

LYNWOOD QUARRY, NSW

Ecological Monitoring of Retained Vegetation 2020

Prepared for:

Holcim Australia Pty Ltd

PO Box 5697

WEST CHATSWOOD NSW 1515

SLR Ref: 630.30045-R01
Version No: -v1.0
March 2021

SLR 

PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
10 Kings Road
New Lambton NSW 2305 Australia
(PO Box 447 New Lambton NSW 2305)
T: +61 2 4037 3200
E: newcastleau@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Holcim Australia Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
630.30045-R01-v1.0	31 March 2021	Fiona Iolini	Jeremy Pepper	Jeremy Pepper

CONTENTS

1	INTRODUCTION	5
1.1	Background.....	5
1.2	Previous Ecological Reports.....	5
1.2.1	Ecological Assessment	5
1.2.2	Box Gum Woodland Management Plan	7
1.2.3	Rehabilitation and Landscape Management Plan	7
1.3	Objectives	8
2	METHODS	9
2.1	Staff Roles and Qualifications	9
2.2	Flora and Fauna Monitoring Methods	9
2.2.1	Monitoring Site Selection.....	9
2.2.2	Vegetation Survey Techniques	12
2.2.3	Fauna Survey Techniques.....	13
2.3	Nest-box Monitoring Methods	14
2.4	Hoary Sunray Monitoring Methods	14
2.5	Survey Details	17
2.5.1	Survey Limitations	17
2.5.2	SLR Permits and Licenses	18
3	RESULTS.....	19
3.1	Flora and Fauna Monitoring Results	19
3.1.1	Vegetation Monitoring Results.....	19
3.1.2	Fauna Monitoring Results	21
3.2	Nest-box Monitoring Results.....	21
3.3	Hoary Sunray Monitoring Results.....	22
4	DISCUSSION.....	23
5	CONCLUSION AND RECOMMENDATIONS.....	24
6	REFERENCES	25

DOCUMENT REFERENCES

TABLES

Table 1	Staff Roles and Qualifications	9
Table 2	Flora and Fauna Monitoring Sites	12
Table 3	Fauna Survey Techniques and Effort	13
Table 4	Hoary Sunray Monitoring Sites	14
Table 5	Details of the 2020 Ecological Monitoring	17
Table 6	Identification of Plant Community Types at Monitoring Sites	19
Table 7	BAM Plot Data Comparisons to PCT Benchmark Data.....	20
Table 8	Fauna Species Composition per Monitoring Site	21
Table 9	Hoary Sunray Counts and Extrapolated Population Estimate.....	22

FIGURES

Figure 1	Site Location.....	6
Figure 2	Monitoring Sites	10
Figure 3	Vegetation Communities	11
Figure 4	BAM Plot Layout	12
Figure 5	Nest Box Locations	15
Figure 6	Hoary Sunray Monitoring Sites	16

APPENDICES

Appendix A	BioNet Vegetation Classification Profiles and Benchmarks
Appendix B	BAM Plot Data
Appendix C	BAM Plot Attribute Comparison Graphs
Appendix D	Fauna Data
Appendix E	Nest box Inventory
Appendix F	Hoary Sunray Monitoring Data

1 INTRODUCTION

1.1 Background

SLR Consulting Australia Pty Ltd (SLR) was commissioned by Holcim (Australia) Pty Ltd ('Holcim') to undertake ecological monitoring at the Lynwood Quarry, a hard rock quarry approximately two kilometres west of Marulan, in the Southern Highland IBRA Region and Bungonia Sub-region of New South Wales (NSW) (see Figure 1).

Initial planning consent for the Lynwood Quarry was granted to Cemex (now Holcim) on 21 December 2005 for an approved five million tonnes per annum (mta) output. Since the original development approval, five modifications have been approved, with quarrying operations approved until 01 January 2038. Ecological monitoring is a requirement of the project approval and associated ecology reports and management plans.

