) within the Project site

PCT	Condition	EEC	Area (ha)
Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark Shrubby Woodland in the Cessnock - Kurri Kurri Area	Intact	Kurri Sand Swamp Woodland in the Sydney Basin Bioregion	1.35
Spotted Gum – Red Ironbark – Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	Intact	Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion	1.15

Figure 5: Plant Community Types within the Project site

5.3 Flora

Four threatened flora species were detected within the broader study area by ELA (2015) (**Table 9**). *Eucalyptus parramattensis* ssp*. decadens* is a dominant or co-dominant canopy species throughout much of the Kurri Sand Swamp Woodland within the study area. *Grevillea parviflora* subsp. *parviflora (***Plate 4**) was also found in scattered patches throughout much of the Kurri Sand Swamp Woodland within the study area and was particularly abundant within and directly adjacent to the large power easements to the north and south of the Project site.

Four individuals of *Eucalyptus parramattensis* subspecies *decadens* (listed as vulnerable under the TSC Act and EPBC Act) were found to occur within the Project site. A single clump of *Grevillea parviflora* subsp. *parviflora* (listed as vulnerable under the TSC Act and EPBC Act) consisting of five stems was also found within the proposed containment cell area in the west of the Project site. No other threatened flora species were detected.

Table 9: Listed threatened flora species found in the study area

Common Name	Scientific Name	Status TSC Act	Status EPBC Act	Notes on records
Bynoe's Wattle	*Acacia bynoeana*	Endangered	Vulnerable	Only detected by ELA (2015) in far east of study area.
Bottlebrush	*Callistemon linearifolius*	Vulnerable	Not listed	Widespread but uncommon through the study area. Many individuals found in south of study area.
Parramatta Redgum	*Eucalyptus parramattensis* ssp*. decadens*	Vulnerable	Vulnerable	Dominant or co-dominant species throughout much of the Kurri Sand Swamp Woodland in the Project site and study area
Small-flowered Grevillea	*Grevillea parviflora* ssp. *parviflora*	Vulnerable	Vulnerable	Found in scattered patches throughout much of the Kurri Sand Swamp Woodland. Common in the grassy power easements

Plate 3: The *Acacia bynoeana* found in the north east of study area

Plate 4: The threatened *Grevillea parviflora* subsp. *parviflora* adjacent to a power easement within the study area

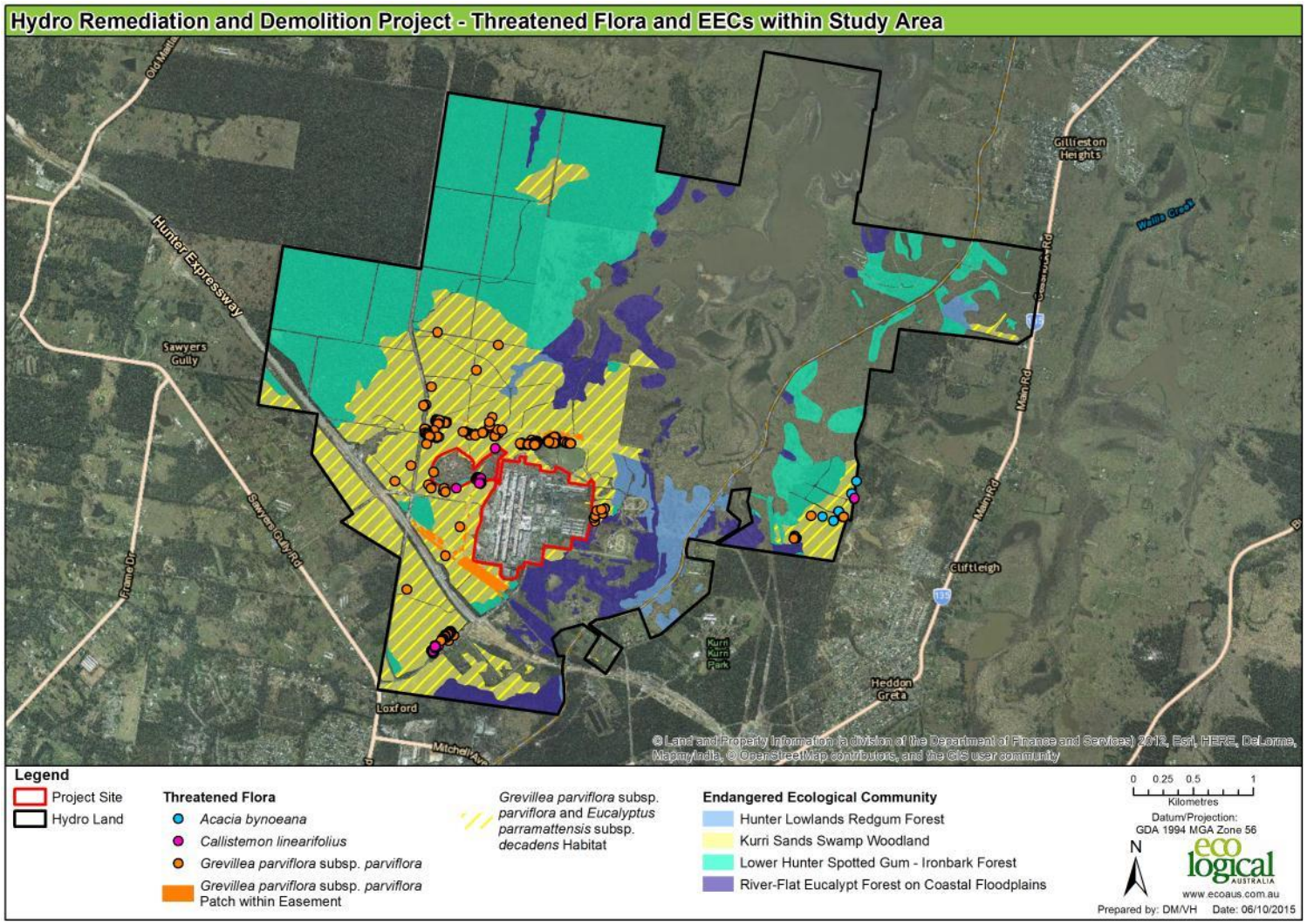

Figure 6: Recorded threatened flora locations and EEC's within Hydro land.

*Note: Flora surveys have focussed on specific areas and records do not represent all the individuals in the Hydro land.

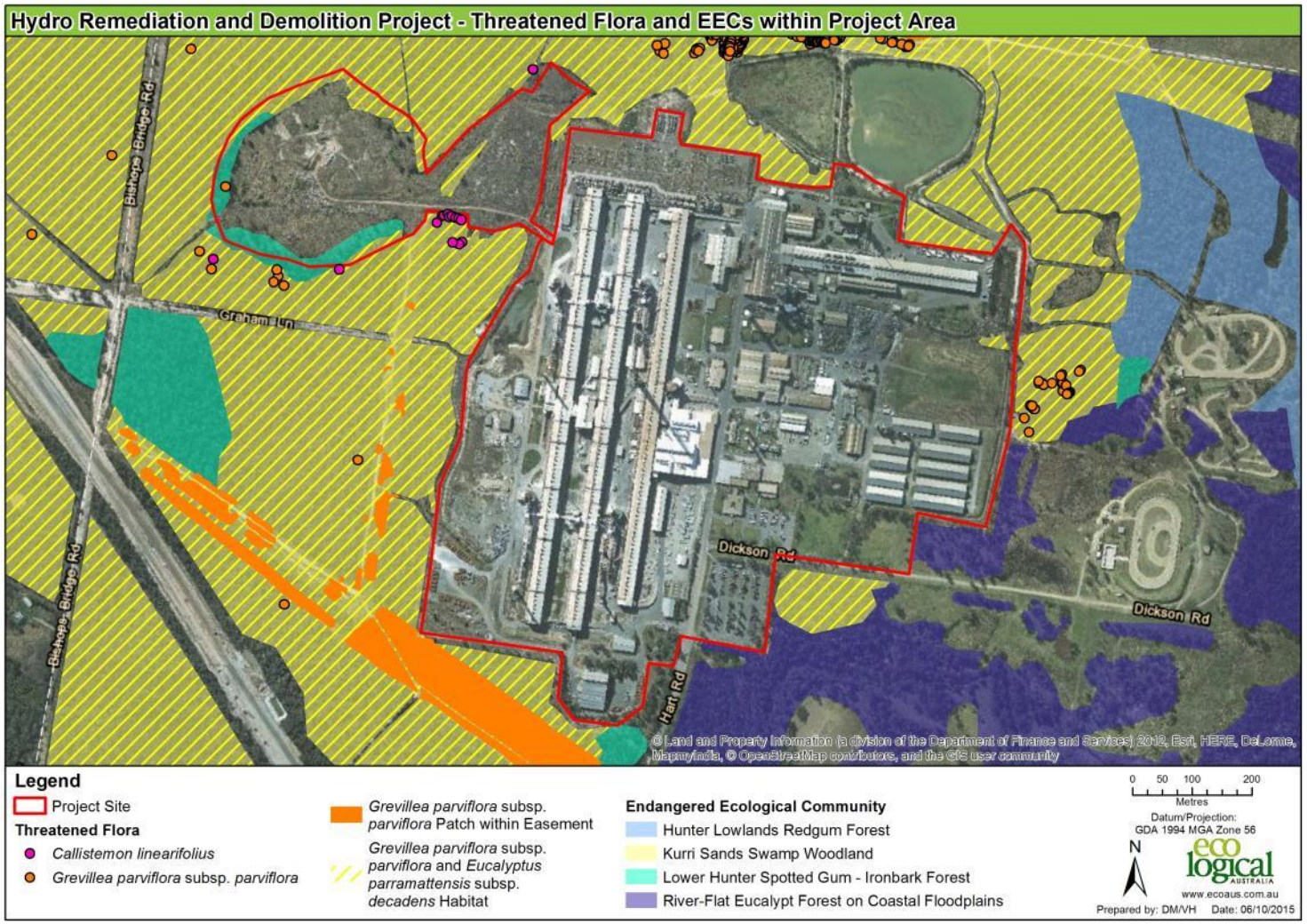

Figure 7: Threatened flora and EEC's within and surrounding the Project site*.

*Note: Flora surveys have focussed on specific areas and records do not represent all the individuals in the study area.

5.4 Fauna

In total 167 fauna species were recorded by ELA. This consisted of 15 microbat species, a further 15 mammal species, 110 bird species, 15 reptile and 12 amphibian species were detected within the study area. A species list for all fauna detected by ELA is provided in **Appendix A.**

Ten threatened and six listed migratory fauna species were detected by ELA within the Hydro land (the study area). Two threatened fauna species; Squirrel Glider and Little Lorikeet were also recorded within the Project site. Additional fauna species are considered likely or have some potential to utilise the Project site despite not being recorded during survey, which are all provided in **Table 10**.

Plate 5: Squirrel Glider captured on remote camera within the Project site

Table 10: Threatened and migratory species recorded by ELA or considered likely to utilise the Project site.

Class	Common Name	Scientific Name	Species credit	TSC Act	EPBC Act	Comments
Aves	Regent Honeyeater	*Xanthomyza phrygia*	Yes	Endangered	Endangered	There are nearby database records for the species and Roderick et al. (2013) shows several records in the vicinity and identify the locality as an important area for the species. Therefore, vegetation communities containing winter flowering gums have been mapped as suitable habitat.
	Square-tailed Kite	*Lophoictinia isura*	No	Vulnerable	Not listed	Recorded by CENWEST 2010
	Little Eagle	*Hieraaetus morphnoides*	No	Vulnerable	Not listed	Recorded by CENWEST 2010
	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	No	Not listed	Marine and Migratory	Observed hunting and nesting near Wentworth Swamp. A juvenile bird was also observed hunting over water storage areas to the north of the Project site
	Freckled Duck	*Stictonetta naevosa*	No	Vulnerable	Not listed	A single bird observed on Wentworth Swamp
	White-throated Needletail	*Hirundapus caudacutus*	No	Not listed	Marine and Migratory	Flocks observed flying high above the study area on several occasions
	Sharp-tailed Sandpiper	*Calidris acuminata*	No	Not listed	Marine and Migratory	A group observed on exposed mudflats in Wentworth Swamp
	Latham's Snipe	*Gallinago hardwickii*	No	Not listed	Marine and Migratory	A single bird observed flying out of dense wetland vegetation to the north of study area in Wentworth Swamp
	Rainbow Bee-eater	*Merops ornatus*	No	Not listed	Marine and Migratory	Regularly observed perching on dead branches adjacent to tracks within Kurri Sand Swamp Woodland

Class	Common Name	Scientific Name	Species credit	TSC Act	EPBC Act	Comments
	Brown Treecreeper	*Climacteris picumnus victoriae*	No	Vulnerable	Not listed	Individual heard to north of Project site
	Grey-crowned Babbler	*Pomatostomus temporalis*	No	Vulnerable	Not listed	Flocks observed on several occasions. Generally in forested areas adjacent to cleared land within the study area.
	Cattle Egret	*Ardea ibis*	No	Not listed	Marine and Migratory	Observed foraging alongside cattle in east of study area
	Eastern Great Egret	*Ardea modesta*	No	Not listed	Marine and Migratory	Observed foraging in wetland in south-east of study area
	Little Lorikeet	*Glossopsitta pusilla*	No	Vulnerable	Not listed	Observed on several occasions flying over study and Project site. Also observed foraging on flowering Eucalypts within Project site.
	Diamond Firetail	*Stagonopleura guttata*	No	Vulnerable	Not listed	Recorded by CENWEST 2004 in the study area
	Hooded Robin	*Melanodryas cucullata cucullata*	No	Vulnerable	Not listed	Recorded by CENWEST 2004 in the study area
	Black-tailed Godwit	*Limosa limosa*	No	Vulnerable	Not listed	Recorded in Wetnworth Swamp by CENWEST 2004 in the study area
	Speckled Warbler	*Pyrrholaemus sagittata*	No	Vulnerable	Not listed	Recorded by CENWEST 2004 in the study area
Mammalia	Grey-headed Flying-fox	*Pteropus poliocephalus*	Yes. Breeding habitat only	Vulnerable	Vulnerable	Observed during spotlight surveys. No suitable breeding habitat in study area

Class	Common Name	Scientific Name	Species credit	TSC Act	EPBC Act	Comments
	Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	No	Vulnerable	Not listed	Detected via anabat survey
	Little Bentwing-bat	*Miniopterus australis*	Yes Breeding/ roost habitat only	Vulnerable	Not listed	Detected via anabat survey. No suitable breeding habitat in study area
	Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Yes Breeding/ roost habitat only	Vulnerable	Not listed	Detected via anabat survey. No suitable breeding habitat in study area
	East-coast Freetail Bat	*Mormopterus norfolkensis*	No	Vulnerable	Not listed	Detected via anabat survey
	Greater Broad-nosed Bat	*Scoteanax rueppellii*	No	Vulnerable	Not listed	Detected via anabat survey
	Large- footed Myotis	*Myotis macropus*	Yes Breeding/ roost habitat only	Vulnerable	Not listed	Detected via anabat survey and by CENWEST 2004. Breeding habitat restricted to 40m of main riparian zones
	Squirrel Glider	*Petaurus norfolcensis*	No	Vulnerable	Not listed	Observed during spotlight surveys, and detected via remote cameras, hairtubes and nest box inspections. Detected within and surrounding Project site.

Class	Common Name	Scientific Name	Species credit	TSC Act	EPBC Act	Comments
	Spotted-tailed Quoll	*Dasyurus maculatus*	No	Vulnerable	Endangered	Recorded via hair sampling by CENWEST 2004
	Koala	*Pascolarctos cinereus*	Yes	Vulnerable	Vulnerable	Old Atlas record from 1980 just outside of the study area that has an accuracy of 10000m. Therefore, a tentative record and not a sign of high Koala activity. Never the less, ELA 2013 identify Kurri Sand Swamp and Forest Red Gum Forest as important habitat for this species in the locality and, therefore, these communities have been mapped as suitable habitat for the species.
	Southern Brown Bandicoot	*Isoodon obesulus*		E	E	Noted by CENWEST 2004 as a >50% probability based on hair samples. This is not considered a legitimate record, given the nearest record is in Sydney
Reptiles	Rosenburgs Goanna	*Varanus rosenbergi*	Yes	Vulnerable	Not listed	Tentative record from CENWEST 2004, which is not considered to be a true record based on the observation that the animal climbed a tree. Species no longer considered to be present in the study area
Amphibians	Green-thighed Frog	*Litoria brevilpalmata*	Yes	Vulnerable	Not listed	Record from CENWEST 2004.
	Green and Golden Bell Frog	*Litoria aurea*	Yes	Endangered	Endangered	Two dated records (1995/98) to the northeast of the site (within 1km) occur and mention a quarry and farm dam at Gilleston Heights. Surveys in suitable habitat around the Smelter and farm dams in the north east were undertaken during appropriate conditions within the study area did not record the species. Although there is a very slim chance that a low number of individuals occur in the Gilleston Heights area, reportedly the habitat that sustained the population at the quarry was destroyed and therefore it is considered unlikely that a persistent population occurs within the study area. Habitat for this specie has therefore not been mapped.

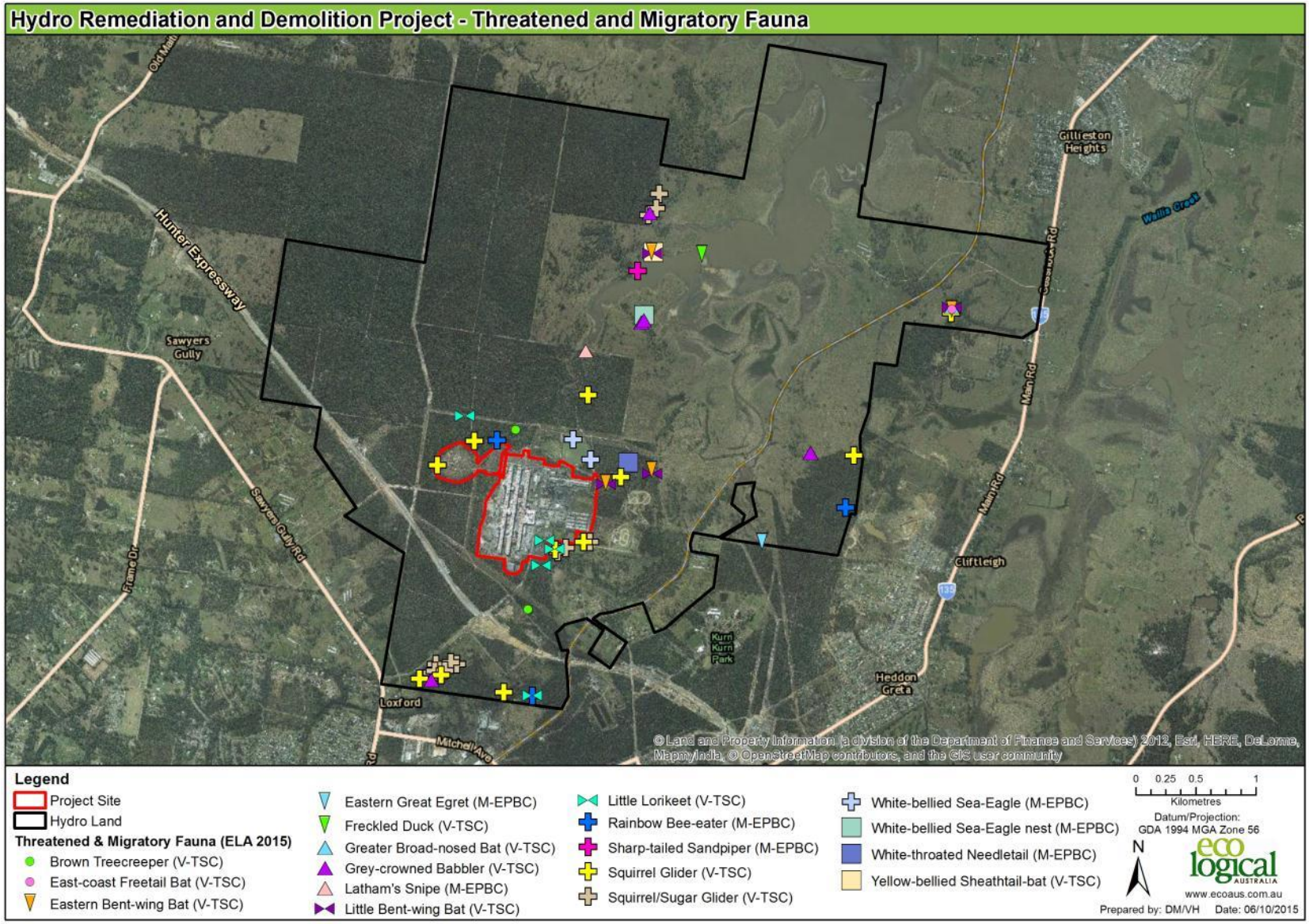

Figure 8: Threatened and Migratory Fauna within and surrounding Hydro land.

6 Impact assessment

6.1 Impact avoidance

The current and assessed project site (**Figure 1**) is the result of several revisions to the preliminary concept plan, whereby the proposed impacts on native vegetation has been reduced as much as possible (i.e. from 4.92 ha to 2.5 ha). This has also resulted in the reduction of impacts on threatened species (i.e. from 159 *Eucalyptus parramattensis* subsp. *decadens* individuals to four individuals).

6.2 Vegetation

The proposed demolition project will remove 1.35 ha of intact Kurri Sand Swamp Woodland EEC and 1.15 ha of Lower Hunter Spotted Gum - Ironbark Forest EEC.

Kurri Sand Swamp Woodland and Lower Hunter Spotted Gum - Ironbark Forest have been listed as an EEC due to the small size of existing remnants, and the threat of further clearing, disturbance and degradation.

The proposed Project would add to the cumulative effect of further clearing of these communities. However, the intact Kurri Sand Swamp Woodland proposed to be removed represents only 0.4% of the mapped occurrence of the intact Kurri Sand Swamp Woodland within the study area. The intact Lower Hunter Spotted Gum - Ironbark Forest proposed to be removed represents 0.3% of the total area of intact Lower Hunter Spotted Gum - Ironbark Forest mapped within the study area.

Table 11: Plant community types and EEC's proposed to be impacted and what is available in the Hydro land.

PCT	Condition	EEC	Area impacted (ha)	Area mapped (ha) in Hydro land
Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark Shrubby Woodland in the Cessnock - Kurri Kurri Area	Intact	Kurri Sand Swamp Woodland in the Sydney Basin Bioregion	1.35	338.96
Spotted Gum – Red Ironbark – Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	Intact	Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion	1.15	366.66

6.3 Threatened species

Four individuals of *Eucalyptus parramattensis subspecies decadens* (listed as vulnerable under the TSC Act) and a single clump of *Grevillea parviflora* subsp. *parviflora* consisting of five stems (listed as

vulnerable under the TSC Act and EPBC Act), were found to occur within the Project site. Two individual Squirrel Gliders were observed utilising a nest box within the demolition footprint. Little Lorikeets were observed flying over the Project site and would be expected to utilise this vegetation when in flower. Threatened and migratory species that are considered '*likely*' or are considered to have potential to utilise the Project site are listed in **Table 8**.

6.4 Summary of assessment under s5A of the EP&A Act

The proposed Project would remove or modify up to 2.5 ha of intact native vegetation (see **Table 11**). All of this vegetation is considered to qualify as either *Kurri Sand Swamp Woodland in the Sydney Basin Bioregion* or *Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion.* Those TSC Act listed species in **Table 8** and the described EEC's were assessed pursuant to s5A of the EP&A Act in **Appendix D**. The result of these assessments deemed that the Project was unlikely to have a significant impact on threatened biodiversity, primarily due to the impact being relatively small (<5 ha), being quite disturbed given it includes the Smelter and that the study area provides a large area of suitable habitat for all the assessed species and EEC's (see **Table 11**).

6.5 Summary of assessment under EPBC Act

Assessments of vulnerable, endangered and migratory species pursuant to the EPBC Act have been assessed in **Appendix E** and concluded that the Project was unlikely to have a significant impact on the listed species. A referral for these species has also been submitted to the Commonwealth Department of the Environment, which concludes no significant impact is likely.

6.6 SEPP 44 Koala Habitat Protection

The data collected from the Koala habitat assessments have been used to address the criteria of SEPP 44.

Step 1: Is the land potential Koala habitat?

The vegetation within the Project site does not comprise potential koala habitat as the tree types listed on Schedule 2 'feed tree species' do not constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. No Schedule 2 feed tree species are present within the Project site.

As the Project site does not constitute potential Koala habitat as defined in SEPP 44, Step 2 and 3 of the SEPP assessment is not required.

6.7 Koala EPBC Act referral assessment

The Koala and its habitat was considered in the referral submitted to the Commonwealth Department of the Environment. Habitat within the Project site scored a total of 5 utilising the Koala Habitat Assessment Tool provided in the Commonwealth Referral Guidelines for the species. As such, the small area of habitat on the Project site is considered to comprise habitat critical to the survival of the species on the basis that it:

- Contains one food tree species that alone accounts for >50% of the vegetation in the relevant strata (small pockets of vegetation that contain food trees occur outside of the smelter security fence and are accessible to Koala – 1.35 ha);
- is part of a contiguous landscape ≥ 500 ha; and
- may be important for achieving the interim recovery objectives for the species

Surveys did not record the presence of the species within the Project site during the survey period. However, potential habitat for the species does occur within the Project site and surrounding lands and as such it is considered possible that the species may utilise the Project site from time to time.

The Project will result in the loss of a small area of remnant vegetation (1.35ha) containing feed trees that are outside of the smelter security fencing (refer to Smelter threatened flora vegetation map attachment). The Project has been designed to minimise the clearance of vegetation as much as practicable through the careful selection of the proposed containment cell.

While the Project will impact habitat critical to the survival of the species, the habitat to be removed is a narrow linear band of vegetation along the periphery of previously cleared lands. As such, the Project would not result in the fragmentation of habitat for the Koala and is unlikely to reduce the area of occupation of the species. The loss of 1.35 ha of potential habitat for the species is a minor impact in the context of the areas of potential habitat available for the species in the lands immediately surrounding the Project site and within the surrounding region. Therefore, it is considered unlikely that the Project would result in a significant impact to the Koala.

7 Biobanking assessment

As per the Secretary's Environmental Assessment Requirements (SEAR's) and based on consultation with the Office of Environment and Heritage (OEH), the proposed development has some impact on threatened species and EEC's and OEH has determined that the Project requires biodiversity offsets. Credit calculations for ecosystem and species credits, using the Biobanking Assessment Methodology (BBAM), have been completed and a summary of this assessment is provided in the following section. Hydro will look to secure both ecosystem and species credits within the broader study area (i.e. smelter Hydro lands), though the timing of the credit transfer is proposed to be delayed until after a Biocertifcation assessment, using the Biocertification Assessment Methodology (BCAM), application has been submitted for the entirety of the Kurri Hydro land. If the Biocertification assessment is not successful, Hydro will still secure the offsets through a Biobank site within the Hydro land.

7.1 Landscape values assessment

7.1.1 Assessment circles

The amount of vegetation currently within the 100 ha and 1000 ha assessment circles was calculated using ArcGIS at a scale of 1:10,000. The amount of vegetation in the circles once the Biobank site is established, and managed into the future, was also estimated in ArcGIS.

For the 100 ha circle, 41.47 ha of over-storey vegetation occurs (referred to as 'remnant' vegetation) and represents 41% cover. The development proposes to remove 2.5 ha of vegetation within the 100 ha circle. The total amount of over-storey cover (after Development), consequently, within the 100 ha circle will be reduced to 39.97 ha. Therefore the amount of vegetation in the 100 ha circle will go down one cover class after development.

The assessment for the 1000 ha circle was also completed. Before Development 597.76 ha of vegetation was mapped as 'remnant' vegetation (60%) within the 1000 ha circle. The Project proposes to remove 2.5 ha of vegetation within the 1000 ha circle. The total amount of over-storey cover (after Development), consequently, within the 1000 ha circle would be reduced to 595.26 ha. Therefore the amount of vegetation in the 1000 ha circle would remain unchanged and in the same condition class for over-storey cover for both before and after development.

Table 12 summarises the results of the assessment for each circle. The 1000 ha assessment circle remains within the same native vegetation cover class before and after biobanking, at 56-60%. The 100 ha assessment circle goes down one native vegetation cover class from 41-45 % before biobanking, to 36-40% after biobanking. The locations of the assessment circles are shown in **Figure 9**.

Table 12: Area of vegetation in each assessment circle before and after.

CIRCLE No.	CIRCLE TYPE	BEFORE BIOBANK	AFTER BIOBANK
1	100ha	41-45%	36-40%
	1000ha	56-60%	56-60%

7.1.2 Connectivity assessment

A connectivity assessment was conducted for the Project using the technique outlined in the Biobanking Methodology. The following aspects were considered:

- The width of the current and future connecting link
- The condition of the current and future connecting link (over-storey and mid-storey/ground cover)

The areas to the north-east of the Project site are well vegetated and have good over-storey cover. Although there are some disturbance factors within this area due to past agricultural practices, the vegetation in the connecting link is considered to be at benchmark.

Connectivity Width Assessment

The narrowest point of the current vegetated connection is identified in **Figure 10** and occurs to the east of the Project site. GIS analysis has identified the minimum width of the current connection at approximately 31 m, placing it into the >30-100 m connectivity width category. As the most limiting connection occurs outside the Project site, the after development score for connectivity width will remain >30-100 m (**Table 13**).

Table 13: Width classes before and after

	WIDTH CLASS (BEFORE BIOBANK)	WIDTH CLASS (AFTER BIOBANK)
Connectivity Value (Width)	>30-100m	>30-100m

Connectivity Condition Assessment

The vegetation within the 'connection' (including the development site) is at benchmark for over-storey cover, mid-storey and groundcover (**Table 14**).

The average condition of the vegetation would not change after the development site is established. Therefore, the condition classes allocated after development would not change from those allocated before development.

Table 14: Condition classes before and after (PFC – Projected Foliage Cover)

STRATA	CONDITION CLASS (BEFORE BIOBANK)	CONDITION CLASS (AFTER BIOBANK)
Connectivity Value (Over-storey Condition)	PFC at benchmark	PFC at benchmark
Connectivity Value (Mid-storey/Ground Cover Condition)	PFC at benchmark	PFC at benchmark

7.1.3 CMA Region and CMA Subregion

The development site occurs entirely within the Hunter Central Rivers CMA region and within the Hunter CMA subregion.

7.1.4 Patch Size and Mitchell Landscape

Using the Mitchell Landscapes Version 3 layer, the Project site is wholly within the Newcastle Coastal Ramp Mitchell Landscape.

The area to the north-east of the Project site is well vegetated. These areas are therefore predominantly in moderate to good condition, resulting in a Patch Size of 201 hectares (the maximum required to achieve an 'extra large' patch size class for a Mitchell Landscape that is 54% cleared).

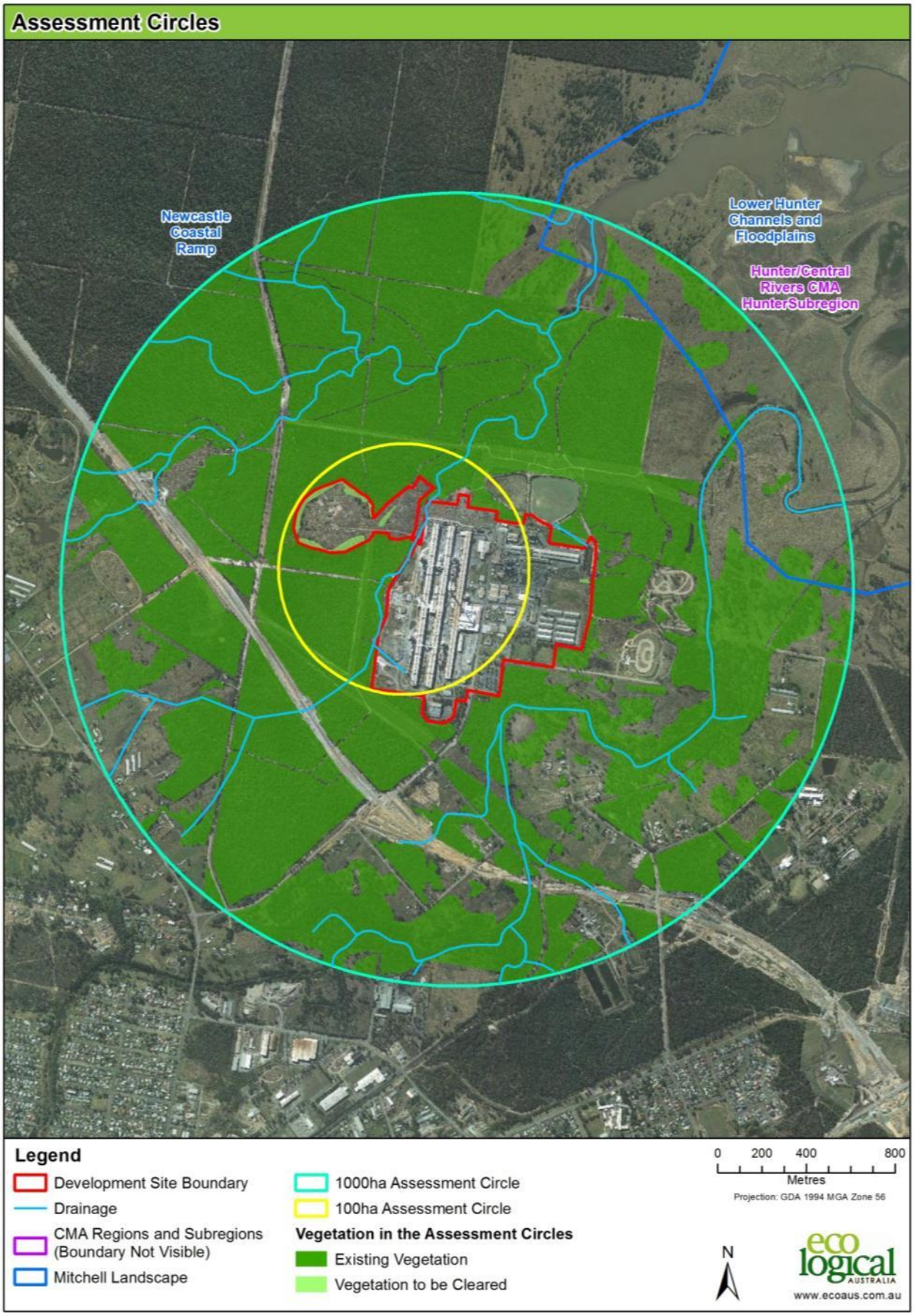

Figure 9: Assessment circles

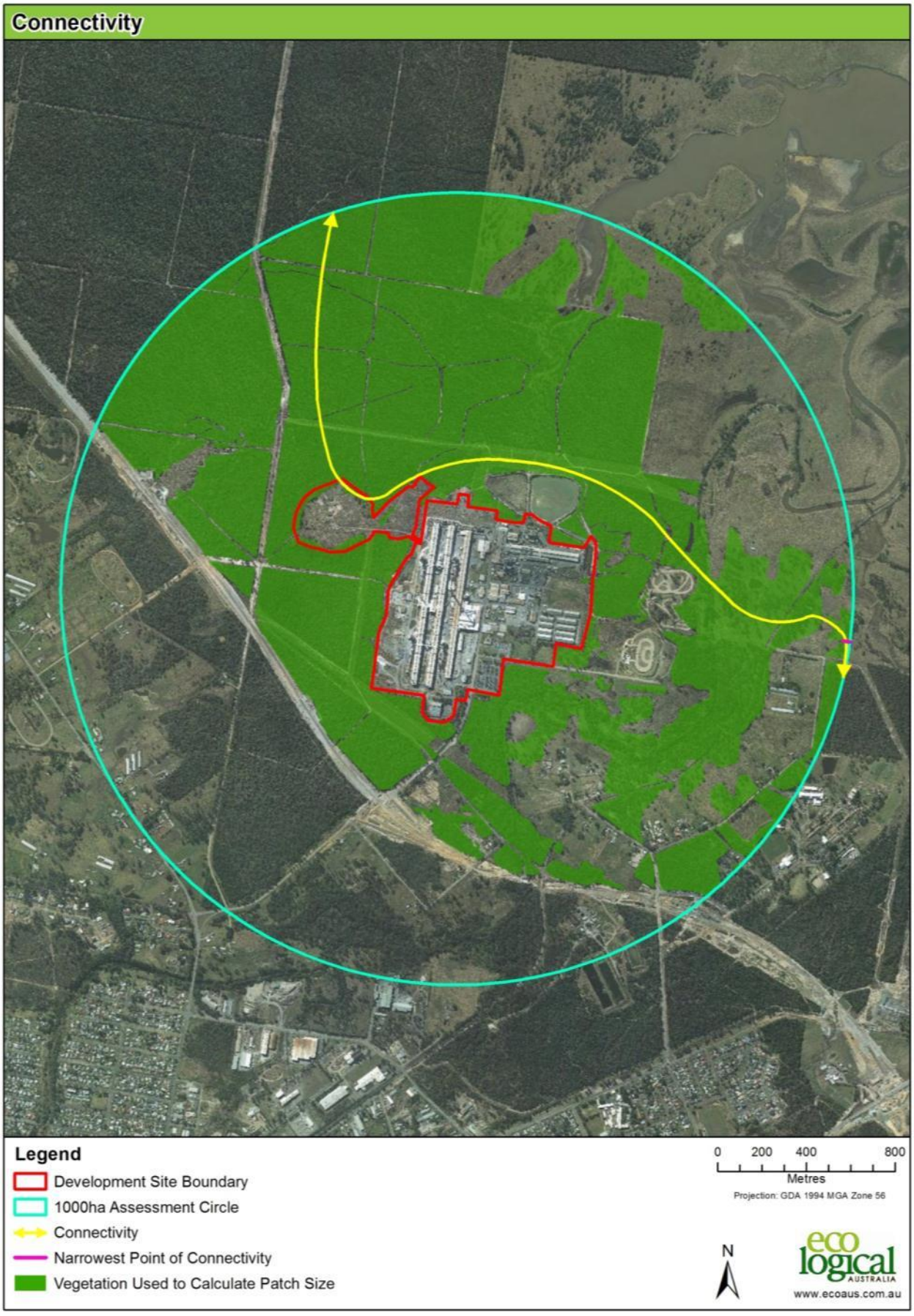

Figure 10: Connectivity

7.2 Assessment of threatened species

7.2.1 Predicted species

Threatened species sub zones were mapped for the Project site. The threatened species sub zones are the threatened species that can be predicted to occur on site based on the vegetation type and the patch size. A list of the predicted threatened species is provided in **Table 15**.

Table 15: Predicted threatened species

Common Name	Scientific Name	Tg offset multiplier
Barking Owl	*Ninox connivens*	3
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis* subsp. *gularis*	1.3
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus* subsp. *victoriae*	2
Bush Stone-curlew	*Burhinus grallarius*	2.6
Corben's Long-eared Bat	*Nyctophilus corbeni*	2.1
Diamond Firetail	*Stagonopleura guttata*	1.3
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	2.2
Eastern Freetail-bat	*Mormopterus norfolkensis*	2.2
Gang-gang Cockatoo	*Callocephalon fimbriatum*	2
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	1.8
Greater Broad-nosed Bat	*Scoteanax rueppellii*	2.2
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis* subsp. t*emporalis*	1.3
Hooded Robin (south-eastern form)	*Melanodryas cucullata* subsp. *cucullata*	1.7
Little Eagle	*Hieraaetus morphnoides*	1.4
Little Lorikeet	*Glossopsitta pusilla*	1.8
Masked Owl	*Tyto novaehollandiae*	3
Painted Honeyeater	*Grantiella picta*	1.3
Powerful Owl	*Ninox strenua*	3
Scarlet Robin	*Petroica boodang*	1.3
Speckled Warbler	*Chthonicola sagittata*	2.6
Spotted-tailed Quoll	*Dasyurus maculatus*	2.6
Square-tailed Kite	*Lophoictinia isura*	1.4
Squirrel Glider	*Petaurus norfolcensis*	2.2
Swift Parrot	*Lathamus discolor*	1.3
Turquoise Parrot	*Neophema pulchella*	1.8
Varied Sittella	*Daphoenositta chrysoptera*	1.3
Yellow-bellied Glider	*Petaurus australis*	2.3
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	2.2

7.2.2 Threatened species habitat

Table 16 provides a list of species credits that have been recorded on or near the Project site or are predicted to occur within the Project site.

Table 16: Threatened species credits.

Common Name	Scientific Name	Count
Green-thighed Frog	*Litoria brevipalmata*	1.46 ha
Koala	*Phascolarctos cinereus*	1.35 ha
Southern Myotis	*Myotis macropus*	14.23 ha
Regent Honeyeater	*Anthochaera phrygia*	1.15 ha
Eucalyptus parramattensis subsp. *decadens*	*Eucalyptus parramattensis* subsp. *decadens*	4 ind.
Small-flower Grevillea	*Grevillea parviflora* subsp. *parviflora*	5 ind.

7.3 Credit calculations

7.3.1 Ecosystem credits

Table 17 provides the number of ecosystem credits required to offset the impact of the Project.

Table 17: Ecosystem credits required

Veg Zone	Biometric Vegetation Type	Ancillary	Area (ha)	Credits
1a	Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area	Intact	1.35	94
5a	Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	Intact	1.15	61
			2.5	**155**

7.3.2 Species credits

Table 18 provides the species credits required for the Project site and **Figure 11** to **16** provide the mapped extent of habitat or locations

Table 18: Species credits required.