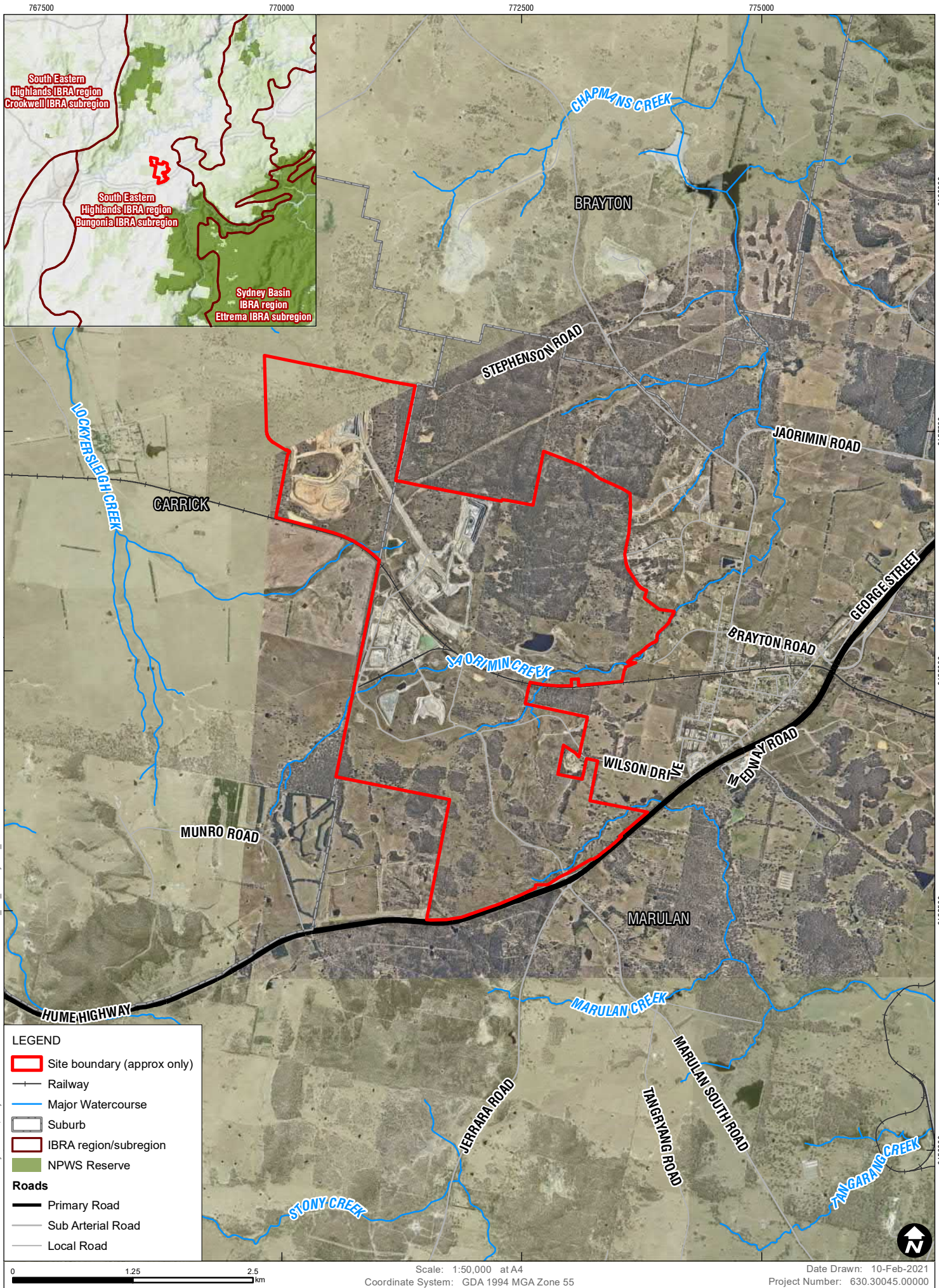
1.2 Previous Ecological Reports

Various documents were prepared during the approval phase of the quarry (Umwelt 2005, 2013, 2018) and these have been relied upon for background information in relation to the ecology and management of the site. A summary of previous ecological reports is provided below.