Common Name	Scientific Name	Count	Credits
Green-thighed Frog	*Litoria brevipalmata*	1.46 ha	19
Koala	*Phascolarctos cinereus*	1.35 ha	35
Southern Myotis	*Myotis macropus*	14.23 ha	313
Regent Honeyeater	*Anthochaera phrygia*	1.15 ha	89
Eucalyptus parramattensis subsp. *decadens*	*Eucalyptus parramattensis* subsp. *decadens*	4 ind.	56
Small-flower Grevillea	*Grevillea parviflora* subsp. *parviflora*	5 ind.	70

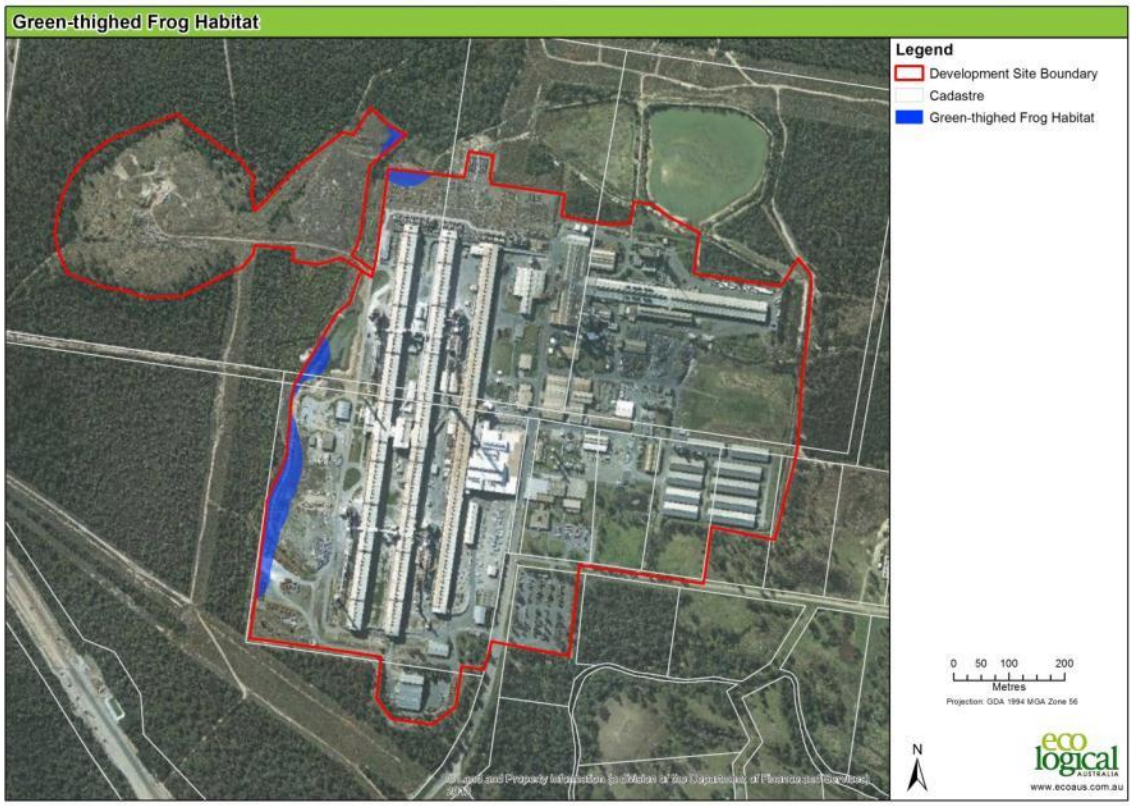

Figure 11: Green-thighed Frog habitat

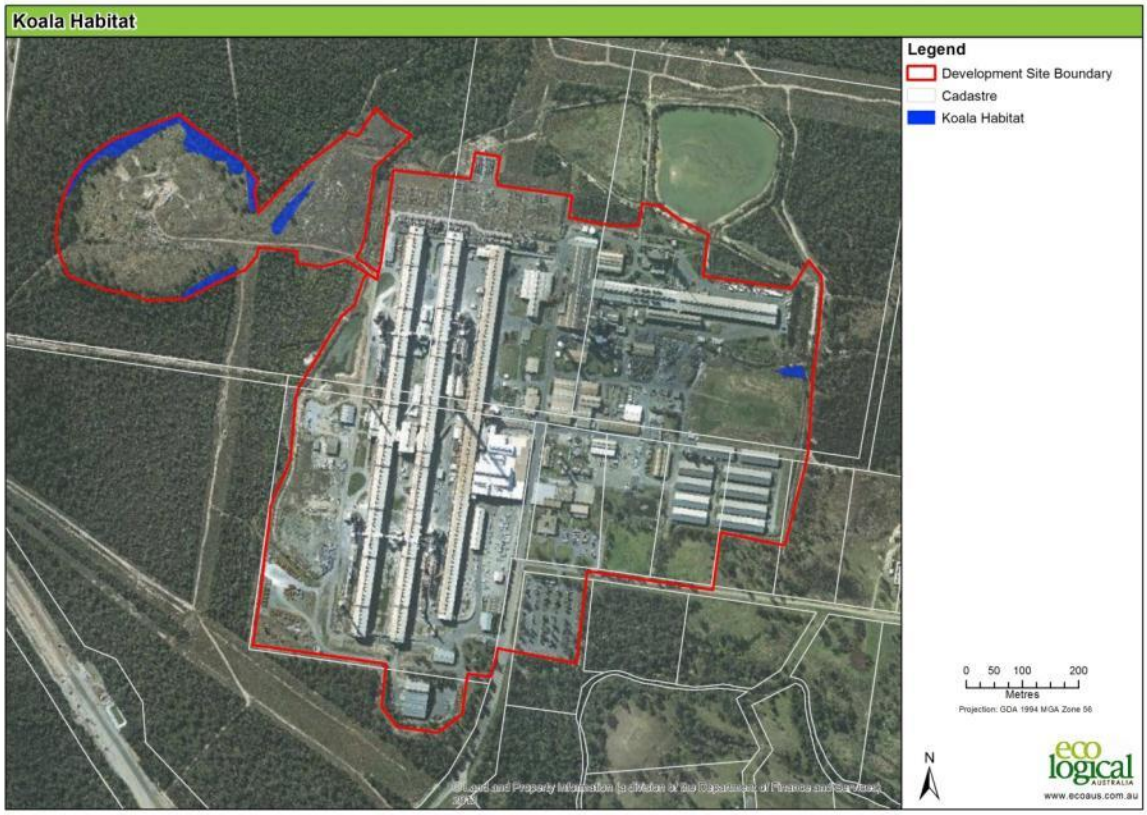

Figure 12: Koala habitat

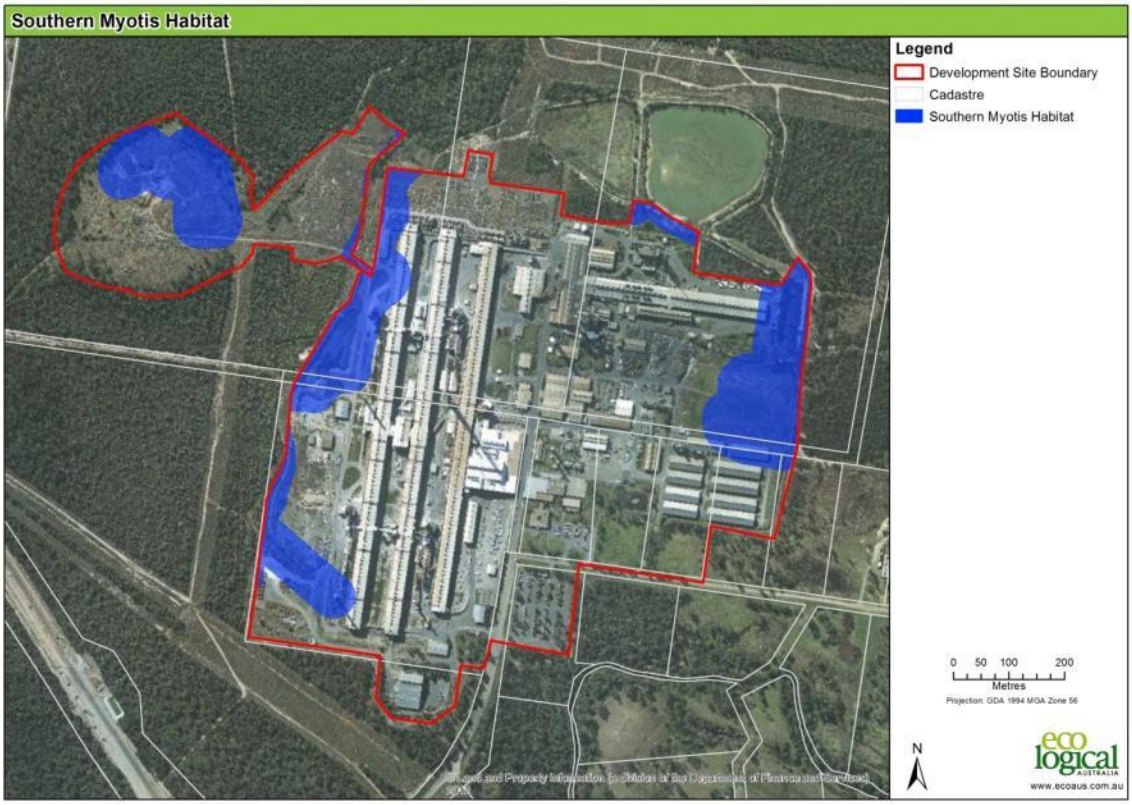

Figure 13: Myotis habitat

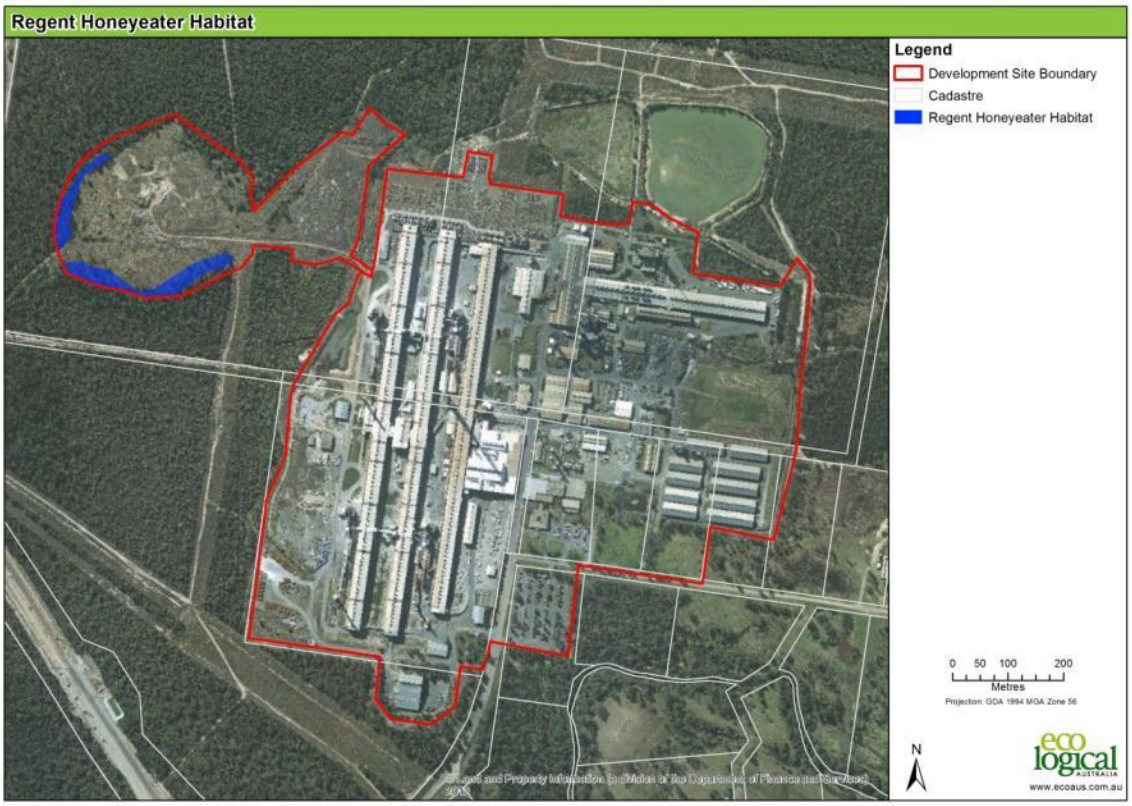

Figure 14: Regent Honeyeater habitat

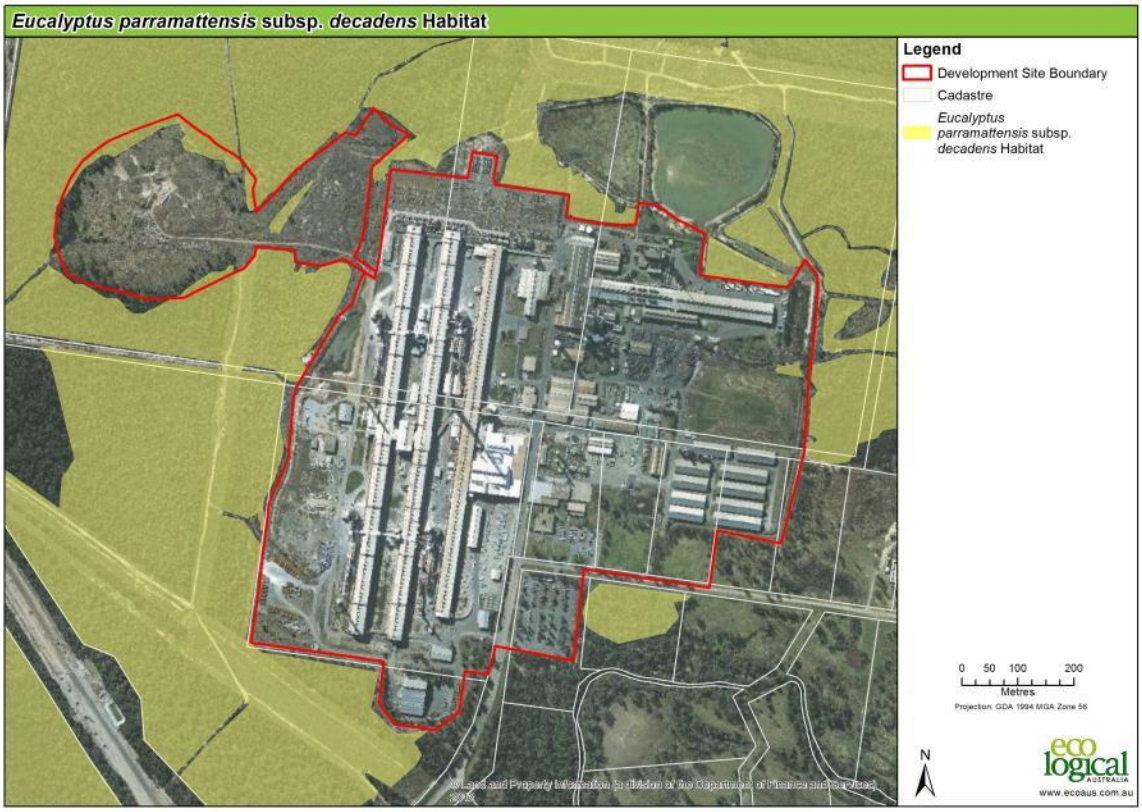

Figure 15: *Eucalyptus parramattensis* habitat

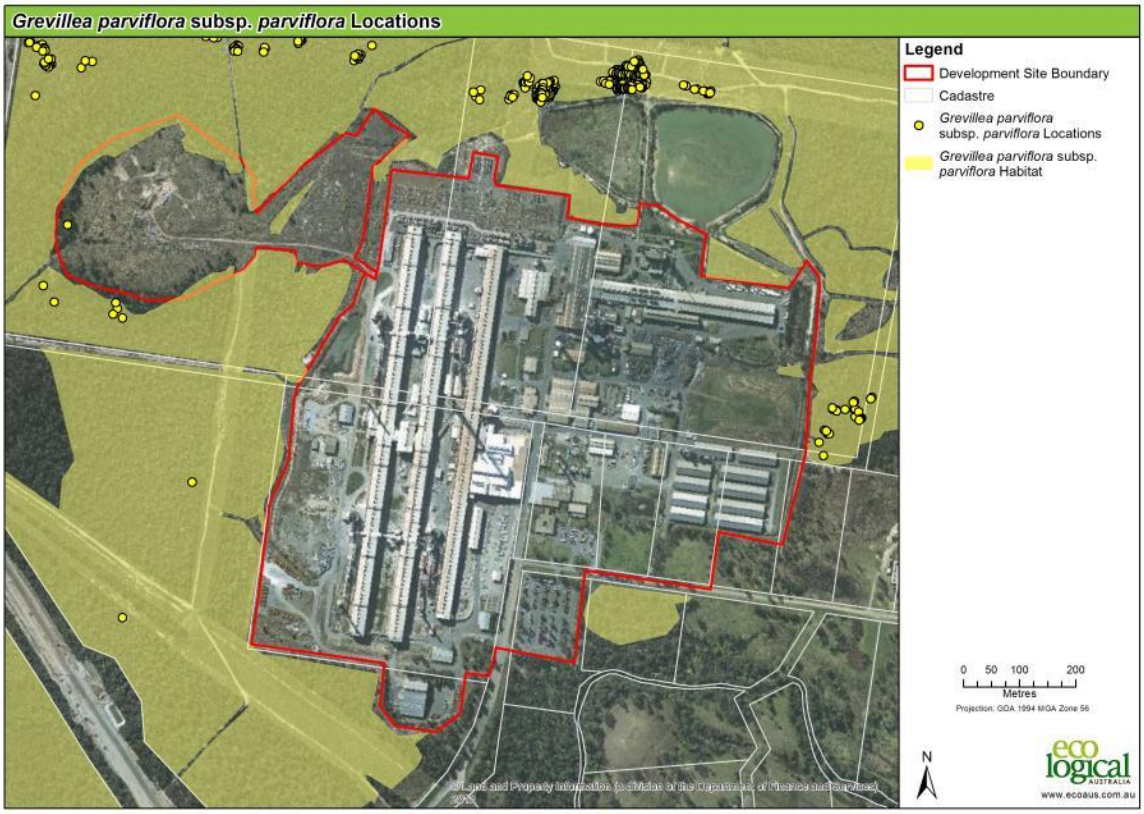

Figure 16: Small-flowered Grevillea locations and habitat

8 Conclusion and statement of commitments for biodiversity

This report has been prepared to fulfil the biodiversity assessment requirements as listed in the Secretary's Environmental Assessment Requirements (SEARs). This report provides the information necessary to address 'scenario 2' of the SEARs, whereby a traditional impact assessment on threatened biodiversity potentially impacted by the Project has been prepared. In addition, based on consultation with the Office of Environment and Heritage (OEH), the Project was considered to require biodiversity offsets. Credit calculations using the BioBanking Assessment Methodology (BBAM) have been completed to inform the quantum of credits necessary to offset the impacts of the Project. It is proposed that the required number of ecosystem and species credits will be sourced within the broader Hydro land around the Project site and the credit transfer is to be completed subsequent to a BCAM assessment on the Hydro land.

This report provides an ecological assessment for the proposed Hydro Aluminium Kurri Kurri smelter demolition and remediation project (the Project). Detailed flora and fauna surveys were completed within the Project site and broader Hydro land (the study area) to ascertain the extent of habitat and number of individuals (for threatened flora species) of threatened and migratory biodiversity listed under the TSC Act and EPBC Act.

The results of the surveys and likelihood of occurrence assessment identified several species and EEC's that were present or considered likely to occur within the Project site, which are provided in **Table 9** and **Table 10**. Assessments of the impacts of the Project on these species and EEC's are provided in **Appendix D** (EP&A Act) and **Appendix E** (EPBC Act). The results of these assessments concluded that the Project is not considered likely to have a significant impact on any of these species or EECs.

Based on consultation with OEH, the Project was considered to require biodiversity offsets. Credit calculations using the BBAM have been prepared in **section 7** (Biobanking Assessment) of this report. It is proposed that the required number of ecosystem and species credits would be sourced within the Hydro land around the Project site and the credit transfer is to be completed subsequent to a BCAM assessment on the Hydro land.

8.1 Biodiversity statement of commitments

Although the Project is not considered likely to trigger a significant impact on threatened or migratory biodiversity pursuant to the EP&A Act and/or the EPBC Act, several recommendations are suggested (though not limited to) to be included in the statement of commitments for the project, as follows:

- Statement of commitments and Environmental Impact Statement would include a commitment on when the offset credits for the Project would be secured, that as part of an approved Biocertification strategy for the Hydro land planning proposal or by a fixed date if the Biocertification strategy is not successful.
- A Flora and Fauna Management Plan is to be prepared and include, but not be limited to the following items:
    - Pre-clearing surveys and supervision during vegetation clearing
    - Hygiene protocols, including vehicle wash-downs, for all plant machinery
    - Nest box installation and monitoring strategy to compensate for hollow bearing tree loss

References

CENWEST Environmental Services 2004. Terrestrial Vertebrate Fauna Assessment, Hydro Aluminium Property, Kurri Kurri. Report prepared for Hydro Aluminium Kurri Kurri.

CENWEST Environmental Services 2010. Avifauna Monitoring Survey, Hydro Aluminium Property, Kurri Kurri. Report prepared for Hydro Aluminium Kurri Kurri.

DEC 2004 *Threatened species survey and assessment; guidelines for developments and activities (working draft)* New South Wales Department of Environment and Conservation, Hurstville, NSW.

DECC 2008 *Vegetation Types Database*, NSW Department of Environment and Climate Change, Sydney. Available http://www.environment.gov.au/biobanking/VegTypeDatabase.html

DECC 2008a *BioBanking Assessment Methodology*. NSW Department of Environment and Climate Change, Sydney.

DECC 2008b *Recovery plan for the Koala (Phascolarctos cinereus)* . NSW Department of Environment and Climate Change, Sydney, November 2008.

DECCW 2009a *Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians*. DECCW, Sydney.

DECCW 2011 *Biodiversity Certification Assessment Methodology*. NSW Department of Environment Climate Change and Water, Sydney.

Eco Logical Australia (2015) Hydro Aluminium Kurri Kurri Remediation and Demolition project EPBC Act referral. Unpublished report for Hydro Aluminium Kurri Kurri

FloraSearch 2004 Hydro Aluminium Kurri Kurri Flora Assessment. Unpublished report for Hydro Aluminium Kurri Kurri

FloraSearch 2008 Hydro Aluminium Kurri Kurri Spring Baseline Survey. Unpublished report for Hydro Aluminium Kurri Kurri.

Greg Richards and Associates 2004. Hydro Aluminium Kurri Kurri Spring Baseline Survey. Unpublished report for Hydro Aluminium Kurri Kurri.

Roderick, M., Ingwersen, D.A. and Tzaros, C.L. (2013). Swift Parrots and Regent Honeyeaters in the Lower Hunter Region of New South Wales: an assessment of status, identification of high priority habitats and recommendations for conservation. Report for Sustainable Regional Development Program. Department of Sustainability, Environment, Water, Population and Communities. BirdLife Australia, Melbourne.

Appendix A : Fauna Species List for Study Area

Class	Order	Family	Common Name	Scientific Name
Amphibia				
	Anura	Hylidae	Green Tree Frog	*Litoria caerulea*
			Bleating Tree Frog	*Litoria dentata*
			Eastern Dwarf Tree Frog	*Litoria fallax*
			Broad-palmed Frog	*Litoria latopalmata*
			Emerald-spotted Tree Frog	*Litoria peronii*
			Laughing Tree Frog	*Litoria tyleri*
		Limnodynastidae	Banjo Frog	*Limnodynastes dumerilii*
			Striped Marsh Frog	*Limnodynastes peronii*
			Spotted Grass Frog	*Limnodynastes tasmaniensis*
			Ornate Burrowing Frog	*Platyplectrum ornatum*
		Myobatrachidae	Common Froglet	*Crinia signifera*
			Dusky Toadlet	*Uperoleia fusca*
Aves				
	Accipitriformes	Accipitridae	Wedge-tailed Eagle	*Aquila audax*
			Swamp Harrier	*Circus approximans*
			White-bellied Sea-Eagle	*Haliaeetus leucogaster*
			Whistling Kite	*Haliastur sphenurus*
	Aegotheliformes	Aegothelidae	Australian Owlet-nightjar	*Aegotheles cristatus*

Class	Order	Family	Common Name	Scientific Name
	Anseriformes	Anatidae	Chestnut Teal	*Anas castanea*
			Grey Teal	*Anas gracilis*
			Australasian Shoveler	*Anas rhynchotis*
			Pacific Black Duck	*Anas superciliosa*
			Hardhead	*Aythya australis*
			Australian Wood Duck	*Chenonetta jubata*
			Black Swan	*Cygnus atratus*
			Pink-eared Duck	*Malacorhynchus membranaceus*
			Freckled Duck	*Stictonetta naevosa*
	Apodiformes	Apodidae	White-throated Needletail	*Hirundapus caudacutus*
	Caprimulgiformes	Podargidae	Tawny Frogmouth	*Podargus strigoides*
	Charadriiformes	Charadriidae	Black-fronted Dotterel	*Elseyornis melanops*
			Red-kneed Dotterel	*Erythrogonys cinctus*
			Masked Lapwing	*Vanellus miles*
		Recurvirostridae	Black-winged Stilt	*Himantopus himantopus*
			Red-necked Avocet	*Recurvirostra novaehollandiae*
		Scolopacidae	Sharp-tailed Sandpiper	*Calidris acuminata*
			Latham's Snipe	*Gallinago hardwickii*
	Columbiformes	Columbidae	Bar-shouldered Dove	*Geopelia humeralis*
			Peaceful Dove	*Geopelia striata*
			Crested Pigeon	*Ocyphaps lophotes*
			Common Bronzewing	*Phaps chalcoptera*
	Coraciiformes	Coraciidae	Dollarbird	*Eurystomus orientalis*
		Halcyonidae	Laughing Kookaburra	*Dacelo novaeguineae*
			Sacred Kingfisher	*Todiramphus sanctus*

Class	Order	Family	Common Name	Scientific Name
		Meropidae	Rainbow Bee-eater	*Merops ornatus*
	Cuculiformes	Cuculidae	Fan-tailed Cuckoo	*Cacomantis flabelliformis*
			Pallid Cuckoo	*Cacomantis pallidus*
			Pheasant Coucal	*Centropus phasianinus*
	Falconiformes	Falconidae	Nankeen Kestrel	*Falco cenchroides*
	Gruiformes	Rallidae	Eurasian Coot	*Fulica atra*
			Dusky Moorhen	*Gallinula tenebrosa*
			Purple Swamphen	*Porphyrio porphyrio*
	Passeriformes	Acanthizidae	Brown Thornbill	*Acanthiza pusilla*
			White-throated Gerygone	*Gerygone albogularis*
			White-browed Scrubwren	*Sericornis frontalis*
			Weebill	*Smicrornis brevirostris*
		Artamidae	Pied Butcherbird	*Cracticus nigrogularis*
			Australian Magpie	*Cracticus tibicen*
			Grey Butcherbird	*Cracticus torquatus*
		Campephagidae	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
		Cisticolidae	Golden-headed Cisticola	*Cisticola exilis*
		Climacteridae	Brown Treecreeper	*Climacteris picumnus*
			White-throated Treecreeper	*Cormobates leucophaea*
		Corvidae	Australian Raven	*Corvus coronoides*
		Estrildidae	Red-browed Finch	*Neochmia temporalis*
			Double-barred Finch	*Taeniopygia bichenovii*
		Eupetidae	Eastern Whipbird	*Psophodes olivaceus*

Class	Order	Family	Common Name	Scientific Name
		Hirundinidae	Welcome Swallow	*Hirundo neoxena*
		Maluridae	Superb Fairy-wren	*Malurus cyaneus*
			Variegated Fairy-wren	*Malurus lamberti*
		Meliphagidae	Eastern Spinebill	*Acanthorhynchus tenuirostris*
			Yellow-faced Honeyeater	*Lichenostomus chrysops*
			Fuscous Honeyeater	*Lichenostomus fuscus*
			White-eared Honeyeater	*Lichenostomus leucotis*
			Yellow-tufted Honeyeater	*Lichenostomus melanops*
			Noisy Miner	*Manorina melanocephala*
			Bell Miner	*Manorina melanophrys*
			Lewin's Honeyeater	*Meliphaga lewinii*
			Brown-headed Honeyeater	*Melithreptus brevirostris*
			Scarlet Honeyeater	*Myzomela sanguinolenta*
			Noisy Friarbird	*Philemon corniculatus*
			White-cheeked Honeyeater	*Phylidonyris niger*
			Striped Honeyeater	*Plectorhyncha lanceolata*
		Monarchidae	Magpie-lark	*Grallina cyanoleuca*
			Leaden Flycatcher	*Myiagra rubecula*
		Motacilidae	Australasian Pipit	*Anthus novaeseelandiae*
		Nectariniidae	Mistletoebird	*Dicaeum hirundinaceum*
		Oriolidae	Olive-backed Oriole	*Oriolus sagittatus*
		Pachycephalidae	Grey Shrike-thrush	*Colluricincla harmonica*
			Golden Whistler	*Pachycephala pectoralis*

Class	Order	Family	Common Name	Scientific Name
			Rufous Whistler	*Pachycephala rufiventris*
		Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*
			Striated Pardalote	*Pardalotus striatus*
		Petroicidae	Eastern Yellow Robin	*Eopsaltria australis*
		Pomatostomidae	Grey-crowned Babbler	*Pomatostomus temporalis*
		Ptilonorhynchidae	Satin Bowerbird	*Ptilonorhynchus violaceus*
		Rhipiduridae	Grey Fantail	*Rhipidura albiscapa*
			Willie Wagtail	*Rhipidura leucophrys*
		Sturnidae	Common Myna[I]	*Sturnus tristis*
		Timaliidae	Silvereye	*Zosterops lateralis*
	Pelecaniformes	Ardeidae	Cattle Egret	*Ardea ibis*
			Eastern Great Egret	*Ardea modesta*
			White-necked Heron	*Ardea pacifica*
			White-faced Heron	*Egretta novaehollandiae*
			Nankeen Night-Heron	*Nycticorax caledonicus*
			Yellow-billed Spoonbill	*Platalea flavipes*
			Royal Spoonbill	*Platalea regia*
			Australian White Ibis	*Threskiornis molucca*
			Straw-necked Ibis	*Threskiornis spinicollis*
		Pelecanidae	Australian Pelican	*Pelecanus conspicillatus*
	Podicipediformes	Podicipedidae	Hoary-headed Grebe	*Poliocephalus poliocephalus*
			Australasian Grebe	*Tachybaptus novaehollandiae*
	Psittaciformes	Cacatuidae	Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*
		Psittacidae	Australian King-Parrot	*Alisterus scapularis*
			Musk Lorikeet	*Glossopsitta concinna*

Class	Order	Family	Common Name	Scientific Name
			Little Lorikeet	*Glossopsitta pusilla*
			Eastern Rosella	*Platycercus eximius*
			Red-rumped Parrot	*Psephotus haematonotus*
			Rainbow Lorikeet	*Trichoglossus haematodus*
	Strigiformes	Strigidae	Southern Boobook	*Ninox novaeseelandiae*
	Suliformes	Anhingidae	Australasian Darter	*Anhinga novaehollandiae*
		Phalacrocoracidae	Little Pied Cormorant	*Microcarbo melanoleucos*
			Great Cormorant	*Phalacrocorax carbo*
			Little Black Cormorant	*Phalacrocorax sulcirostris*
Mammalia				
	Artiodactyla	Cervidae	Sambar Deer	*Rusa unicolor*
	Carnivora	Canidae	Fox	*Vulpes vulpes*
		Felidae	Cat	*Felis cattus*
	Chiroptera	Emballonuridae	Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*
		Miniopteridae	Little Bentwing-bat	*Miniopterus australis*
			Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*
		Molossidae	East-coast Free-tailed Bat	*Micronomus norfolkensis*
			Eastern Free-tailed Bat	*Mormopterus ridei* (formerly *Mormopterus* sp. 2)
			-	*Mormopterus petersi* (formerly *Mormopterus* sp. *3*)
			Southern Free-tailed Bat	*Mormopterus planiceps* (formerly *Mormopterus* sp. *4*)
			White-striped Freetail Bat	*Tadarida australis*
		Vespertilonidae	Gould's Wattled Bat	*Chalinolobus gouldii*
			Chocolate Wattled Bat	*Chalinolobus morio*
			Long-eared Bats	*Nyctophilus spp.*
			Greater Broad-nosed Bat	*Scoteanax rueppellii*

Class	Order	Family	Common Name	Scientific Name
			Eastern Broad-nosed Bat	*Scotorepens orion*
			Southern Forest Bat	*Vespadelus regulus*
			Little Forest Bat	*Vespadelus vulturnus*
	Dasyuromorphia	Dasyuridae	Brown Antechinus	*Antechinus stuartii*
	Diprotodontia	Acrobatidae	Feathertail Glider	*Acrobates pygmaeus*
		Macropodidae	Eastern Grey Kangaroo	*Macropus giganteus*
			Red-necked Wallaby	*Macropus rufogriseus*
			Swamp Wallaby	*Wallabia bicolor*
		Petauridae	Sugar Glider	*Petaurus breviceps*
			Squirrel Glider	*Petaurus norfolcensis*
		Phalangeridae	Brushtail Possum	*Trichosurus vulpecula*
		Pseudocheiridae	Ringtail Possum	*Pseudocheirus peregrinus*
	Lagomorpha	Leporidae	Rabbit	*Oryctolagus cuniculus*
	Rodentia	Muridae	Bush Rat	*Rattus fuscipes*
			Black Rat	*Rattus rattus*
Reptillia				
	Squamata	Agamidae	Jacky Dragon	*Amphibolurus muricatus*
			Eastern Water Dragon	*Intellagama lesueurii*
			Bearded Dragon	*Pogona barbata*
		Elapidae	Yellow-faced Whip-snake	*Demansia psammophis*
			Red-bellied Black Snake	*Pseudechis porphyriacus*
			Eastern Brown Snake	*Pseudonaja textilis*
		Gekkonidae	Eastern Stone Gecko	*Diplodactylus vittatus*

Class	Order	Family	Common Name	Scientific Name
		Scincidae	Southern Rainbow-Skink	*Carlia tetradactyla*
			Robust Ctenotus	*Ctenotus robustus*
			Tree Skink	*Egernia striolata*
			Eastern Water Skink	*Eulamprus quoyii*
			Bar-sided Forest-skink	*Eulamprus tenuis*
		Typhlopidae	Blackish Blind Snake	*Ramphotyphlops nigrescens*
		Varanidae	Lace Monitor	*Varanus varius*
	Testudines	Chelidae	Eastern Long-necked Turtle	*Chelodina longicollis*

Appendix B : Flora Species List

Table 19: Flora species list from biometric quadrat in Kurri Sand Swamp Woodland within the Project site

Family	Scientific Name	Common Name	Cover/Abundance Score
Apocynaceae	*Parsonsia straminea*	Common Silkpod	1
Cyperaceae	*Baumea teretifolia*		6
Fabaceae (Faboideae)	*Pultenaea retusa*		1
Goodeniaceae	*Scaevola* sp.		1
Lauraceae	*Cassytha glabella*		2
Lobeliaceae	*Pratia purpurascens*	Whiteroot	2
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	1
Myrtaceae	*Angophora bakeri*	Narrow-leaved Apple	4
Myrtaceae	*Callistemon rigidus*	Stiff Bottlebrush	3
Myrtaceae	*Eucalyptus parramattensis* subsp. *decadens**	Parramatta Red Gum	4
Myrtaceae	*Leptospermum polygalifolium*	Tantoon	3
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree	2
Myrtaceae	*Melaleuca nodosa*	Ball Honeymyrtle	2
Myrtaceae	*Melaleuca sieberi*		2

Family	Scientific Name	Common Name	Cover/Abundance Score
Myrtaceae	*Melaleuca thymifolia*		1
Pittosporaceae	*Billardiera scandens*	Appleberry	2
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	1
Proteaceae	*Banksia paludosa*		3
Thymelaeaceae	*Pimelea linifolia*		2

* = Listed threatened species

Table 20: Flora species list from biometric quadrat in Lower Hunter Spotted Gum/ Ironbark forest within the Project site

Family	Scientific Name	Common Name	Cover/Abundance Score
Adiantaceae	*Cheilanthes sieberi*	Rock Fern	3
Asteraceae	*Aster spp.*		1
Asteraceae	*Bidens pilosa**	Cobbler's Pegs	2
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting, Yellow Buttons	1
Asteraceae	*Conyza albida*	Tall Fleabane	2
Cyperaceae	*Cyperus polystachyos*		1
Epacridaceae	*Styphelia triflora*	Pink Five-Corners	1
Euphorbiaceae	*Phyllanthus spp.*		2
Fabaceae (Faboideae)	*Bossiaea rhombifolia*		1
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea	2

Family	Scientific Name	Common Name	Cover/Abundance Score
Fabaceae (Faboideae)	*Glycine clandestina*		3
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla	1
Juncaceae	*Juncus usitatus*		1
Lobeliaceae	*Pratia purpurascens*	Whiteroot	2
Lomandraceae	*Lomandra confertifolia*		2
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush	2
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne	2
Myrtaceae	*Callistemon rigidus*	Stiff Bottlebrush	2
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark	4
Myrtaceae	*Melaleuca nodosa*	Ball Honeymyrtle	4
Oxalidaceae	*Oxalis perennans*		1
Phormiaceae	*Dianella longifolia*	Blue Flax-Lily	2
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn	2
Poaceae	*Aristida vagans*	Threeawn Speargrass	3
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	3
Poaceae	*Cynodon dactylon*	Common Couch	3
Poaceae	*Dichelachne* spp.	Plumegrass	1

Family	Scientific Name	Common Name	Cover/Abundance Score
Poaceae	*Entolasia stricta*	Wiry Panic	2
Poaceae	*Microlaena stipoides*	Weeping Grass	3
Poaceae	*Rytidosperma spp.*		2
Poaceae	*Setaria* sp.	Pigeon Grass	3
Poaceae	*Themeda australis*	Kangaroo Grass	1
Proteaceae	*Grevillea montana*ł		2
Proteaceae	*Grevillea parviflora* subsp. *parviflora**	Small-flower Grevillea	1
Proteaceae	*Hakea dactyloides*	Finger Hakea, Broad-leaved Hakea	2
Rutaceae	*Correa reflexa*	Native Fuschia	2

* = Listed threatened species ł = ROTAP 2V

Appendix C : Likelihood of Occurrence Table

Threatened Flora

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
Fabaceae (Mimosoideae)	*Acacia bynoeana*	Bynoe's Wattle	E1	V	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains.	Heath or dry sclerophyll forest on sandy soils.	Potential, known from study area but not recorded during flora surveys in Project site	Yes
Myrtaceae	*Angophora inopina*	Charmhaven Apple	V	V	Endemic to the Central Coast region of NSW. Populations occur around Karuah, and from Toronto to Charmhaven. There is an unconfirmed record of the species near Bulahdelah.	Occurs most frequently in *Eucalyptus haemastoma – Corymbia gummifera–Angophora inopina* woodland/forest, *Hakea teretifolia–Banksia oblongifolia* wet heath, *Eucalyptus resinifera–Melaleuca sieberi–Angophora inopina* sedge woodland and	No	No

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
						Eucalyptus capitellata–Corymbia gummifera–Angophora inopina woodland/forest.		
Rutaceae	*Asterolasia elegans*		E1	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.	The canopy at known sites includes *Syncarpia glomulifera subsp. glomulifera* (Turpentine), *Angophora costata* (Smooth-barked Apple), *Eucalyptus piperita* (Sydney Peppermint), *Allocasuarina torulosa (*Forest Oak*)* and *Ceratopetalum gummiferum* (Christmas Bush). Ecological knowledge about this species is very limited.	No	No

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
Myrtaceae	*Callistemon linearifolius*	Netted Bottle Brush	V		Georges River to Hawkesbury River in the Sydney area (limited to the Hornsby Plateau area), and north to the Nelson Bay area of NSW. Also Coalcliff in the northern Illawarra.	Dry sclerophyll forest.	Unlikely, surveys completed	No

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
Orchidaceae	*Cryptostylis hunteriana*	Leafless Tongue Orchid	V	V	In NSW, recorded mainly on coastal and near coastal ranges north from Victoria to near Forster, with two isolated occurrences inland north-west of Grafton.	Coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest.	Unlikely	No
Orchidaceae	*Cymbidium canaliculatum*	*Cymbidium canaliculatum* population in the Hunter Catchment	E2		The Hunter population occurs as far south as Weston and Pokolbin in the Lower Hunter, but is centred in the Upper Hunter, predominantly north of Singleton. Isolated occurrences are also known from the Merriwa plateau, Bylong valley and the Gungal area near Goulburn River.	Grows on trees in sclerophyll forest or woodland, where its host trees typically occur on Permian Sediments of the Hunter Valley floor. Within the Hunter Catchment, most commonly found in *Eucalyptus albens* (White Box) dominated woodlands.	Unlikely	No

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
Apocynaceae	*Cynanchum elegans*	White-flowered Wax Plant	E1	E	Restricted to eastern NSW, from Brunswick Heads on the north coast to Gerroa in the Illawarra region, and as far west as Merriwa in the upper Hunter River valley.	Dry rainforest; littoral rainforest; *Leptospermum laevigatum-Banksia integrifolia subsp. integrifolia* (Coastal Tea-tree – Coastal Banksia) coastal scrub; *Eucalyptus tereticornis* (Forest Red Gum) or *Corymbia maculata* (Spotted Gum) open forest and woodland; and *Melaleuca armillaris* (Bracelet Honeymyrtle) scrub.	Unlikely	No
Orchidaceae	*Diuris pedunculata*	Small Snake Orchid	E1	E	Confined to north east NSW, now mainly found on the New England Tablelands, around Armidale, Uralla, Guyra and Ebor.	Grassy slopes or flats, on peaty soils in moist areas, on shale and trap soils, on fine granite, and among boulders.	Unlikely	No

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
Orchidaceae	*Diuris tricolor*	Pine Donkey Orchid	V		Sporadically distributed on the western slopes of NSW, from south of Narrandera all the way to the north of NSW. There is an endangered population at Muswellbrook.	Sclerophyll woodland and derived grassland on flats or small rises.	Unlikely	No
Myrtaceae	*Eucalyptus glaucina*	Slaty Red Gum	V	V	Only on the north coast of NSW. Found near Casino and farther south, from Taree to Broke, west of Maitland.	Grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils.	Unlikely – previous records on site regarded as *E.tereticornis* (Forest Red Gum)	No
Myrtaceae	*Eucalyptus parramattensis* subsp. *decadens*	Parramatta Red Gum	V	V	Two separate meta-populations: one bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south, and the other bounded by Salt	Dry sclerophyll woodland, wet or dry heath on deep, low-nutrient sands, often subject to periodic inundation or where water tables are	Yes – known to occur in Project site	Yes

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
					Ash and Tanilba Bay in the north and Williamtown and Tomago in the south.	relatively high.		
Scrophulariaceae	*Euphrasia arguta*		E4A	CE	In NSW, recently recorded only from Nundle area of the north western slopes and tablelands, from near the Hastings River and from the Barrington Tops.	Eucalypt forest with a mixed grass and shrub understorey, disturbed areas, along roadsides.	Unlikely	No
Proteaceae	*Grevillea parviflora* subsp. *parviflora*	Small-flower Grevillea	V	V	Sporadically distributed throughout the Sydney Basin and in the Hunter in the Cessnock - Kurri Kurri area. Also known from Putty to Wyong and Lake Macquarie on the Central Coast.	Heath and shrubby woodland to open forest on sandy or light clay soils usually over thin shales.	Yes - known to occur	Yes

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
Juncaginaceae	*Maundia triglochinoides*		V		Coastal NSW north from Wyong and extending into southern Qld.	Swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay.	Unlikely	No
Myrtaceae	*Melaleuca biconvexa*	Biconvex Paperbark	V	V	Only found in NSW, populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	Damp places, often near streams or low-lying areas on alluvial soils.		
Asteraceae	*Ozothamnus tesselatus*		V	V	Restricted to a few locations in an east-west zone south of Bunnan and between west Bylong and east Ravensworth.	Eucalypt woodland.		

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
Polygonaceae	*Persicaria elatior*	Tall Knotweed	V	V	In south-eastern NSW recorded from Mt Dromedary, Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests).	Beside streams and lakes, swamp forest or disturbed areas.		
Orchidaceae	*Prasophyllum sp. Wybong*		P	CE	Endemic to NSW. Known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area.	Open eucalypt woodland and grassland.		

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
Lamiaceae	*Prostanthera cineolifera*	Singleton Mint Bush	V	V	Restricted to only a few localities near Walcha, Scone, Cessnock and St Albans.	Open woodlands on exposed sandstone ridges.		
Orchidaceae	*Pterostylis gibbosa*	Illawarra Greenhood	E1	E	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).	Open forest or woodland, on flat or gently sloping land with poor drainage.		
Asteraceae	*Rutidosis heterogama*	Heath Wrinklewort	V	V	Between Cessnock and Kurri Kurri, in Howes Valley, and north from Wyong to Newcastle on the Central Coast. Also on the north coast between Wooli and Evans Head in Yuraygir and Bundjalung National Parks. Also occurs on	Heath on sandy soils, moist areas in open forest, and along disturbed roadsides.		

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
					the New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes.			
Moraceae	*Streblus pendulinus*	Siah's Backbone, Sia's Backbone, Isaac Wood	P	E	East coast south to Milton, south-east NSW, as well as Norfolk Island.	Warmer rainforests, chiefly along watercourses.		
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E1	V	Only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest.	Subtropical and littoral rainforest on gravels, sands, silts and clays.		
Elaeocarpaceae	*Tetratheca juncea*	Black-eyed Susan	V	V	Confined to the northern Sydney Basin bioregion and the southern North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle,	Low open forest/woodland, heathland and moist forest, mainly on low nutrient soils associated with the Awaba Soil		

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact assessment required
					Port Stephens, Great Lakes and Cessnock.	Landscape.		