1.2.1 Ecological Assessment

Key findings of the Ecological Assessment (EA) (Umwelt 2005) are as follows:

- Vegetation mapping by Umwelt (2005) suggests that four vegetation map units occur across the site: Tableland Low Woodland, Western Tablelands Dry Forest, Tableland Grassy Box-Gum Woodland, Riparian Gum Box-Apple Woodland and Camden Woollybutt Low Open Forest.
- No threatened species of flora were found but areas of the site were thought to provide potential habitat for Buttercup Doubletail *Diuris aequalis*, Pine Donkey Orchid *Diuris tricolor*, Cotoneaster *Pomaderris Pomaderris cotoneaster*, Tallong Midge Orchid *Genoplesium plumosum* and Cabbage Kunzea *Kunzea cabbagei*.
- Areas of retained vegetation across the site were found to provide habitat to a suite of local fauna species as well as the following threatened species which are listed as 'vulnerable' under the Biodiversity Conservation Act 2016 (BC Act): Speckled Warbler, Squirrel Gilder, Eastern Costal Free-tailed Bat (previously Eastern Freetail-bat), Eastern False Pipistrelle and Large Bent-winged Bat (previously known as Eastern Bentwing-bat).
- The site was also thought to provide potential habitat to the following BC Act threatened fauna species: Giant Burrowing Frog, Rosenberg's Goanna, Striped Legless Lizard, Blue-billed Duck, Swift Parrot, Barking Owl, Masked Owl, Brown Treecreeper, Regent Honeyeater, Hooded Robin, Diamond Firetail, Spotted-tailed Quoll, Grey-headed Flying-fox, Large-eared Pied Bat.
- To mitigate the impacts of the development the EA proposed monitoring in retained vegetation on a three-yearly basis involving four monitoring locations to be established within a Habitat Management Area (HMA), Joarimin Creek Management Area and Cultural Management Area (CMA). The proposed approach was a standard 20 m by 20 m flora quadrat to record species diversity and structural composition, as well as photo monitoring and fauna monitoring targeting threatened species. Nest boxes were also proposed to be installed and monitored on an annual basis for five years.



H:\Projects\SLR\660-Srv\WCOL\630-NTL\630_30045_00000\Lynwood Quarry\Ecol06_SLR_Data\01_CAD\GIS\SLR\63030045_G1_LocalityPlan_01.mxd



Data Source: NSW SS, 2020, Basemap supplied by ESRI and other sources
 Aerial imagery supplied by Nearmap (January, 2021) and © Department of Customer Service 2020

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

SITE LOCATION

FIGURE 1

1.2.2 Box Gum Woodland Management Plan

Key aspects of the Box Gum Woodland Management Plan (Umwelt 2013) are as follows:

- During construction the site was found to contain a large population of the threatened plant Hoary Sunray *Leucochrysum albicans* var. *tricolor*, which is listed as vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and areas of White Box - Yellow-Box - Blakely's Red Gum Woodland, which is listed as a critically endangered ecological community (CEEC) under the NSW Biodiversity Conservation Act 2016 (BC Act).
- To mitigate and offset the loss of these threatened entities, a Box Gum Woodland Management Plan was prepared which details management actions, regeneration, and revegetation strategies.
- A Biodiversity Offset Area was set aside, which incorporates a 185 ha area in the southwest portion of the site and includes the Cultural Management Area. As such, three-yearly plot monitoring in the CMA (as previously proposed under the Rehabilitation Plan) was identified as suitable to capture the 'retained vegetation' monitoring requirements of the biodiversity offset area.
- The plan also commits to annual monitoring and reporting to determine success of rehabilitation and general condition including weed and pest animal presence, presence of Hoary Sunray and other matters of national environmental significance (MNES).

1.2.3 Rehabilitation and Landscape Management Plan

The relevant ecological components of the Rehabilitation and Landscape Management Plan (Umwelt 2018) can be summarised as follows:

- Holcim is to establish and maintain the HMA and Joarimin Creek corridor for the conservation of ecological values. Management includes fencing and signposting the boundary of the management areas and removal of dilapidated fences throughout. The HMA is approximately 130 ha of which 105 ha is presently vegetated and an area of 25 ha is proposed to be rehabilitated via assisted regeneration and plantings.
- Maintenance and replacement of arboreal habitat is to occur through the relocation of salvaged tree hollows or installation of nest boxes. Nest boxes are to be monitored annually for a period of five years, followed by condition inspections every four years.
- Preliminary Completion Criteria for the HMA are as follows:
 - HMA signposted and fenced off from active quarry operations to prevent access. Barb wire completely removed from internal fencing.
 - Installation of fencing around the perimeter of the HMA to exclude cattle.
 - Nest boxes are being utilised or show signs of use by native species. Each nest box installed should be in good structural condition and functioning in the landscape.
 - Weed and pest inspections show no increase in weed population and monitoring indicates the absence of or decline in weed species.
 - Signs of recruitment in all strata or evidence to demonstrate that the ecosystem will progress towards recruitment. More than 56% of trees are healthy and growing and are recognisable as PCT 1330¹.