Likelihood Table - Fauna

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Regent Honeyeater	E4A	E	Inland slopes of south-east Australia, and less frequently in coastal areas. In NSW, most records are from the North-West Plains, North-West and South-West Slopes, Northern Tablelands, Central Tablelands and Southern Tablelands regions; also recorded in the Central Coast and Hunter Valley regions.	Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of *Casuarina cunninghamiana* (River Oak).	Potential	Yes
Fork-tailed Swift	P	C,J,K, Mar	Recorded in all regions of NSW.	Riparian woodland., swamps, low scrub, heathland, saltmarsh, grassland, Spinifex sandplains, open farmland and inland and coastal sand-dunes.	Potential	Yes
Great Egret	P	C, J, Mar	Widespread, occurring across all states/territories. Also a vagrant on Lord Howe and Norfolk Island.	Swamps and marshes, grasslands, margins of rivers and lakes, salt pans, estuarine mudflats and other wetland habitats.	Unlikely	No
Cattle Egret	P	C,J, Mar	Widespread and common across NSW.	Grasslands, wooded lands near water and terrestrial wetlands.	Unlikely	No
Australasian Bittern	E1	E	Found over most of NSW except for the far north-west.	Permanent freshwater wetlands with tall, dense vegetation, particularly Typha spp. (bullrushes) and Eleocharis spp. (spikerushes).	Unlikely	No

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Sharp-tailed Sandpiper	P	C,J,K	Summer migrant. Widespread in most regions of NSW, especially in coastal areas, but sparse in the south-central Western Plain and east Lower Western Regions.	Shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Unlikely	No
Curlew Sandpiper	E1	C,J,K	Occurs along the entire coast of NSW, and sometimes in freshwater wetlands in the Murray-Darling Basin.	Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	No	No
Pectoral Sandpiper	P	J,K	Summer migrant to Australia. Widespread but scattered in NSW. East of the Great Divide, recorded from Casino and Ballina, south to Ulladulla. West of the Great Divide, widespread in the Riverina and Lower Western regions.	Shallow fresh to saline wetlands, including coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	No	No
Red-necked Stint	P	C,J,K	Summer migrant to Australia, widespread coastal and inland NSW.	Tidal mudflats, saltmarshes, sandy and shelly beaches, saline and freshwater wetlands, saltfields, sewage ponds.	No	No
Gang-gang Cockatoo	V		In NSW, distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. Isolated records known from as far north as Coffs Harbour and as far west as Mudgee.	Tall mountain forests and woodlands in summer; in winter, may occur at lower altitudes in open eucalypt forests and woodlands, and urban areas.	Unlikely	No
Glossy Black-Cockatoo	V		In NSW, widespread along coast and inland to the southern tablelands and central western	Open forest and woodlands of the coast and the Great Dividing Range where stands of	Unlikely	No

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
			plains, with a small population in the Riverina.	sheoak occur.		
Eastern Pygmy-possum	V		In NSW it extents from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes.	Rainforest, sclerophyll forest (including Box-Ironbark), woodland and heath.	Potential	Yes
Large-eared Pied Bat	V	V	Recorded from Rockhampton in Qld south to Ulladulla in NSW. Largest concentrations of populations occur in the sandstone escarpments of the Sydney basin and the NSW north-west slopes.	Wet and dry sclerophyll forests, Cyprus Pine dominated forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country.	Potential	Yes
Speckled Warbler	V		From south-eastern Qld, the eastern half of NSW and into Victoria, as far west as the Grampians, mostly on hills and tablelands of the Great Dividing Range and rarely on coast.	Eucalyptus-dominated communities with a grassy understorey and sparse shrub layer, often on rocky ridges or in gullies.	Potential	Yes
Brown Treecreeper (eastern subspecies)	V		From eastern through central NSW, west to Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell.	Eucalypt woodlands and dry open forest.	Likely	Yes
Wallum Froglet	V		Along the coastal margin from Litabella National Park in south-east Qld to Kurnell in Sydney.	Acidic swamps on coastal sand plains (typically in sedgelands and wet heathlands), drainage lines, and swamp sclerophyll forests.	No	No

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Varied Sittella	V		Distribution in NSW is nearly continuous from the coast to the far west.	Inhabits eucalypt forests and woodlands, mallee and Acacia woodland.	Potential	Yes
Eastern Bristlebird	E1	E	There are three main populations: Northern - southern Qld/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft Peninsula and Southern - Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border.	Central and southern populations inhabit heath and open woodland with a heathy understorey. In northern NSW, habitat comprises open forest with dense tussocky grass understorey.	No	No
Spotted-tailed Quoll	V	E	Found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Qld.	Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Potential	Yes
Black-necked Stork	E1		Coastal and subcoastal northern and eastern Australia, south to central-eastern NSW and with vagrants recorded further south and inland.	In NSW, floodplain wetlands of the major coastal rivers are key habitat. Also minor floodplains, coastal sandplain wetlands and estuaries.	No	No
Latham's Snipe	P	C,J,R, Mar	Migrant to east coast of Australia, extending inland west of the Great Dividing Range in NSW.	Freshwater, saline or brackish wetlands up to 2000 m above sea-level; usually freshwater swamps, flooded grasslands or heathlands.	Unlikely	No

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Little Lorikeet	V		In NSW, found from the coast westward as far as Dubbo and Albury.	Dry, open eucalypt forests and woodlands, including remnant woodland patches and roadside vegetation.	Yes	Yes
White-bellied Sea-Eagle	P	C	Distributed along the coastline of mainland Australia and Tasmania, extending inland along some of the larger waterways, especially in eastern Australia.	Freshwater swamps, rivers, lakes, reservoirs, billabongs, saltmarsh and sewage ponds and coastal waters. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and urban areas.	Yes	Yes
Little Eagle	V		Throughout the Australian mainland, with the exception of the most densely-forested parts of the Dividing Range escarpment.	Open eucalypt forest, woodland or open woodland, including sheoak or Acacia woodlands and riparian woodlands of interior NSW.	Potential	Yes
White-throated Needletail	P	C,J,K	All coastal regions of NSW, inland to the western slopes and inland plains of the Great Divide.	Occur most often over open forest and rainforest, as well as heathland, and remnant vegetation in farmland.	Yes	Yes
Pale-headed Snake	V		In NSW, it occurs from the coast to the western side of the Great Divide as far south as Tuggerah. Historically recorded west to Mungindi and Quambone on the Darling Riverine Plains, across the North West Slopes, and the New England Tablelands.	Dry eucalypt forests and woodlands, cypress forest, rainforest and moist eucalypt forest.	Yes	Yes

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Broad-headed Snake	E1	V	Largely confined to Triassic and Permian sandstones within the coast and ranges in an area within approximately 250 km of Sydney.	Dry and wet sclerophyll forests, riverine forests, coastal heath swamps, rocky outcrops, heaths, grassy woodlands.	No	No
Black Bittern	V		In NSW, records are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.	Terrestrial and estuarine wetlands. Also flooded grassland, forest, woodland, rainforest and mangroves where permanent water is present.	Unlikely	No
Swift Parrot	E1	E	Migrates from Tasmania to mainland in Autumn-Winter. In NSW, the species mostly occurs on the coast and south west slopes.	Box-ironbark forests and woodlands.	Potential	Yes
Black-tailed Godwit	V	C,J,K	Arrives in August and leaves in March. In NSW, most frequently recorded at Kooragang Island, with occasional records elsewhere along the coast, and inland in the Murray-Darling Basin, on the western slopes of the Northern Tablelands and in the far north-western corner of the state.	Usually sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found around muddy lakes and swamps.	Unlikely	No
Green and Golden Bell Frog	E1	V	Since 1990, recorded from ~50 scattered sites within its former range in NSW, from the north coast near Brunswick Heads, south along the coast to Victoria. Records exist west to Bathurst, Tumut and the ACT region.	Marshes, dams and stream-sides, particularly those containing Typha spp. (bullrushes) or Eleocharis spp. (spikerushes). Some populations occur in highly disturbed areas.	Potential	Yes

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Green-thighed Frog	V		Isolated localities along the coast and ranges from just north of Wollongong to south-east Qld.	Rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain.	Yes	Yes
Littlejohn's Tree Frog	V	V	Plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest south to Buchan in Victoria. The species has not been recorded in southern NSW within the last decade.	Breeding habitat is the upper reaches of permanent streams and perched swamps. Non-breeding habitat is heath-based forests and woodlands	No	No
Square-tailed Kite	V		In NSW, it is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast.	Timbered habitats including dry woodlands and open forests, particularly timbered watercourses.	Potential	Yes
Black-chinned Honeyeater (eastern subspecies)	V		Widespread in NSW from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Also Richmond and Clarence River areas and a few scattered sites in the Hunter, Central Coast and Illawarra regions.	Open forests or woodlands dominated by box and ironbark eucalypts, or by smooth-barked gums, stringybarks, river sheoaks and tea-trees.	Potential	Yes
Rainbow Bee-eater	P	J	Distributed across much of mainland Australia, including NSW.	Open forests and woodlands, shrublands, farmland, areas of human habitation, inland and coastal sand dune systems, heathland, sedgeland, vine forest and vine thicket.	Yes	Yes

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Little Bentwing-bat	V		East coast and ranges south to Wollongong in NSW.	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub.	Yes	Yes
Eastern Bentwing-bat	V		In NSW it occurs on both sides of the Great Dividing Range, from the coast inland to Moree, Dubbo and Wagga Wagga.	Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland.	Yes	Yes
Stuttering Frog	E1	V	Along the east coast of Australia from southern Qld to north-eastern Victoria.	Rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	No	No
Giant Barred Frog	E1	E	Coast and ranges from Eumundi in south-east Qld to Warrimoo in the Blue Mountains.	Freshwater permanent/semi-permanent streams, generally at lower elevation. Riparian rainforest or wet sclerophyll forest is favoured.	No	No
Black-faced Monarch	P	Bonn, Mar	In NSW, occurs around the eastern slopes and tablelands of the Great Divide, inland to Coutts Crossing, Armidale, Widden Valley, Wollemi National Park and Wombeyan Caves. It is rarely recorded farther inland.	Rainforest, open eucalypt forests, dry sclerophyll forests and woodlands, gullies in mountain areas or coastal foothills, Brigalow scrub, coastal scrub, mangroves, parks and gardens.	No	No
Spectacled Monarch	P	Bonn, Mar	Coastal eastern Australia south to Port Stephens in NSW.	Mountain/lowland rainforest, wooded gullies, riparian vegetation including mangroves.	No	No

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Eastern Freetail-bat	V		Found along the east coast from south Qld to southern NSW.	Dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	Yes	Yes
Satin Flycatcher	P	Bonn, Mar	In NSW, widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains.	Eucalypt-dominated forests, especially near wetlands, watercourses, and heavily-vegetated gullies.	No	No
Southern Myotis	V		In NSW, found in the coastal band. It is rarely found more than 100 km inland, except along major rivers.	Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20m.	Potential	Yes
Turquoise Parrot	V		Occurs along the length of NSW from the coastal plains to the western slopes of the Great Dividing Range.	Eucalypt and cypress pine open forests and woodlands, ecotones between woodland and grassland, or coastal forest and heath.	Potential	Yes
Barking Owl	V		Wide but sparse distribution in NSW, avoiding the most central arid regions. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests.	Woodland and open forest, including fragmented remnants and partly cleared farmland, wetland and riverine forest.	Potential	Yes
Powerful Owl	V		In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains.	Woodland, open sclerophyll forest, tall open wet forest and rainforest.	Potential	Yes

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Little Curlew	P	C,J,K	Summer migrant to Australia. In NSW, most records scattered east of the Great Dividing Range, from Casino, south to Greenwell Point with a few scattered records west of the Great Dividing Range.	Dry grasslands, open woodlands, floodplains, margins of drying swamps, tidal mudflats, airfields, playing fields, crops, saltfields, sewage ponds.	No	No
Yellow-bellied Glider	V		Along the eastern coast to the western slopes of the Great Dividing Range, from southern Qld to Victoria.	Tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils.	No	No
Squirrel Glider	V		Widely though sparsely distributed on both sides of the Great Dividing Range in eastern Australia, from northern Qld to western Victoria.	Mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	Yes	Yes
Brush-tailed Rock-wallaby	E1	V	In NSW they occur from the Qld border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit.	Rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.	No	No
Scarlet Robin	V		In NSW, it occurs from the coast to the inland slopes.	Dry eucalypt forests and woodlands, and occasionally in mallee, wet forest, wetlands and tea-tree swamps.	No	No

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Flame Robin	V		In NSW, breeds in upland areas, and in winter many birds move to the inland slopes and plains, or occasionally to coastal areas. Likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands.	Breeds in upland tall moist eucalypt forests and woodlands. In winter uses dry forests, open woodlands, heathlands, pastures and native grasslands. Occasionally occurs in temperate rainforest, herbfields, heathlands, shrublands and sedgelands at high altitudes.	No	No
Brush-tailed Phascogale	V		In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide.	Dry sclerophyll open forest, heath, swamps, rainforest and wet sclerophyll forest.	Potential	No
Koala	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. There are sparse and possibly disjunct populations in the Bega District, and at several sites on the southern tablelands.	Eucalypt woodlands and forests.	Potential	No
Common Planigale	V		Occurs in coastal north-eastern NSW, and reported from as far south as the central NSW coast west of Sydney.	Rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas.	Potential	No
Grey-crowned Babbler (eastern subspecies)	V		In NSW, occurs on the western slopes of the Great Dividing Range, and as far as Louth and Balranald on the western plains. Also occurs in woodlands in the Hunter Valley and in some locations on the north coast	Open woodland habitats; favours Box-gum woodlands on the slopes and Box-cypress and open Box woodlands on alluvial plains.	Yes	Yes

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
New Holland Mouse	P	V	Fragmented distribution across eastern NSW.	Open heathlands, woodlands and forests with a heathland understorey, vegetated sand dunes.	Unlikely	No
Grey-headed Flying-fox	V	V	Along the eastern coast of Australia, from Bundaberg in Qld to Melbourne in Victoria.	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	Likely	Yes
Rufous Fantail	P	Bonn, Mar	Coastal and near coastal districts of northern and eastern Australia, including on and east of the Great Divide in NSW.	Wet sclerophyll forests, subtropical and temperate rainforests. Sometimes drier sclerophyll forests and woodlands.	Unlikely	No
Australian Painted Snipe	E1	E, Mar	In NSW most records are from the Murray-Darling Basin. Other recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys.	Swamps, dams and nearby marshy areas.	No	No
Yellow-bellied Sheathtail-bat	V		There are scattered records of this species across the New England Tablelands and North West Slopes. Rare visitor in late summer and autumn to south-western NSW.	Almost all habitats, including wet and dry sclerophyll forest, open woodland, open country, mallee, rainforests, heathland and waterbodies.	Yes	Yes
Greater Broad-nosed Bat	V		Both sides of the great divide, from the Atherton Tableland in Qld to north-eastern Victoria, mainly along river systems and gullies. In NSW it is widespread on the New England Tablelands.	Woodland, moist and dry eucalypt forest and rainforest.	Yes	Yes

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Diamond Firetail	V		Widely distributed in NSW, mainly recorded in the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina, and less commonly found in coastal areas and further inland.	Grassy eucalypt woodlands, open forest, mallee, Natural Temperate Grassland, secondary derived grassland, riparian areas and lightly wooded farmland.	Potential	Yes
Little Tern	E1	C,J,K	In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria.	Sheltered coastal environments, harbours, inlets and rivers.	No	No
Freckled Duck	V		Inland river systems, occurring as far as coastal NSW in times of drought.	Freshwater swamps and creeks, lakes, reservoirs, farm dams and sewage ponds.	Unlikely	No
Masked Owl	V		Recorded over approximately 90% of NSW, excluding the most arid north-western corner. Most abundant on the coast but extends to the western plains.	Dry eucalypt forests and woodlands from sea level to 1100 m.	Likely	Yes
Sooty Owl	V		Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands.	Dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests.	No	No
Rosenberg's Goanna	V		In NSW, found on the Sydney Sandstone in Wollemi National Park, in the Goulburn and ACT regions and near Cooma in the south. Also recorded from the South West Slopes near Khancoban and Tooma River.	Heath, open forest and woodland.	Unlikely	No

Common Name	TSC Act Status	EPBC Act Status	Distribution	Habitat	Likelihood of occurrence in Project site	Impact Assessment Required
Eastern Cave Bat	V		Found in a broad band on both sides of the Great Dividing Range south to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT.	Dry open forest and woodland, near cliffs or rocky overhangs, cliff-lines in wet eucalypt forest and rainforest.	Potential	Yes

Appendix D : Assessment of Significance

The following appendix provides an assessment of the potential significance of the impacts from the Project on ecological values listed under the TSC Act pursuant to S5A of the EP&A Act (7 part test). The ecological values considered relevant to this assessment are identified in **Section 6.2** of this report.

Endangered Ecological Communities – Kurri Sand Swamp *Woodland in the Sydney Basin Bioregion* and *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion*

Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion is restricted to a range of approximately 65 km by 35 km centred on the Cessnock - Beresfield area in the Central and Lower Hunter Valley. Within this range, the community was once widespread. Four large patches of Lower Hunter Spotted Gum-Ironbark Forest are estimated to have covered nearly 50,000 ha prior to European settlement, representing 75% of the total distribution. The community is currently mapped as occurring in more than 4,800 fragments, of which more than 4,500 are less than 10 ha in area.

1.15 ha of intact Lower Hunter Spotted Gum Ironbark Forest occurs in the Project site.

Kurri Sand Swamp Woodland is a low woodland or heathland, generally with a low open canopy rarely exceeding 15 m in height and a shrubby understorey. The overstorey is usually dominated by *Eucalyptus parramattensis* subsp. *decadens* (Parramatta Red Gum) and *Angophora bakeri* (Narrow-leaved Apple). This community occurs on soils developed on poorly-drained Tertiary sand deposits that blanket Permian sediments in the Kurri Kurri – Cessnock area.

1.35 ha of intact Kurri Sand Swamp Woodland occurs in the Project site.

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

Not applicable

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

Not applicable

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    - *I. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    - *II. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

The local occurrence of these endangered ecological communities will be reduced in extent as a result of the Project. However 365.51 ha of intact Lower Hunter Spotted Gum Ironbark Forest and 337.61 ha of intact Kurri Sand Swamp Woodland occur outside of the Project site in the Hydro land and would not be impacted directly by the Project. Thus the local occurrence is unlikely to be reduced to such an extent or composition modified that it is placed at risk of extinction.

4. *In relation to the habitat of a threatened species, population or ecological community:*
    I. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    II. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    III. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

1.15 ha of intact Lower Hunter Spotted Gum Ironbark Forest occurs in the Project site and would be removed under the Project.

1.35 ha of intact Kurri Sand Swamp Woodland also occurs in the Project site and would be removed under the Project.

No areas of EEC are likely to become fragmented or isolated from other areas of habitat as these areas occur on the periphery of larger areas of habitat.

As the area proposed to be removed is a small proportion (0.4%) of the mapped occurrence of Kurri Sand Swamp Woodland and 0.3% of the intact Lower Hunter Spotted Gum - Ironbark Forest within the study area, and is unlikely to contain species not found elsewhere in the study area, the habitat to be removed and modified is not considered important to the long-term survival of the ecological communities in the locality.

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

No critical habitat has been declared for these Endangered Ecological Communities

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

No recovery plan has been prepared for these EEC's and the action is consistent with relevant threat abatement plans.

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

The action is part of the key threatening processes*; Clearing of native vegetation, Loss of hollow bearing trees* and *Removal of dead wood and dead trees.* Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems.

After considering the above questions the Project is considered unlikely to have a significant impact on the EEC's assessed.

Plants – *Acacia bynoeana* (Bynoe's Wattle) *Eucalyptus parramattensis* subsp. *decadens* and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)

Bynoe's Wattle is a semi-prostrate shrub up to a metre high, but generally less than 30 cm. Bynoe's wattle is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. The species is currently known from about 30 locations, with the size of the populations at most locations being very small (1-5 plants).

The species is known from study area with a population detected approximately 1 km to the east of the Project site. No individuals were observed in the Project site. The species is likely to be restricted to Kurri Sand Swamp Woodland.

There are two separate meta-populations of *E. parramattensis* subsp. *decadens*. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Aberdare in the south. Large aggregations of the subspecies are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south.

E. parramattensis subsp. *decadens* is often the dominant canopy species within Kurri Sand Swamp Woodland of which 1.35 ha of intact vegetation occurs in the Project site and 337.61 ha occurs in the surrounding study area. Four (4) individuals of *Eucalyptus parramattensis* were found to occur within the Project site.

Grevillea parviflora subsp. *parviflora* is a small shrub, generally achieving less than a metre in height. The species is sporadically distributed throughout the Sydney Basin, with a large population occurring in the Cessnock – Kurri Kurri area. A single clump of *Grevillea parviflora* subsp. *parviflora* consisting of five stems was also found within the proposed containment cell area in the west of the Project site. This species is found in scattered patches throughout much of the Kurri Sand Swamp Woodland within the study area and was particularly abundant within and directly adjacent to the large power easements to the north and south of Project site.

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

The proposed clearance of vegetation would remove four individual *E. parramattensis* subsp. *decadens* and five stems of *Grevillea parviflora* subsp. *parviflora.* No *Acacia bynoeana* were found within the Project site, however potential habitat for the species would be removed. The intact Kurri Sand Swamp Woodland proposed to be removed represents only 0.4% of the mapped occurrence of the intact Kurri Sand Swamp Woodland within the study area.

Very large numbers of *Grevillea parviflora* subsp. *parviflora* and *E. parramattensis* subsp. *decadens* are known to occur outside of the Project site. An estimate of the number of *E. parramattensis* subsp. *decadens* outside of the Project site within Hydro land gives a result of > 45,000 individuals. Thus the impact of removing four trees on the lifecycle of the local population is expected to be minor. Similarly an estimate of the number of *Grevillea parviflora* stems within the large power easements (not including those in intact vegetation) on hydro land gives a number > 500,000 stems.

The Project is considered unlikely to adversely affect the life cycle of individuals occurring outside of the Project site and as a result a viable local population of these species is unlikely to be placed at risk of extinction

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

Not applicable – the local population of these three species have not been listed as endangered populations

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    I. *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    II. *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable-endangered ecological communities will be assessed separately.

4. *In relation to the habitat of a threatened species, population or ecological community:*
    I. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    II. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    III. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

1.35 ha of *E .parramattensis* habitat containing four individual *E. parramattensis* would be removed under the Project. 1.35 ha of *Grevillea parviflora* habitat containing 5 stems of *Grevillea parviflora* would be removed under the Project.

As the vegetation proposed to be removed occurs on the periphery of larger adjoining areas of the same vegetation community, the Project is unlikely to fragment or isolate any significant areas of habitat for these species.

The habitat to be removed is not considered particularly important for the long-term survival of these species due to the high numbers of *Grevillea parviflora* and *E. parramattensis* occurring outside of the Project site and that *A. bynoeana* was not detected in the Project site despite intensive survey.

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

No critical habitat has been declared for *Grevillea parviflora*, *Eucalyptus parramattensis* or *Acacia bynoeana.*

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

No recovery plan has been prepared for *Grevillea parviflora*, *Eucalyptus parramattensis* or *Acacia bynoeana*. The Project is consistent with threat abatement plans.

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

The action is part of the key threatening processes*; Clearing of native vegetation, Loss of hollow bearing trees* and *Removal of dead wood and dead trees.* Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. However as part of the Project, these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the species assessed.

Cave breeding bats – *Miniopterus australis* (Little Bentwing-bat), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), *Chalinolobus dwyeri* (Large-eared Pied Bat) and *Vespadelus troughtoni* (Eastern Cave Bat)

The Little Bentwing-bat, Eastern Bentwing-bat and Eastern Cave Bat have been grouped in this assessment due to the species preference for breeding and roosting in rocky caves, overhangs, disused mineshafts and stormwater drains. The Little Bentwing-bat is thought to exclusively use caves for breeding but will utilise a range of structures, including tree hollows for diurnal roosts.

The Little Bentwing-bat is distributed along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. However only five nursery sites /maternity colonies are known in Australia and the conservation of these important caves is critical to the survival of the species. Within the Hunter Region the species is associated with a wide range of habitat types but is generally found in well-timbered areas such as forests and woodlands where they forage below the canopy.

The Eastern Bentwing-bat is more widespread than the Little Bentwing-bat and occurs along the east and north-west coasts of Australia. Maternity caves with very specific temperature and humidity regimes are used in spring and summer before populations disperse within about 300 km range of maternity caves. The Eastern Bentwing-bat hunts in forested areas, catching moths and other flying insects above the tree tops

The Large-eared Pied Bat roosts in rock overhang, caves, mine tunnels and Martin nests and has been recorded in a diverse range of habitat types including dry sclerophyll forest and woodlands.

Little is known of the ecology of the Eastern Cave Bat. The species is along the Great Dividing Range from Cape York to south of Sydney, with occasional records further south. The western limit appears to be the Warrumbungle Range in central NSW. The species is usually found in forest and woodland areas.

Both Little and Eastern Bentwing-bats have been recorded in the study area. Both the Large-eared Pied Bat and Eastern Cave Bat are predicted to occur. Rocky areas containing caves do not occur in the Project site and as such no breeding habitat is likely to be removed for these species.

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

Rocky areas containing caves do not occur in the study area. Due to a history of timber removal, few hollow bearing trees are present in the Project site. As such, breeding and roosting habitat is unlikely to be removed for these species. The removal of this forest and woodland will impact areas of foraging habitat for local populations. However this equates to a removal of 2.5 ha (less than 0.5 % of surrounding forest and woodland areas within the study area). As such the Project is considered unlikely have an adverse effect on the life cycle of these four species such as to place a viable local population at risk of extinction.

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

Not applicable – the local population of these species have not been listed as endangered populations

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
   I. *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
   II. *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable – impacts to endangered ecological communities are assessed separately.

4. *In relation to the habitat of a threatened species, population or ecological community:*
   I. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
   II. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
   III. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The proposed project would remove approximately 2.5 ha of forested habitat for the species. This constitutes less than 0.5% of the available forested habitat in the study area.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas, the Project is unlikely to fragment or isolate any significant areas of habitat for the species.

While contributing to habitat loss for these species on a broader scale; the foraging habitat proposed to be removed is considered small enough that the long-term survival of the species in the locality is not dependent on the resources provided by the Project site.

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

No critical habitat has been declared for these species.

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

No recovery plans have been prepared for these species. Threat abatement plans have been prepared to assist with the management of the Red Fox, Mosquito Fish and Bitou Bush/ Boneseed. The action proposed is largely consistent with these threat abatement plans.

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

The action is part of the key threatening processes*; Clearing of native vegetation, Loss of hollow bearing trees* and *Removal of dead wood and dead trees.* Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the

functioning of many ecosystems. However as part of the Project, these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the Little Bentwing-bat, Eastern Bentwing-bat, Large-eared Pied Bat and Eastern Cave Bat

After considering the above questions the Project is considered unlikely to have a significant impact on the species assessed.

Hollow breeding bats - *Micronomus norfolkensis* (Eastern Freetail-bat), *Myotis macropus* (Large-footed Myotis), *Saccolaimus flaviventris* (Yellow-bellied Sheathtail-bat), *Scoteanax rueppellii* (Greater Broad-nosed Bat)

The Eastern Freetail-bat roosts in hollows and spouts of mature eucalypts and forages over open spaces near riparian areas and on the edges of eucalypt forest and woodland.

The Large-footed Myotis is consistently found near water from rainforest streams to large lakes. Roosting mostly occurs in tree hollows, caves, mines and under bridges.

The Yellow-bellied Sheathtail-bat is found in a wide variety of habitats and is found across most of Australia, with the exception of the south-west of the continent. This species roost and breeds in large tree hollows and generally forages at or above the tree canopy.

The Greater Broad-nosed Bat occurs in a variety of forested habitats from woodlands to rainforest along the east coast of Australia.

The Eastern Freetail-bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat were detected foraging in the study area during surveys by ELA. The Large-footed Myotis was detected adjacent to Wentworth Swamp by Greg Richards and Associates 2004.

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

Due to a history of timber removal, few hollow bearing trees are present in the Project site. As such it is unlikely that important breeding habitat would be removed under the Project. The removal of this forest and woodland would remove areas of foraging habitat for local populations. However this equates to a removal of less than 1% of surrounding forest and woodland areas within the study area. As such the Project is considered unlikely have an adverse effect on the life cycle of these three species such *as* to place a viable local population at risk of extinction.

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

Not applicable – the local population of these three species have not been listed as endangered populations.

3. . *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    I. *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    II. *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable – impacts to endangered ecological communities are assessed separately.

4. *In relation to the habitat of a threatened species, population or ecological community:*
    I. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    II. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    III. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The Project will remove approximately 2.5 ha of forested habitat for the species. This constitutes less than 0.5% of the available forested habitat in the study area.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas, the Project is unlikely to fragment or isolate any significant areas of habitat for these mobile species.

While contributing to habitat loss for these species on a broader scale; the foraging habitat proposed to be removed is considered small enough that the long-term survival of the species in the locality is not likely to be dependent on the resources provided by the Project site.

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

No critical habitat has been declared for these species.

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

No recovery plans have been prepared for these species. Threat abatement plans have been prepared to assist with the management of the Red Fox, Mosquito Fish and Bitou Bush/ Boneseed. The Project is largely consistent with these threat abatement plans.

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

The action is part of the key threatening processes*; Clearing of native vegetation, Loss of hollow bearing trees* and *Removal of dead wood and dead trees.* Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. However as part of the Project, these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the Eastern Freetail-bat, Large-footed Myotis, Yellow-bellied Sheathtail-bat, or Greater Broad-nosed Bat.

Flying-fox - *Pteropus poliocephalus (*Grey-headed Flying-fox)

Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. These flying-fox feed on the nectar and pollen of native trees, in particular *Eucalyptus, Melaleuca* and *Banksia*, and fruits of rainforest trees and vines. Thus Grey-headed Flying-Fox are important for pollination and dispersal of seed for many plant species.

Seven highly productive and reliably flowering nectar species occur in the wider north-east NSW region that are important for Flying-fox conservation. These are *Corymbia maculata* (Spotted Gum) *C. gummifera* (Red Bloodwood) *C. intermedia* (Pink Bloodwood), *Eucalyptus robusta* (Swamp Mahogany) *Eucalyptus siderophloia* (Grey Ironbark), *E. tereticornis* (Forest Red Gum) and *Melaleuca quinquenervia* (Broad-leaved Paperbark)**.**

Of these species *Corymbia maculata, Eucalyptus robusta* and *E. tereticornis* flower in the winter and autumn, a time when few other Eucalypt species are flowering, and thus are particularly important.

Grey-headed Flying-Fox congregate in camps that are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.

No camps occur in the Project site and the site likely represents a small area of seasonal foraging habitat. The usually summer flowering *E. parramattensis* subsp *decadens* and *E. fibrosa* (Broad-leaved Ironbark) are the dominant Eucalypt species in the Project site.

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

No camps occur in the Project site and it is unlikely that any important roosting habitat would be removed under the Project. The removal of this forest and woodland would remove an area of summer foraging habitat for the local population. However this equates to 2.5ha (less than 0.5% of surrounding forest and woodland areas within the study area). As such, the Project is considered unlikely have an adverse effect on the life cycle of these three species such *as* to place a viable local population at risk of extinction.

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

Not applicable – the local population of this species has not been listed as endangered population

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    I. *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    II. *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable – impacts to endangered ecological communities are assessed separately.

4. *In relation to the habitat of a threatened species, population or ecological community:*
    I. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    II. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    III. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The Project would remove approximately 2.5 ha of forested habitat for the species. This constitutes less than 0.5% of the available forested habitat in the study area.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas, the Project is unlikely to fragment or isolate any significant areas of habitat for this mobile species.

While contributing to habitat loss for these species on a broader scale; the foraging habitat proposed to be removed is considered small enough and flowers at a less critical time of year for the Grey-headed Flying Fox, that the long-term survival of the species in the locality is not likely to be dependent on the resources provided by the Project site.

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

No critical habitat has been declared for these species.

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

No recovery plans have been finalised for this species. Threat abatement plans have been prepared to assist with the management of the Red Fox, Mosquito Fish and Bitou Bush/ Boneseed. The action proposed is largely consistent with these threat abatement plans.

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

The action is part of the key threatening processes*; Clearing of native vegetation, Loss of hollow bearing trees* and *Removal of dead wood and dead trees.* Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. However as part of the Project, these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the Grey-headed Flying-fox.

Nomadic Honeyeaters – *Anthochaera phrygia* (Regent Honeyeater) and *Melithreptis gularis gularis* (Black-chinned Honeyeater)

The Black-chinned Honeyeater is often found in the canopy of dry open eucalypt forests and woodland, particularly box and ironbark forests, on the tablelands and western slopes of NSW. It has been infrequently recorded at a number of locations in the Hunter Valley. The Black-chinned Honeyeater feeds mainly on nectar and insects.

The Regent Honeyeater is now confined to Victoria and New South Wales, and is strongly associated with the western slopes of the Great Dividing Range. The Hunter Region, with its coastal rainfall influence, provides a key refuge for these the Regent Honeyeater when drought reduces resource availability (e.g. flowering of key Eucalypts) in other parts of their range(s). Key foraging species listed under the Regent Honeyeater Recovery Plan that occur in the wider study area include *Corymbia maculata* (Spotted Gum), *Eucalyptus fibrosa* (Broad-leaved Ironbark) and *Eucalyptus punctata* (Grey Gum). Of these only *E. fibrosa* occurs within the Project site.

Regent Honeyeater and Black-chinned Honeyeater were not observed in the study area or Project site but are regarded as having potential to occur. A large number of NSW Wildlife Atlas records of Black-chinned Honeyeater and a smaller number of Regent Honeyeater records are present approximately 4km to the south of the study area. Regent Honeyeater and Black-chinned Honeyeater were not observed in the study area or Project site but are regarded as having potential to occur.

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

Core breeding areas for the Regent Honeyeater are generally recognised as Chiltern in Victoria and the Capertee Valley and Bundarra-Barraba district in NSW. However in recent years breeding activity has been detected at nearby Quorrobolong and Ellalong and also in Lower Hunter Spotted Gum/Ironbark Forest near Kurri Kurri in 2007. Most records in the Hunter region are associated with flowering *C. maculata* which does not occur in the Project site.

The proposed removal of forest and woodland would remove an area of potential habitat for local populations of these two species. This impact has the potential to effect aspects of the species lifecycle through a reduction in foraging and nesting opportunities. However this equates to 2.5 ha (less than 0.5 % of surrounding forest and woodland areas within the study area. As such the Project is considered unlikely have an adverse effect on the life cycle of these three species such *as* to place a viable local population at risk of extinction.

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

Not applicable – the local population of these two species have not been listed as endangered populations.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    - *I. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    - *II. Is likely to substantially and adversely modify the composition of the ecological*

community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable – impacts to endangered ecological communities are assessed separately.

4. *In relation to the habitat of a threatened species, population or ecological community:*
    - *I. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    - *II. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    - *III. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The Project will remove approximately 2.5 ha of forested habitat for the species. This constitutes less than 0.5 % of the available forested habitat in the study area.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas, the Project is unlikely to fragment or isolate any significant areas of habitat for the species.

While contributing to habitat loss for these species on a broader scale; the habitat proposed to be removed is considered small and marginal enough that the long-term survival of the species in the locality is not dependent on the resources provided by the Project site.

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

No critical habitat has been declared for these species.

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

A recovery plan has not been prepared for the Black-chinned Honeyeater. A federal recovery plan has been prepared for the Regent Honeyeater (Menkhorst et al. 1999). The long term objectives of this plan include:

- To ensure the species persists in the wild
- To achieve a down-listing from nationally endangered to vulnerable by stabilising the population and securing habitat extent and quality in the main areas of occupancy
- Achieve increasing reporting rates (5%) in areas previously used regularly, e.g. Munghorn Gap, Bendigo, north-east Melbourne, Eildon area.

Specific objectives of this recovery plan include:

- Effectively organise and administer the recovery effort to ensure that recovery plan objectives are met.
- Maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites
- Monitor trends in the Regent Honeyeater population size and dispersion across its range to allow assessment of the efficacy of management actions.
- Facilitate research on strategic questions which will enhance the capacity to achieve the long-term objectives. In particular, determine the whereabouts of Regent Honeyeaters during the non-breeding season and during breeding season absences from known sites.

Identify important sites and habitat requirements at these times.

- Maintain and increase community awareness, understanding and involvement in the recovery effort.
- Maintain the captive population of Regent Honeyeaters at a size which will provide adequate stock to: provide insurance against the demise of the wild population; continuously improve captive-breeding and husbandry techniques; provide adequate stock for trials of release strategies; and maintain 90% of the wild heterozygosity in the captive population.

The Project and associated removal of potential habitat is unlikely to assist the Regent Honeyeater population in the area. However the Project is consistent with the majority of these objectives.

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

The action is part of the key threatening processes; *Clearing of native vegetation*, *Loss of hollow bearing trees* and *Removal of dead wood and dead trees*. Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems.

After considering the above questions the Project is considered unlikely to have a significant impact on the Regent Honeyeater or Black-Chinned Honeyeater.

Small parrots and lorikeets - *Lathamus discolor* (Swift Parrot), *Glossopsitta pusilla* (Little Lorikeet) and *Neophema pulchella* (Turquoise Parrot)

The Swift Parrot is an endangered species that breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as *Eucalyptus robusta* (Swamp Mahogany), *Corymbia maculata*, *C. gummifera* (Red Bloodwood), *E. sideroxylon* (Mugga Ironbark), and *E. albens* (White Box).

Nearby forests within Cessnock LGA have been regarded as important habitat for the Swift Parrot and appear to be visited regularly by large numbers of the species. However favoured food tree species do not occur in any numbers within the Project site. Within the Project site canopy species are dominated by the generally summer flowering *E. fibrosa* (Broad-leaved Ironbark) and *E. parramattensis* subsp. *decadens.* However the habitat present within the subject may be used occasionally for roosting or foraging on foliage insects.

Little Lorikeet is listed as vulnerable by the NSW TSC Act. This species was observed on several occasions flying over the Project site and also foraging in the few flowering *E. tereticornis* (Forest Red Gum) adjacent to the smelter carpark and the nearby creek line outside of the Project site.

This species is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. Nomadic movements are common, influenced by season and food availability. Riparian habitats are particularly used by Little Lorikeets, due to higher soil fertility and hence greater productivity.

Turquoise Parrot is also listed as vulnerable by the NSW TSC Act. The Turquoise Parrot is found from south-eastern Queensland, through New South Wales to eastern and north-eastern Victoria. The range

was formerly more extensive. This species was not detected during past and present surveys. However several NSW Wildlife Atlas records of the species are located within close proximity to the study area. This species favours forest edges or grassy woodlands where it feeds on grass seeds and vegetation.

Hollow-bearing trees on the mainland are used by both Little Lorikeet and Turquoise Parrot for reproduction. The Turquoise parrot is believed to favour dead trees with near vertical hollows.

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

The Project would potentially remove foraging habitat for the three species. Foraging habitat within the Project site is considered marginal for Swift Parrot due to the general lack of favoured winter flowering trees. However habitat within the Project site may provide for some foraging on foliage insects during winters with increases in lerp numbers.

Seasonal forage is provided for Little Lorikeet with generally summer flowering *E. parramattensis* subsp *decadens* and *E. fibrosa.* Turqoise Parrot is most likely to utilise forest edges for foraging on grasses and herbs, retreating into the surrounding forest outside the Project site to escape predators and for breeding opportunities.

It is considered unlikely that suitable breeding habitat structures exist at present in the Project site for the Little Lorikeet or Turquoise Parrot as the vast majority of trees appear moderate aged and have not yet developed hollows.

As the habitat proposed to be removed is small in extent (2.5 ha or <0.5% of mapped forest in study area), contains marginal foraging habitat for both the Swift Parrot and Little Lorikeet and is unlikely to provide breeding opportunities for the Little Lorikeet or Turquoise Parrot the action proposed is considered unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

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

Not applicable – these species do not form part of a listed endangered population.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    - *I. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    - *II. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable – these species are not an endangered ecological community

4. *In relation to the habitat of a threatened species, population or ecological community:*
    - *I. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    - *II. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    - *III. the importance of the habitat to be removed, modified, fragmented or isolated to the*

long-term survival of the species, population or ecological community in the locality

The proposed project would remove approximately 2.5 ha of forested habitat for these species. Although potentially contributing to habitat loss for these species on a broader scale, this area constitutes less than 1% of the available forested habitat in the study area.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas, the Project is unlikely to fragment or isolate any significant areas of habitat for the species.

The habitat to be removed is considered likely to be marginal foraging habitat for Swift Parrot due to a lack of preferred winter flowing tree species. The Little Lorikeet is likely to find mixed seasonal forage in the Project site and Turquoise Parrot may also forage in grassland adjacent to forested areas. Due to the small size of the habitat to be removed in relation to habitat not affected by the Project in the study area the habitat is expected to be of minor importance for the continued survival of these species.

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

No critical habitat has been listed for these species in the area.

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

A recovery plan has not been prepared for the Little Lorikeet or Turquoise Parrot. A recovery plan has been prepared for the Swift Parrot with the following objectives and actions:

- To prevent further decline of the Swift Parrot population.
- To achieve a demonstrable sustained improvement in the quality and quantity of Swift Parrot habitat
- To increase carrying capacity
- Action 1 - Identify the extent and quality of habitat.
- Action 2 - Manage and protect Swift Parrot habitat at the landscape scale.
- Action 3 - Monitor and manage the impact of collisions, competition and disease.
- Action 4 - Monitor population and habitat

The removal of this minor amount of marginal foraging habitat is not considered likely to lead to decline of the local Swift Parrot population and the Project is generally consistent with these objectives and actions. However a minor amount of marginal foraging habitat would be removed and which conflicts with objective 2 of the recovery plan.

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

The action is part of the key threatening processes; *Clearing of native vegetation*, potentially also *Loss of hollow bearing trees* and *Removal of dead wood and dead trees*. Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. However these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the Swift Parrot, Little Lorikeet and Turquoise Parrot.

Eagles and kites - *Hieraaetus morphnoides* (Little Eagle) and *Lophoictinia isura* (Square-tailed Kite)

The Little Eagle and Square-tailed Kite are listed under the NSW TSC Act as vulnerable species. The Square-tailed Kite was reportedly observed within the study area by CENwest Environmental Consultants in 2010. The Little Eagle has not been observed in the study area during wildlife surveys but is regarded to have potential to occur.

The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March.

The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW.

Both species have large feeding ranges with the Square tailed Kite often having a hunting range of more than 100 km^2.

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

The Project would potentially remove a small amount of foraging habitat for these two species. Nests of Little Eagle or Square tailed Kite were not observed in the Project site. As such, any effect on the life cycle of these species as a result of the Project is expected to be very minor and highly unlikely to place the local population at risk of extinction.

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

Not applicable – these species do not form part of a listed endangered population.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    - *I. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    - *II. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable – these species are not an endangered ecological community

4. *In relation to the habitat of a threatened species, population or ecological community:*
    I. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    II. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    III. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The proposed project would remove approximately 2.5 ha of forested habitat for these species. Although potentially contributing to habitat loss for these species on a broader scale, this area constitutes less than 0.5% of the available forested habitat in the study area. A small amount of native grassland/ shrubland and exotic pasture would also be removed or modified.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas, the Project is unlikely to fragment or isolate any significant areas of habitat for these highly mobile species.

Due to the small size of the habitat proposed to be removed in relation to habitat not affected by the Project in the study area, the habitat in the Project site is expected to be of minor importance for the continued survival of these species.

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

No critical habitat has been listed for these species in the area.

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

A recovery plan has not been prepared for the Little Eagle or Square-tailed Kite. Existing threat abatement plans are not directly relevant for these species.

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

The action is part of the key threatening processes; *Clearing of native vegetation*, potentially also *Loss of hollow bearing trees* and *Removal of dead wood and dead trees*. Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. However these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the Little eagle and Square-tailed Kite.

Large forest owls – *Ninox connivens* (Barking Owl), *Ninox strenua* (Powerful Owl) and *Tyto novaehollandiae* (Masked Owl)

These three large forest owls are lasted as vulnerable under the NSW TSC Act. All species require large tree hollows in which to reproduce. These are generally scarce within the landscape due to continued habitat removal and both historical and current habitat modification due to forestry practices.

The Barking Owl is found throughout continental Australia except for the central arid regions. Although common in parts of northern Australia, the species has declined greatly in southern Australia. The

Barking Owl inhabits woodland and open forest where it generally preys on arboreal mammals and birds.

The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest where it preys on arboreal mammals and birds.

The Masked Owl's distribution extends from the coast where it is most abundant to the western plains. It generally inhabits open eucalypt forest where it often hunts on forest edges for rodents.

None of these three forest owls were detected during nocturnal surveys or call playback. However foraging or hunting habitat for these species is present in the Project site and they are assumed present. No large hollows or other suitable structures that might support nesting are located in the Project site.

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

The Project would potentially remove a small amount of foraging habitat for these three species. No. large hollows or other suitable structures that might support nesting are present. As such, any effect on the life cycle of these species as a result of the Project is expected to be very minor and highly unlikely to place a local population at risk of extinction.

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

Not applicable – these species do not form part of a listed endangered population.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    - *I. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    - *II. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable – these species are not an endangered ecological community

4. *In relation to the habitat of a threatened species, population or ecological community:*
    - *I. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    - *II. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    - *III. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The Project would remove approximately 2.5 ha of forested habitat for these species. Although

potentially contributing to habitat loss for these species on a broader scale, this area constitutes less than 0.5% of the available forested habitat in the study area. A small amount of native grassland/ shrubland and exotic pasture would also be removed or modified that may constitute hunting areas for Masked Owl. However this habitat is also widely available in the surrounding landscape.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas, the Project is unlikely to fragment or isolate any significant areas of habitat for these highly mobile species.

Due to the small size of the habitat proposed to be removed (in relation to habitat not affected by the Project in the study area and the large territory sizes of these forest owls) the habitat in the Project site is expected to be of minor importance for the continued survival of these species in the locality.

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

No critical habitat has been listed for these species in the area.

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

A recovery plan has been prepared for these Large Forest Owls. The objectives of this recovery plan are:

"Objective 1: Assess the distribution and amount of high quality habitat for each owl species across public and private lands to get an estimate of the number and proportion of occupied territories of each species that are, and are not, protected.