¹ PCT 1330 is Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion

1.3 Objectives

The purpose of the Lynwood ecological monitoring program is to monitor ecological values within areas of retained vegetation within the site and demonstrate the achievement of objectives in accordance with the Ecological Assessment (Umwelt 2005), Box Gum Woodland Management Plan (Umwelt 2013) and Rehabilitation and Landscape Management Plan (Umwelt 2018). Rehabilitation monitoring was not undertaken as part of the 2020 program but can be incorporated in future years.

The objectives of the 2020 ecological monitoring are to:

- Determine the condition of retained vegetation areas through comparison with benchmarks.
- Establish baseline data so that future monitoring can detect changes in retained vegetation.
- Identify any deterioration or improvement in habitat quality within areas of retained vegetation.
- Assess changes to fauna species assemblages within the areas of retained vegetation.
- Determine whether nest boxes are being utilised by native fauna and determine whether any nest box maintenance actions are required.
- Establish Hoary Sunray monitoring sites so that future monitoring can detect changes in population size and impacts on the population.

2 METHODS

2.1 Staff Roles and Qualifications

The roles and qualifications of all staff responsible for preparation of this report are listed in Table 1.

Table 1 Staff Roles and Qualifications

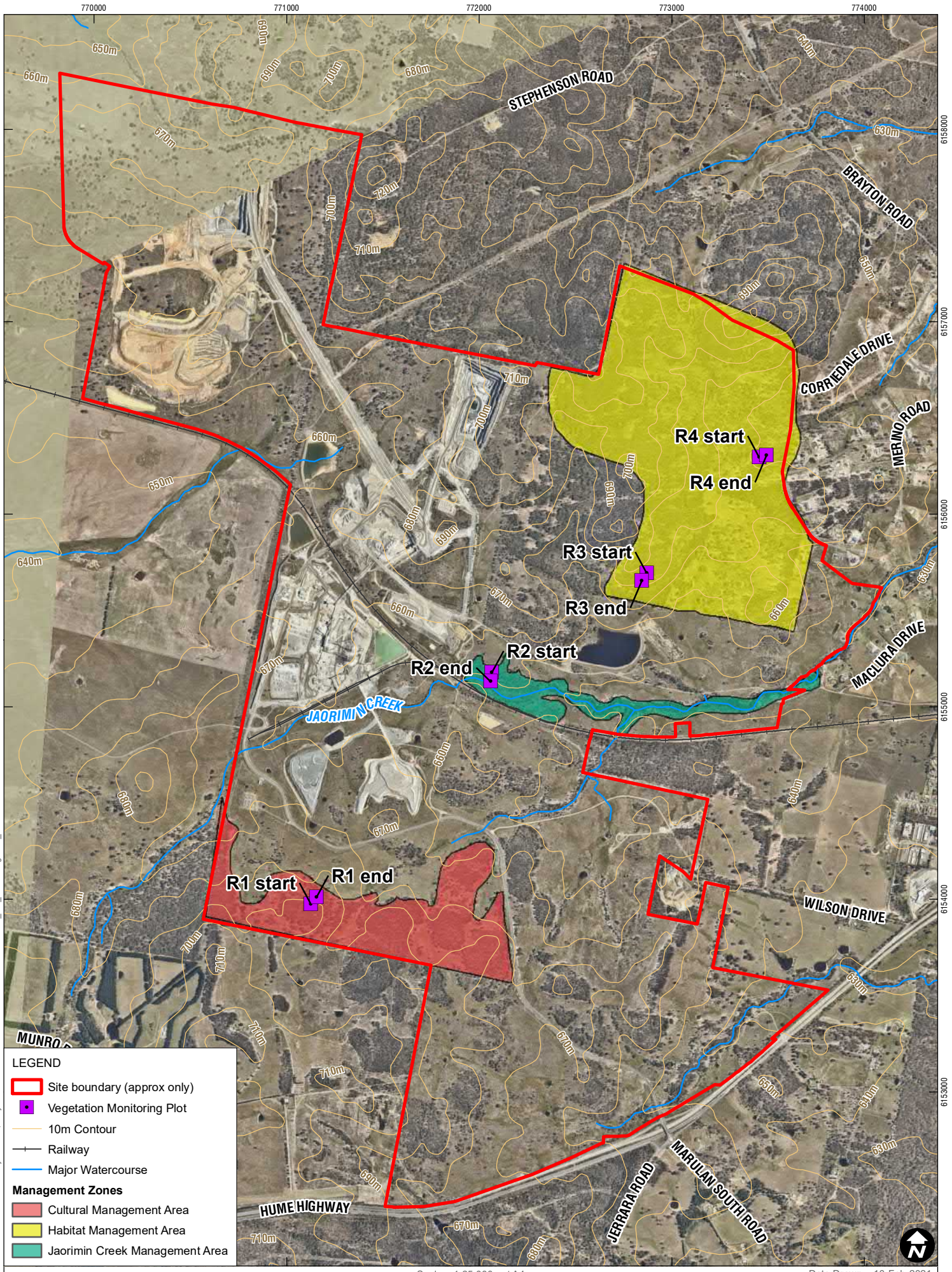
Staff Name & Title	Qualifications and Training	Role
Jeremy Pepper Principal Ecologist	Bachelor of Science (Hons Class 1) University of NSW 1996 Cert II Bushland Regeneration, TAFE NSW Cert III Horticulture (Arboriculture), TAFE NSW BAM accredited assessor (#BAAS17104)	Project Director, report technical review