Objective 2: To monitor trends in population parameters (numbers, distribution, territory fidelity and breeding success) across the range of the three species and across different land tenures and disturbance histories.

Objective 3: To assess the implementation and effectiveness of forest management prescriptions designed to mitigate the impact of timber-harvesting operations on the three owl species and, (if necessary), to use this information to refine the prescriptions so that forestry activities on state forests are not resulting in adverse changes in species abundance and breeding success.

Objective 4: Ensure the impacts on large forest owls and their habitats are adequately assessed during planning and environmental assessment processes.

Objective 5: Minimise further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites).

Objective 6: To improve the recovery and management of the three large forest owls based on an improved understanding of key areas of their biology and ecology.

Objective 7: To raise awareness of the conservation requirements of the three large forest owls amongst the broader community, to involve the community in owl conservation efforts and in so doing increase the information base about owl habitats and biology.

Objective 8: To coordinate the implementation of the recovery plan and continually seek to integrate actions in this plan with actions in other recovery plans or conservation initiatives."

The Project is largely consistent with these objectives and associated actions. The impacts on large

forest owls and their habitats are currently being adequately assessed during this environmental assessment process.

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

The action is part of the key threatening processes; *Clearing of native vegetation*, potentially also *Loss of hollow bearing trees* and *Removal of dead wood and dead trees*. Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. However as part of the Project these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the large forest owls assessed

Woodland birds – *Climacteris picumnus victoriae* (Brown Treecreeper), *Daphoenositta chrysoptera* (Varied Sittella), *Chthonicola sagittata* (Speckled Warbler), *Stagonopleura guttata* (Diamond Firetail) and *Pomatostomus temporalis temporalis* (Grey-crowned Babbler)

The woodland birds being assessed are all listed as vulnerable under the NSW TSC Act. These species have been listed due to both historical and ongoing habitat loss and modification. Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range and the Hunter Valley. It is less commonly found on coastal plains and ranges.

The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. It is believed to have undergone a decline in numbers in the past several decades.

The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range but is also present in the Hunter Valley.

The Diamond Firetail is endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW. The species is not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. The Diamond Firetail is often found in grassy eucalypt woodlands particularly near creeks.

The vulnerable eastern sub-species of Grey-crowned Babbler occur on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. Grey-crowned Babblers build and maintain several conspicuous, dome-shaped stick nests about the size of a football.

The Grey-crowned Babbler and Brown Treecreeper were detected by ELA in the study area. A Diamond Firetail was recorded during bird surveys by CENwest 2010 but was not detected by ELA.

None of these threatened species or signs of their use (Grey-crowned Babbler nests) were observed within the Project site. However suitable habitat is present.

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

The Project would remove a small amount of potential habitat for these five species. No Grey-crowned Babblers or nesting structures were observed in or nearby the Project site during both fauna and flora surveys. As such Grey-crowned Babblers are considered to be unlikely to be currently using the Project site. The grassy riparian woodland where Diamond Firetails are often associated is not present in the Project site and the area is considered to be marginal habitat.

Typical habitat for Brown Treecreepers, Speckled Warbler and Varied Sittella exists in the Project site in the form of shrubby Ironbark woodland with fallen logs and it is likely that the Project site is used occasionally for foraging and nesting.

The size of the habitat to be removed constitutes less than 0.5% of the available forested habitat in the study area. As such, any effect on the life cycle of these species as a result of the Project is expected to be minor, temporary and unlikely to place a local population at risk of extinction.

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

Not applicable – these species do not form part of a listed endangered population.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    I. *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    II. *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable – these species are not an endangered ecological community

4. *In relation to the habitat of a threatened species, population or ecological community:*
    I. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    II. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    III. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The Project would remove approximately 2.5 ha of forested habitat for these species. Although potentially contributing to habitat loss for these species on a broader scale, this area constitutes less than 0.5% of the available forested habitat in the study area.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas, the Project is unlikely to fragment or isolate any significant areas of habitat.

Due to the suitability of habitat (considered marginal for Diamond Firetail) and small area of the vegetation proposed to be removed; the habitat in the Project site is expected to be of minor importance for the continued survival of these species in the locality.

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

No critical habitat has been listed for these species in the area.

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

A recovery plan has not been prepared for any of these woodland birds. Existing threat abatement plans are largely inapplicable to the conservation of these species and the action is considered consistent with them.

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

The action is part of the key threatening processes; *Clearing of native vegetation*, potentially also a small *Loss of hollow bearing trees* and *Removal of dead wood and dead trees*. Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. However as part of the Project these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the woodland birds assessed.

Marsupials – *Petaurus norfolcensis* (Squirrel Glider), *Dasyurus maculatus* (Spotted-tail Quoll and *Cercartetus nanus* (Eastern Pygmy-possum)

The Squirrel Glider is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. The throughout its distribution the species occurs in a range of different forest and woodland types where it lives on nectar, pollen, invertebrates as well as Eucalypt and Acacia sap. Tree hollows are important habitat features and are used for shelter.

The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found in scattered locations in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. A wide range of habitat types are used by the Spotted-tailed Quoll with individual animals using hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares.

In NSW the distribution of the Eastern Pygmy-possum extends from the coast inland as far as the Pilliga and the towns of Dubbo, Parkes and Wagga Wagga on the western slopes. In most areas woodlands and heath appear to be preferred habitat.

Squirrel Gliders are known to use the Project site and were observed by ELA to also occur widely across the study area. Spotted-tail Quoll was detected by CENwest 2004 via hair analysis. Eastern Pygmy Possum has not been previously recorded in the study area during fauna surveys by ELA in the current survey or CENwest in 2004. Never-the-less heathy areas of Kurri Sand Swamp Woodland in the study area appear to be suitable habitat and the species is considered to potentially occur in the Project site.

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

The Project would remove a small amount of potential habitat for these three species. It is considered unlikely that the habitat proposed to be removed is especially important for the lifecycle of the local population of Squirrel Glider, Spotted-tail Quoll or Pygmy Possum. Habitat attributes that may suggest

an important or “core” breeding or foraging area for these species (such as rocky outcrops with caves, abundant hollow-bearing trees and logs or a particularly high density and diversity of nectar sources in comparison with surrounding vegetation) are not present in the Project site. Potential Pygmy-possum habitat in the Project site does not appear as suitable as elsewhere in areas of Kurri Sand Swamp vegetation of which patches are dominated by heath plant species such as *Lambertia formosa* (Mountain Devil) and a range of *Banksia* and other nectar sources.

As such the lifecycle of a viable local population of these species is unlikely to be effected such that the species is placed at risk of extinction as a result of the proposed habitat removal.

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

Not applicable – these species do not form part of a listed endangered population.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    - I. *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    - II. *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable – these species are not an endangered ecological community.

4. *In relation to the habitat of a threatened species, population or ecological community:*
    - I. *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    - II. *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    - III. *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The proposed project would remove approximately 2.5 ha of forested habitat for these species. Although potentially contributing to habitat loss for these species on a broader scale, this area constitutes less than 0.5% of the available forested habitat in the study area and a tiny proportion of an individual Quoll home range. Potentially suitable habitat for the Eastern Pygmy Possum is restricted to the Kurri Sand Swamp vegetation of which 1.35 ha is proposed for removal. 337.61ha of this community would remain in the study area following the project.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas and adjoins similar habitat, the Project is unlikely to fragment or isolate any significant areas of habitat.

Due to the suitability of habitat (considered marginal for Pygmy-possum) and small area of the vegetation proposed to be removed; the habitat in the Project site is expected to be of minor importance for the continued survival of these species in the locality.

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

No critical habitat has been listed for these species in the area.

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

A recovery plan has not been prepared for any of these species. The action is consistent with threat abatement plans.

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

The action is part of the key threatening processes; *Clearing of native vegetation*, potentially also a small *Loss of hollow bearing trees* and *Removal of dead wood and dead trees*. Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. However as part of the Project these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the marsupial species assessed.

Reptiles and Amphibians – *Hoplocephalus bitorquatus* (Pale-headed Snake), *Litoria brevipalmata* (Green-thighed Frog) and *Litoria aurea* (Green and Golden Bell Frog)

The Pale-headed Snake is an uncommonly encountered species that is believed to have contracted to a patchy and fragmented distribution from north-east Queensland to the north-eastern quarter of NSW and is listed as vulnerable in NSW. This species is largely arboreal, living beneath decorticating bark and in hollow trees. The Pale-headed Snake feeds on tree dwelling amphibians and reptiles and is found mainly in dry eucalypt forests and woodlands In drier climates this species is often located on creek lines.

The Green-thighed Frog occurs in isolated localities along the coast and ranges from just north of Wollongong to south-east Qld. Rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. Breeding occurs following heavy rainfall from spring to autumn, preferentially in larger temporary pools and flooded areas. Eggs are laid in loose clumps among waterplants. Green-thighed Frog was recorded within the study area to the north of the project site by CENWEST 2004 and there is a slim chance that the species may use drainage lines adjacent to the site

The endangered Green and Golden Bell Frog is a largely aquatic species that typically occurs in open unshaded wetlands. Although once abundant and distributed from the coast to the western slopes and plains, it has declined dramatically and is now found only in scattered, mostly coastal locations from the north coast of NSW to Gippsland in Victoria. The closest records of Green and Gold Bell Frog are located 4 km to the north-east of the Project site in a disused quarry and adjacent farm dams adjacent to Cartwright Street, Gillieston Heights. Fourteen adult and sub-adult frogs were recorded in the quarry pond in 1998. Tadpoles were observed during this period in the quarry water body along with calling adult males and adult females in an adjacent paddock pond. Extensive damage to this habitat occurred in the summer of 2001/02 involving excavation of the quarry pond, creek line and removal of aquatic and riparian vegetation. No Green and Golden Bell Frogs have been observed in the area since this time.

The most recent and last record of the Green and Golden Bell Frog population in the locality is also from an abandoned quarry approximately 5km to the north of the Project site in the year 2000.

Targeted surveys for Green and Golden Bell Frog were conducted within the study area during summer 2014. No Green and Golden Bell Frogs were located.

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

The Project would remove a small amount of potential habitat for these species. It is considered unlikely that the habitat proposed to be removed is especially important for the lifecyle of the local population of Green and Golden Bell Frog, Green-thighed Frog or Pale-headed Snake. Potential habitat for Green and Golden Bell Frog and Green-thighed Frog in the Project site consists of a number of small sparsely vegetated water storage areas on the outskirts of the aluminium smelter. Targeted surveys for Green and Golden Bell Frog and Green-thighed Frog were conducted within these areas and no individuals were located. Few hollow bearing trees are present in the Project site as sheltering sites for Pale-headed Snake and this species was not observed during nocturnal surveys.

As such the lifecycle of a viable local population of these species is unlikely to be effected such that the species is placed at risk of extinction as a result of the proposed habitat removal.

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

Not applicable – these species do not form part of a listed endangered population.

3. *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*
    - *I. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
    - *II. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Not applicable – these species are not an endangered ecological community

4. *In relation to the habitat of a threatened species, population or ecological community:*
    - *I. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
    - *II. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activity, and*
    - *III. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality*

The proposed project would remove approximately 2.5 ha of forested habitat and potentially several water small storage areas surrounding the current smelter. Although potentially contributing to habitat loss for these species on a broader scale, this area constitutes less than 0.5% of the available forested habitat in the study area for the Pale-headed Snake.

As the vegetation proposed to be removed occurs on the periphery of larger forested areas and adjoins similar habitat, the Project is unlikely to fragment or isolate any significant areas of habitat for the Pale-headed Snake. The potential removal of water storage areas is unlikely to fragment or isolate any significant areas of habitat for the Green and Golden Bell Frog or Green-thighed Frog as no individuals

have been recorded during survey and the most recent records of the species are 5km to the north of the Project site at the northern end of Wentworth Swamp.

Due to the small area of vegetation and wetland proposed to be removed and the surveys undertaken for Green and Golden Bell Frog and Green-thighed Frog in the area, habitat in the Project site is expected to be of minor importance for the continued survival of these species in the locality.

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

No critical habitat has been listed for these species in the area.

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

A recovery plan has not been prepared for the Pale-headed Snake. A draft recovery plan has been developed for the Green and Golden Bell Frog. The specific objectives of this plan are to

- increase the security of key Green and Golden Bell Frog populations by way of preventing the further loss of Green and Golden Bell Frog habitat at key populations across the species range and where possible secure opportunities for increasing protection of habitat areas (reservation / conservation status);
- ensure extant Green and Golden Bell Frog populations are managed to eliminate or attenuate the operation of factors that are known or discovered to be detrimentally affecting the species (threat and habitat management);
- implement habitat management initiatives that are informed by data obtained through investigations into the general biology and ecology of the Green and Golden Bell Frog through a systematic and coordinated monitoring program (research and monitoring);
- establish, within more than one institution, self sustaining and representative captive populations (particularly ‘at risk’ populations) of the Green and Golden Bell Frog for the primary purpose of maintaining ‘insurance’ colonies for re-establishment and supplementation of populations of the species (captive breeding and translocation; with research and educational purposes a secondary objective.);
- increase the level of regional and local awareness of the conservation status of the Green and Golden Bell Frog and provide greater opportunity for community involvement in the implementation of this recovery plan (community education, awareness and involvement).

The action is consistent with the majority of these objectives.

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

The action is part of the key threatening processes; *Clearing of native vegetation*, potentially also a small *Loss of hollow bearing trees* and *Removal of dead wood and dead trees*. Native vegetation and these habitat structures provide essential habitat for a wide variety of native animals and are important to the functioning of many ecosystems. However as part of the Project, these processes are limited in extent.

After considering the above questions the Project is considered unlikely to have a significant impact on the species assessed.

Appendix E : Assessment of Significance under the EPBC Act

This section provides an assessment of the potential significance of impacts from the proposed activity on Matters of National Environmental Significance (MNES). The EPBC Act Administrative Guidelines on Significance set out 'Significant Impact Criteria' that are to be used to assist in determining whether a Project is likely to have a significant impact on matters of national environmental significance.

MNES considered relevant to this assessment include:

Flora

Acacia bynoeana (Bynoe's Wattle), *Eucalyptus parramattensis* subsp. *decadens* and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)

Fauna

Large-eared Pied Bat, Regent Honeyeater, Swift Parrot, Grey-headed Flying-fox, Green and Golden Bell Frog and Spotted-tailed Quoll

Migratory Fauna

Fork-tailed Swift, White-throated Needletail, Great Egret, White-bellied Sea-Eagle, Rainbow Bee-eater and Satin Flycatcher

Flora: vulnerable species

***Acacia bynoeana* (Bynoe's Wattle), *Eucalyptus parramattensis* subsp. *decadens* and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)**

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

Lead to a long-term decrease in the size of an important population of a species

Four (4) individuals of *Eucalyptus parramattensis* subspecies *decadens* would be removed under the current Project from the Kurri Kurri meta-population. Five stems of *Grevillea parviflora* subsp. *parviflora* would also be removed. No *Acacia bynoeana* was found in the Project site.

The population of *E. parramattensis* outside of the Project site and within Hydro land gives has been estimated at > 45 000 individuals. An estimate of the number of *Grevillea parviflora* stems within the large power easements (not including those in intact vegetation) on Hydro land is > 500,000 stems.

Thus the loss of these individuals represents a minor decrease in the size of these populations.

Reduce the area of occupancy of an important population

The Project would reduce the area of occupancy of the local population of *Eucalyptus parramattensis* subspecies *decadens and Grevillea parviflora* subsp. *parviflora* by a maximum of 1.35 ha. 337.61 ha of intact habitat for these species would remain in the study area. Thus the reduction in occupancy is considered minor.

Fragment an existing important population into two or more populations

Populations of these species would not be fragmented into two or more populations as a result of the Project.

Adversely affect habitat critical to the survival of a species

These three species all occur in habitats other than Kurri Sand Swamp Woodland and the habitat within the Project site is not regarded as critical to the survival of these species.

Disrupt the breeding cycle of an important population

The removal of Four (4) individuals of *Eucalyptus parramattensis* subspecies *decadens* and 5 stems of *Grevillea parviflora* subsp. *parviflora* is unlikely to disrupt the ability of the local population to reproduce.

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

The Project would remove habitat for *Eucalyptus parramattensis* subspecies *decadens* and *Grevillea parviflora* subsp. *parviflora* by a maximum of 1.35 ha. 1.35 ha of potential habitat for *Acacia bynoeana* would also be removed. However 337.61 ha of intact habitat would remain in the study area. Thus the reduction in occupancy is considered minor.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The proposed project is unlikely to result in establishment of harmful invasive species in the assessed species habitat.

Introduce disease that may cause the species to decline, or

Phytophthora cinnamomi (Cinnamon Fungus) is a microscopic soil-borne plant pathogen that can invade and destroy the root systems of susceptible native and introduced plant species.

Machinery utilised for construction and operation of the proposed activity may carry the spores of *Phytophthora cinnamomi* if they have been working in coastal areas which are known to be infected by the pathogen. However, it is recommended that hygiene practices be employed during all construction activities to limit the risk of disease spread.

With the implementation of the above measures the proposed project is unlikely to result in the introduction of diseases such as *Phytophthora cinnamomi* in the assessed species habitat.

Interfere substantially with the recovery of the species.

In consideration of the above factors, the proposed activity is unlikely to substantially interfere with the recovery of this species.

Conclusion

The proposed activity is not considered likely to have a significant impact on the species for the following reasons:

- The small extent of impacts from the proposed activity relative to available habitat and size of local populations of the species.
- The proposed activity would not disrupt the breeding cycle or reproduction of the local populations.

- A plan would be developed to manage soil disturbance and the introduction of invasive species or Cinnamon Fungus within the Project site.
- Significant habitat would be retained and managed for the species assessed, outside of the Project site.

Fauna: vulnerable species
Chalinolobus dwyeri (Large-eared Pied Bat), *Pteropus poliocephalus* (Grey-headed Flying-fox) and Litoria aurea (Green and Golden Bell Frog)

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

Lead to a long-term decrease in the size of an important population of a species

Surveys for Green and Golden Bell Frog have been completed and it is considered unlikely that there is an important population currently occupying the Project site. Large eared Pied Bat has not been detected in the study area during past and present bat surveys but is considered a potential occurrence. As only a relatively small area of non-optimal foraging habitat would be removed for both the Large-eared Pied Bat and Grey-headed Flying-fox, the Project is considered unlikely to lead to a long-term decrease in the size of the local population of these species.

Reduce the area of occupancy of an important population

It is considered unlikely that an important population of Green and Golden Bell Frog or Large-eared Pied Bat occur in the Project site. As large areas of habitat for the species being assessed occur surrounding the Project and the area being removed is relatively small, the area of occupancy for the Grey-headed Flying-fox species would not be significantly reduced

Fragment an existing important population into two or more populations

The proposed removal of habitat is considered highly unlikely to fragment any of the assessed species into two or more populations. The Grey-headed Flying-fox and Large-eared Pied Bat are highly mobile and can traverse small gaps in habitat with ease. Surveys for Green and Golden Bell Frog have been completed and it is considered unlikely that there is an important population currently occupying the Project site.

Adversely affect habitat critical to the survival of a species

Habitat for the assessed species in the study area is generally considered marginal. There is not any sandstone caves close by for the Large-eared Pied Bat to roost, Summer flowering eucalypts dominate habitats for the Grey-headed Flying-fox and habitat for Green and Golden Bell frog in the Project site is restricted to small sparsely vegetated water storage areas. Habitat critical to the survival of the assessed species is unlikely to be present in the study area.

Disrupt the breeding cycle of an important population

The breeding cycles of the assessed flying-fox and bat populations are unlikely to be disrupted through the removal of a such small area of foraging habitat. It is considered unlikely that a breeding population of Green and Golden Bell Frog occurs in the Project site.

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

The proposed activity would remove 2.5 ha of forested habitat and potentially remove a number of small

water storage areas that have been surveyed for the presence of Green and Golden Bell Frog and are considered be unoccupied by the species. This small amount of habitat removal is considered unlikely to cause the decline of these species.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

It is considered unlikely that an invasive species that is harmful to the Grey-headed Flying-fox, Large-eared Pied Bat or Green and Golden Bell Frog would become established as a result of the Project.

Introduce disease that may cause the species to decline, or

Phytophthora cinnamomi (Cinnamon Fungus) is a microscopic soil-borne plant pathogen that can invade and destroy the root systems of susceptible native and introduced plant species which could potentially degrade habitat for these species.

Machinery utilised for construction and operation of the proposed activity may carry the spores of *Phytophthora cinnamomi* if they have been working in coastal areas which are known to be infected by the pathogen. However, it is recommended that hygiene practices be employed during all construction activities to limit the risk of disease spread.

With the implementation of the above measures the proposed project is unlikely to result in the introduction of diseases such as *Phytophthora cinnamomi*.

Interfere substantially with the recovery of the species.

In consideration of the above factors, the proposed activity is unlikely to substantially interfere with the recovery of these species.

Conclusion

The proposed activity is not considered likely to have a significant impact on the species for the following reasons:

- Habitat within the Project site is not critical habitat.
- The small extent of impacts from the proposed activity relative to available habitat in the landscape.
- The proposed activity would not disrupt the breeding cycle of the species and vegetation patches would not be separated or isolated in a way so as to limit the movement of species throughout the study area.
- Significant habitat would be retained outside the Project site.

Fauna: endangered species

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

Lead to a long-term decrease in the size of a population

The proposed activity is not likely to lead to a long-term decrease in the size of a population of Swift Parrot, Regent Honeyeater and Spotted-tailed Quoll.

These species were not observed during field surveys, nor were signs of the species identified in the Project site or within the wider study area boundary. There is however some potential habitat within the Project site and reports such as Birdlife (2014) indicate that the broader locality offers important habitat

for the Regent Honeater and Swift Parrot in particular. Therefore it is considered that these species have the potential to occur in the study area.

The proposed activity would result in the removal and/or modification of up to 2.5 ha of potential foraging habitat for the species within the Project site. However, this loss is considered relatively minor in the context of similar habitats within the study area and wider region. In addition, as part of the proposed development, an offset is proposed to be set aside in the Hydro Hydro lands. The conservation of this offset area, as well as additional offset lands in the Hydro Hydro lands is considered to provide a good range of preferred foraging species for these species.

As such, it is considered unlikely that the proposed activity would lead to a long-term decrease in the size of a population of the species.

Reduce the area of occupancy of the species

The area of occupancy for the species would be reduced if significant amounts of foraging habitat were lost in the Project site and wider region, or if habitats were degraded to the point that the species avoided degraded areas and could not move through the study region to undisturbed areas.

The proposed activity would result in the removal and/or modification of up to 2.5 ha of potential foraging habitat. This loss is considered relatively minor as the loss of habitat is limited in extent and this species is highly mobile throughout the region.

Fragment an existing population into two or more populations

The proposed activity could potentially fragment foraging habitat. These species can make large movements across their range and are able to traverse the length and width of the study area to access potential foraging resources despite the potential fragmentation caused by the proposed activity. Habitat connectivity would be maintained at a regional level, with contiguous vegetation and habitat connectivity retained around the study area, allowing an existing population to move across the wider landscape. Thus, it is unlikely that the proposed activity would fragment an existing population into two or more populations.

Adversely affect habitat critical to the survival of a species

The proposed activity is unlikely to adversely affect habitat critical to the survival of the species. Habitat for the species is not listed on the Register of Critical Habitat maintained by the minister under the EPBC Act. The recovery plan (Swift Parrot Recovery Team 2011) describes habitat that is critical to the survival of this species as those areas of priority habitat for which the species has a level of site fidelity or possess phonological characteristics likely to be of importance to the Swift Parrot, or are otherwise identified by the recovery team. The study area has not been listed as a priority site and is not known as an area with site fidelity for this species.

The foraging habitat proposed to be removed by the action is considered limited in extent and unlikely to be critical to the survival of the species.

Disrupt the breeding cycle of a population

The study area is not used as a breeding area for the species, and thus the proposed activity would not directly impact on breeding habitat. The Swift Parrot would not use the study area as breeding habitat as it remains in Tasmania during its breeding season (spring and summer months), only migrating to mainland Australia during its non-breeding season (autumn and winter months). The habitat within the

Project site is not suitable for breeding for the Regent Honeyeater and Spotted-tailed Quoll either. Thus, the proposed activity is unlikely to disrupt the breeding cycle of the species.

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

The proposed activity is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

The amount of habitat directly removed is unlikely to be on the scale that would result in a decline of the species. The majority of vegetation representing favoured foraging habitat for the species would be retained in the study area within the Hydro Hydro lands.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

It is unlikely that the proposed activity would result in the introduction of invasive species that would impact on the species in the study area.

Introduce disease that may cause the species to decline, or

A disease that could potentially infect Swift Parrots and/or Regent Honeyeater is beak and feather disease. However, the proposed activity would be unlikely to introduce a disease that may cause this species to decline, given the disease is transmitted by other birds of the same species. There is potential for disease caused by the soil-borne plant pathogen *Phytophthora cinnamomi* to be transported into the site by construction machinery. This pathogen could impact on the vegetation communities that could support foraging habitat for this species. The potential extent of the pathogen in Australia is not completely known (DotE 2014). Control of transportation of the pathogen would occur by controlling soil transportation into the study area. Vehicle wash-down points and inspections have been recommended and would be applied throughout the construction and operation phases.

Interfere substantially with the recovery of the species.

In consideration of the above factors, the proposed activity is unlikely to substantially interfere with the recovery of the species.

Conclusion

The proposed activity is not considered likely to have a significant impact on the species for the following reasons:

- The proposed activity would disturb a very small area (2.5 ha) of available foraging habitat within the study area and wider region.
- The species is highly mobile and thus able to utilise areas across the landscape.
- Favoured foraging species would be retained within the conservation area
- The Swift Parrot and Regent Honeyeater migratory routes would not be affected by the proposed activity.
- The proposed activity would not disrupt the breeding cycle of the species as it breeds exclusively in Tasmania.
- A biodiversity offset strategy and offset management plan manage the vegetation within the Hydro Hydro lands.

Fauna: migratory species

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

Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species

Migratory species considered potential occurrences or that have been recorded in the study area include the Swift Parrot, White-bellied Sea Eagle, White-throated Needletail, Rainbow Beeeater and Fork-tailed Swift. The proposed activity would remove approximately 2.5 ha of vegetation, though not all of this is suitable for species such as the White-bellied Sea Eagle, whereby only artificial dams that serve as potential foraging habitat would be partially modified during construction (i.e. construction activities), above which the White-bellied Sea Eagle could potentially forage. However, the majority of suitable perching/nesting and foraging habitat in the study area would be retained. This does not constitute a substantial modification of important habitat for the assessed species.

Given the relatively small area of vegetation to be removed within the Project site, and the retention of suitable habitat and the provision of a large conservation offset within the Hydro Hydro lands, the proposed activity is not considered to substantially modify an area of important habitat for these species.

Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or

It is unlikely that the proposed activity would result in the introduction of invasive species that would impact on the assessed migratory species in the study area.

A biodiversity offset management plan would be developed as part of the proposed offset and would document actions such as feral animal control and pest and weed management within the study area.

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

The proposed activity would not disrupt the lifecycle of the assessed species as no breeding habitat occurs within the Project site.

Conclusion

The proposed activity is not considered likely to have a significant impact on the species for the following reasons:

- The proposed activity would disturb a very small area (2.5 ha) of available foraging habitat within the study area and wider region.
- The species is highly mobile and thus able to utilise areas across the landscape.
- A biodiversity offset management plan would be developed to manage the vegetation within the study area and offset area.

Appendix F : Field staff CV's and qualifications

CURRICULUM VITAE

Antony von Chrismar

SENIOR ECOLOGIST

QUALIFICATIONS

- Bachelor of Applied Science Environmental Resource Management Southern Cross University 2003
- Biobanking Assessor Accreditation , TAFE/DECC 2009
- Certificate II in Bushland Regeneration TAFE NSW 1999
- TAFE NSW OH&S General Induction for Construction Work in NSW (White card), 2007
- Remote Area First Aid, Workplace Level 2 2009

Antony has a Bachelor of Applied Science in Natural Resource Management as well as a certificate II in Bush Regeneration. He has highly developed project management skills and field ecology skills developed during 10 years combined experience as a consultant ecologist and a bushland manager. Antony has undertaken extra-curricular threatened species research projects, including a current project on Yellow-bellied Glider habitat requirements. He is familiar with the flora and fauna from many parts of NSW including North and Mid Coast, the Hunter region, and Central Coast.

Antony has conducted fauna and flora surveys, vegetation community validation, identification of threatened species habitat requirements, and impact assessment reporting. Antony has been involved with several Biobanking projects, applying the Biobanking field methodology on numerous occasions. He has experience in the preparation of Ecological Constraints Assessments, Environmental and Ecological Impact Assessments and Bushfire Assessment Reports. He is also skilled in the use of GIS (geographical Information Systems), aerial photography interpretation and GPS.

Antony has well developed liaison skills and has experience consulting with both state agencies and private clients.

RELEVANT PROJECT EXPERIENCE

- Hunter Water preliminary desktop Biobank Assessment for three sites at Cessnock, Kurri Kurri and Williamtown
- Foresters Beach Biobanking Assessment (statement) for development at Foresters Beach
- Bushells Ridge Biobank Assessment for Darkingjung Lands Council
- Halekulani Biobank Assessment for Darkingjung Lands Council
- Norah Head Biobank Assessment for Darkingjung Lands Council
- Whitebridge Biobank Assessment for Landcom
- Cessnock Biobank Assessment for Landcom
- Oxley Highway Biobanking Assessment for RTA
- Wyee LES investigation area Squirrel Glider corridor analysis
- Durness Station vegetation survey, analysis and mapping for Great Lakes Council

- Watchimbark Nature Reserve Vegetation Survey and Mapping
- Moolarben Coal Mine flora and fauna monitoring
- Werris Creek Mine biodiversity offset management plan
- Wyee LES Ecological Investigations for Lake Macquarie City Council
- Cameron's Gorge Nature Reserve vegetation surveys and mapping
- Arrawarra interchange of the Sapphire to Woolgoolga Flora and fauna survey assessment
- South West Rocks Sewage Treatment Plant upgrade Flora and fauna survey assessment
- South West Rocks Wallum Froglet Study for an LES
- Ecological constraints for Thrumster road options in Area 13 – Thrumster
- Fauna survey and assessment for Carnegie Cove sub-division and golf course, Bonny Hills
- Flora and fauna survey and assessment for Chevron-Veld (Stage 2) sub-division, Laurieton
- Flora and fauna impact assessment Highway Service Centre at Purfleet
- Flora and fauna survey and assessment for a western distributor road at South West Rocks
- Flora and fauna survey and impact assessment for the Red Head Rising main
- Flora and fauna survey and impact assessment for the RAAF Base William Town
- Flora and fauna survey and impact assessment for Bayswater pumpstation and pipeline augmentation
- Ecological land management plan for DLP
- Review of Environmental Factors (REF) for the Warnervale Link Road
- Porters Creek Weir on behalf of Connell Wagner for Wyong Council.

CURRICULUM VITAE

Daniel McKenzie

ECOLOGIST

QUALIFICATIONS

- Bachelor of Environmental Science and Management (Honours), University of Newcastle, 2011

Daniel has completed a Bachelor of Environmental Science and Management degree with honours at the University of Newcastle. Daniel's honours research project involved estimating the population size and examining the demography of the endangered *Litoria aurea* (Green and Golden Bell Frog) on Kooragang Island near Newcastle, NSW.

Daniel has developed considerable experience in the environmental industry. During his time with Eco Logical Australia Daniel has worked on a diverse range of projects throughout NSW. These have included targeted threatened fauna and flora surveys, ecological assessments, biodiversity monitoring projects, Bio-banking assessments, pre-clearing surveys and supervision of land clearing operations.

Daniel has previously been employed as a Research Assistant for the University of Newcastle and during this time worked on projects studying the ecology of the Green and Golden Bell Frog at both Kooragang Island and Sydney Olympic Park populations. Daniel also worked as a Research Assistant examining the effectiveness of mine rehabilitation techniques in the central Hunter Valley for the University of Newcastle.

Daniel utilised his environmental knowledge and excellent communication skills to work as a tour guide for the NSW National Parks and Wildlife Service.

RELEVANT PROJECT EXPERIENCE

Biodiversity Offsets and Bio-banking

- Kurri Kurri Aluminium Smelter Biodiversity Offset Project – vegetation mapping and threatened flora and fauna survey for a proposed redevelopment of a disused aluminium smelter and surrounding buffer lands in the lower Hunter Valley.
- Caroona Offset Area - vegetation mapping and validation for a potential biodiversity offset for BHP's Caroona Coal Project in the Liverpool Plains region.
- Glenrock Station Biodiversity Offset Investigations - detailed investigations within the Upper Hunter Region to validate vegetation types, condition and threatened species habitat in areas of high biodiversity value and document these values to enable marketing of the offset potential of property.
- OEH Linking Landscapes - Jewells Swamp Biobank Assessment – a Biobanking assessment and preparation of a management plan at a biobank site owned and managed by local government.
- Salamander Bay Biobank Site Assessment – floristic surveys and vegetation mapping to complement a Biobanking Assessment report for Port Stephens Shire Council.
- Karuah East Quarry Offset Site Investigation – Vegetation mapping / validation and threatened flora and fauna surveys.
- Warnervale Precinct 7a - 7g Wetland Biobank Assessment – several Biobanking floristic quadrats and threatened species searches were completed to enable the preparation of a Biobank Assessment report for the site.
- Darkinjung Land Council - Norah Head – an ecological investigation of Darkinjung landholdings at Norah Head to enable a Biocertification application to be submitted.
- Darkinjung Land Council - Bushells Ridge & Associated Conservation Lands - an ecological investigation of land holdings to enable a Biocertification application to be submitted
- Warnervale Town Centre and Wyong Employment Zone - several Biobanking floristic quadrats were completed for the preparation of a Biodiversity Certification Assessment.

eco logical AUSTRALIA

CURRICULUM VITAE

Belinda Failes

ECOLOGIST

QUALIFICATIONS

- Master of Wildlife Management (Macquarie University)
- Bachelor of Environmental Science, (University of Newcastle)
- Senior First Aid Certificate
- OHS Construction Induction Certificate – White Card
- Rail Industry Safety Induction (RISI) Card
- Working at heights
- Tree Rescue training
- Basic Tree Climbing training

Belinda has been working as an ecologist with Eco Logical Australia since 2011, and has been involved in the monitoring of, and preparation of reports for, threatened flora and endangered ecological communities, as well as the preparation of Vegetation Management Plans (VMP), Part 3A and Section 5A Assessments under the EP&A Act, Local Environment Studies, and Species Impact Statements (SIS).

Belinda has built on the skills she learned while studying a Master of Wildlife Management at Macquarie University through on-going professional development, and is skilled in both flora and fauna identification.

RELEVANT PROJECT EXPERIENCE

Biobanking and BioCertification

- Mount Gilead rezoning Biocertification
- Teralba Quarry Biobanking
- Ingleside rezoning Biocertification

Flora and Fauna Impact Assessments

- Bunya, Doonside, flora and fauna field work
- National Broadband Network ISEPP and DA approvals
- ITS for Sydney Water REF
- Water Infrastructure Group REF
- Jet Strike Fighters EIS - ecological impacts literature review
- Bunya, Doonside Themeda - relocation monitoring project (field work)
- South West Growth Centres - translocation of Cumberland Plain Land Snail
- North West Rail Link - ecological assessment (field work)
- Moxham Quarry, Northmead, impact assessment
- Schofield Road, Alex Avenue Precinct - impact assessment
- North Narrabeen Dunes, NSW - impact assessment
- Curl Curl Off-leash Dog Park Proposal - impact assessment
- Kilcare Rd, Blacktown - impact assessment
- Harbord Diggers - ecological constraints and impact assessment
- Metropolitan Colliery Vegetation Monitoring (field work)
- Hamlyn Terrace – ecological constraints and impact assessment
- Greta Freight Train Upgrade, Greta - pre-clearance surveys
- Withers Rd, Kellyville, impact assessment
- Schofields Defence Housing Association
- Wolgan Valley Road – Cranbrook School
- St Leonards Plaza
- Jemena gas pipeline
- Woolahra Biodiversity Management Plan – field work

CURRICULUM VITAE

Gordon Patrick

SENIOR ECOLOGIST / BOTANIST

QUALIFICATIONS

- Bachelor of Environmental Science (Env Mgnt), University of Newcastle
- Bushland Regeneration Certificate II, Hunter Institute of Technology (TAFE)
- Graduate Certificate of Science (Botany/Ecology), University of New England – (Current Studies)
- Diploma of Conservation & Land Management, Tocal

Gordon has a bachelor of Environmental Science (Environmental Management) as well as a certificate II in Bush Regeneration. He has highly developed project management and field ecology / botany skills developed during his 18 years of experience as a consultant botanist / ecologist, bushland manager and a teacher.

As part of his General Manager role at a LandCare organisation he has implemented and managed numerous environmental restoration and bushland regeneration projects (both on a commercial and voluntary basis) of various sizes and complexities for many clients. In addition to project management, he undertook the overall coordination of the organisation, including various volunteer and education programs, a locally indigenous plant nursery, budgeting and managing over 20 staff and many more volunteers.

He has skills in liaising, meeting with community and Government organisations, report writing, supervision, delegation, teaching, quoting and participation in community education. Projects have included native vegetation surveys/identification, threatened species studies, native seed collection and propagation, revegetation and conservation work.

RELEVANT PROJECT EXPERIENCE

- Tuggerah Lakes Saltmarsh Mapping Project Stages 2 and 3 (Tuggerah Lake, Budgewoi Lake and Lake Munmorah), prepared for Wyong Shire Council
- Landscaping Consulting Services for Nambucca to Urunga Pacific Highway. Reviewing the detail and adequacy and providing comment on the landscape design drawings and specifications for the project implementation stages (Abigroup / RMS)
- Rehabilitation Inspection – Annual inspection of both native and pasture rehabilitation areas in previously mined locations. Undertaken for Liddell Colliery (Xstrata)
- Rapid Map Validation Sites in the Hunter Region. Vegetation community validation across over 300 sites in the Upper Hunter and Central Hunter regions. Carried out for NSW Office of Environment and Heritage
- Baseline Biodiversity Surveys in arid far south west Queensland, carried out for Drillsearch
- Species Impact Statement for proposed retail development at Windale, Lake Macquarie. Prepared for Hydrox Nominees Pty Ltd
- Flora and Fauna Monitoring, Annual monitoring program surveys and reporting for the Liddell Colliery, Xstrata
- Callaghan Campus (University of Newcastle) Landscape Management Plan. Provision of input in relation to management of native vegetation across the university campus, prepared for University of Newcastle
- Karuah East Quarry, Offset site and Biobanking investigation, prepared for Hunter Quarries Pty Ltd
- Weed Management Plan for the Threatened Shrub, *Persoonia pauciflora*, North Rothbury, Hunter Valley,

NSW, prepared for DECCW
- Collation of Information on the Status of the Endangered Species *Persoonia pauciflora* in the Lower Hunter Valley of NSW, prepared for DECCW. Information from this report was used for the production of the (Draft) National Recovery Plan for the species
- Green Point Bushland Regeneration Strategy prepared for Lake Macquarie City Council
- Morisset State Conservation Area Weed Survey & Management Strategy, prepared for DECCW
- Flora/Ecological surveys and assessments for the Department of Defence in several locations including: Williamtown RAAF Base and Weapons Range; Singleton Army Base & Training area; and Shoalhaven district (HMAS Albatross).

CURRICULUM VITAE

Emily Mowat

GRADUATE ECOLOGIST

QUALIFICATIONS

- Bachelor of Science (Honours I), University of Sydney
- TAFE Certificate III Conservation and Land Management
- Senior First Aid Certificate
- OHS Construction Induction Certificate – White Card
- Transport for NSW Rail Industry Safety Induction (RISI) Card
- SMARTtrain Chemical Application Certificate (AQF level 3)
- C-class banding authority (Australian Bird & Bat Banding Scheme)

Emily graduated with a Bachelor of Science from the University of Sydney in May 2011, and joined Eco Logical Australia in April 2014. Emily's honours thesis examined the effects of fire regimes on small mammal populations in the Greater Sydney region.

Prior to joining ELA, Emily worked and volunteered for a wide range of ecological projects in many areas of Australia and in New Zealand, gaining experience in flora and fauna surveys; threatened species monitoring; habitat surveys; data collection and management; bird banding; weed management and ecological restoration; and writing research reports. She has worked with a range of government and non-government organisations.

Whilst working for ELA, Emily has worked on a range of projects, including biodiversity monitoring projects, targeted fauna and flora surveys, ecological assessment, vegetation and biodiversity management plans, and Biobanking and Biocertification assessments.

RELEVANT PROJECT EXPERIENCE

Flora and fauna monitoring

- Santos Ltd – Bird assemblage and vertebrate pest monitoring surveys for pilot wells, Narrabri 2015
- Aurizon – Bird and herpetofauna monitoring, Hexham 2014-2015
- Aurizon – Bi-weekly inspections of retention basins for *Gambusia holbrooki* , Hexham 2014-2015
- Santos Ltd – vegetation plots for monitoring of rehabilitation areas, Narrabri 2014
- Werris Creek Coal – Spring flora and fauna monitoring 2014
- Liddell Coal Operations – Annual flora and fauna monitoring 2014
- Anglo Coal – Drayton Coal Mine Monitoring report 2014
- Office of Environment and Heritage – Wildcount remote camera survey, Barrington Tops NP NSW 2014
- Office of Environment and Heritage – Microbat surveys, Scheyville NP, Prospect NR and Edmondson Park NSW 2013
- Australian Wildlife Conservancy – Biodiversity surveys (mammals, birds, herpetofauna and flora), Newhaven Sanctuary NT, Mornington Sanctuary WA & Wongalara Sanctuary NT 2012
- Australian Wildlife Conservancy – Finch census, Mornington Sanctuary WA 2012
- University of Sydney – Biodiversity surveys (mammals and herpetofauna), Simpson Desert QLD 2011

Ecological assessment

- Sydney Trains – Flora and fauna assessment for vegetation maintenance, Auburn to Emu Plains 2015
- Wyong Council – flora and fauna surveys for Wyong Education Precinct ecological assessment 2014-2015
- Investa Commercial Developments – Hollow-bearing tree surveys for Stage 1 Ecological Assessment, Berkleyvale 2015
- Hydro Aluminium – Vegetation plots for Kurri Kurri aluminium smelter demolition ecological assessment 2015
- Redbank Power Station – Bird survey for powerline easement clearance, Warkworth 2014

Biobanking and biocertification

- Wyong Shire Council – flora and fauna surveys for biocertification assessment 2014-2015
- Hydro Aluminium – Vegetation plots for Kurri Kurri aluminium smelter biocertification assessment 2014-2015
- Aurizon – Biobanking plots, Hexham 2014-2015

Vegetation mapping

- NSW National Parks and Wildlife Service – Vegetation surveys for mapping Breelong and Drillwarrina National Parks 2014

Management plans

- Harrington Estates – Vegetation Management Plan for Harrington Precinct O 2015
- Sydney Trains – Vegetation maintenance plan for electricity feeders, Auburn to Emu Plains 2015
- Lend Lease – Nambucca to Urunga Pacific Highway Upgrade weed management recommendations report 2015
- Santos Ltd – Biodiversity Management Plan for Bibblewindi and Dewhurst pilots 2014

Threatened species monitoring & research

- Department of Conservation NZ – radio-tracking reintroduced Kakapo, Little Barrier Island NZ 2013
- Royal Botanic Gardens Sydney – Grey-headed Flying Fox colony monitoring prior to relocation 2011
- Maungatautari Ecological Island Trust NZ – monitoring territory use by Hihi, Maungatautari Sanctuary NZ 2013
- Australian Wildlife Conservancy – radio-tracking reintroduced Numbat, Mala and Bridled Nail-tail Wallabies, Scotia Sanctuary NSW 2013
- Australian Wildlife Conservancy – Northern Quoll population census, Mornington Sanctuary WA 2012
- University of Tasmania – Tasmanian Devil and Spotted Tail Quoll radio-tracking, Arthur River Tasmania 2012
- Office of Environment and Heritage – Koala tree use survey, Gunnedah NSW 2011

ecological AUSTRALIA

HEAD OFFICE
Suite 4, Level 1
2-4 Merton Street
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

SYDNEY
Level 6
299 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9264 0717

ST GEORGES BASIN
8/128 Island Point Road
St Georges Basin NSW 2540
T 02 4443 5555
F 02 4443 6655

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

COFFS HARBOUR
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

PERTH
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 08 9322 1358

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

GOSFORD
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897

DARWIN
16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601
F 08 8941 1220

BRISBANE
Suite 1 Level 3
471 Adelaide Street
Brisbane QLD 4000
T 07 3503 7191
F 07 3854 0310

1300 646 131
www.ecoaus.com.au