Fiona Iolini Associate Ecologist	Bachelor of Environmental Science and Management, University of Newcastle 2007 Certificate of Native Plant Identification, Sydney University 2008 Cert III Conservation and Land Management, TAFE NSW 2015 BAM accredited assessor (#BAAS19042)	Project Manager, Winter and Spring field survey, report preparation
David Martin Project Ecologist	Bachelor of Environmental Science and Management, University of Newcastle 2014 Master of Science (Biosciences), The University of Melbourne 2018	Winter field survey, report preparation
Caitlin Cross Project Ecologist	Bachelor of General Science (Ecology & Conservation), James Cook University, 2016	Spring field survey
Jarrid Beeton Project Ecologist	Bachelor of Environmental Science and Management, University of Newcastle 2018 Dip. Conservation and Land Management, TAFE NSW Cert III Horticulture, TAFE NSW Report writer, Spring field survey	Spring field survey
Ashleigh Pritchard Senior GIS Analyst	Diploma of Spatial Information Services (GIS), TAFE NSW 2009 Esri Certified ArcGIS Desktop Associate 10.5, 2018	GIS data management and figure preparation

2.2 Flora and Fauna Monitoring Methods

2.2.1 Monitoring Site Selection

Four permanent monitoring sites were established within areas of retained vegetation and baseline flora (BAM plot) and fauna (diurnal and nocturnal fauna census) data was collected at each of these locations. The sites were selected randomly whilst in the field, aiming to include one plot within each of the three management areas. Plots were positioned based on proximity to the Lynwood Quarry disturbance footprint and to ensure appropriate representation of the different vegetation types present across the site. Monitoring sites have been pegged using metal star-pickets fitted with a yellow cap and marked with the site reference. Two star-pickets were positioned at each site, one at the start and one at the end of the midline (or 50 m transect) of each BAM plot.

Location and details of the monitoring sites are included below in Table 2 and Figure 2. Regional vegetation community mapping (Tozer et al. 2010) is included in Figure 3.

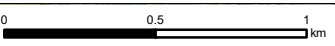


LEGEND

- Site boundary (approx only)
- Vegetation Monitoring Plot
- 10m Contour
- Railway
- Major Watercourse

Management Zones

- Cultural Management Area
- Habitat Management Area
- Jaorimin Creek Management Area



Scale: 1:25,000 at A4
 Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 10-Feb-2021
 Project Number: 630.30045.00000



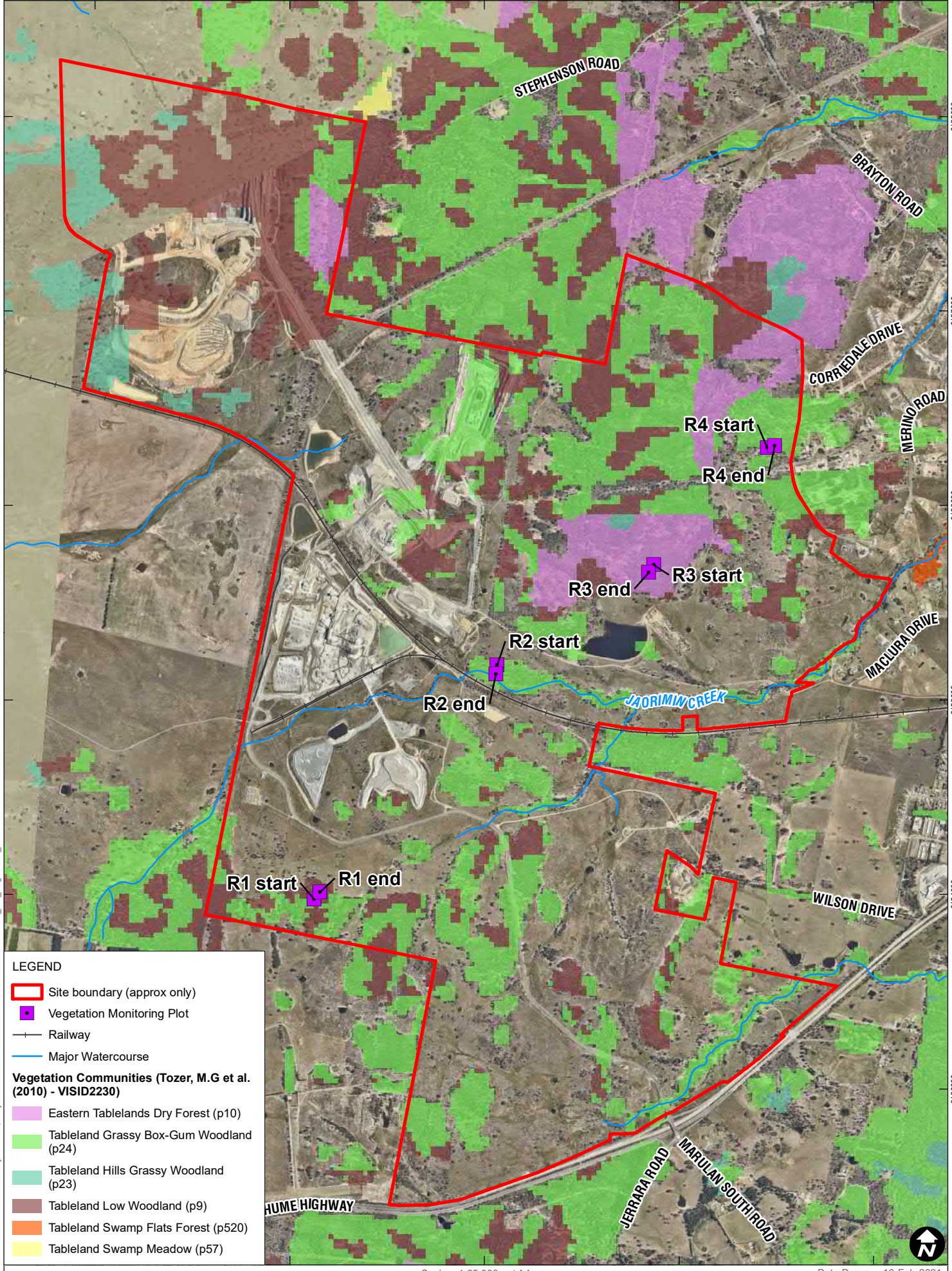
Data Source: NSW SS, 2020, Basemap supplied by ESRI and other sources
 Aerial imagery supplied by Nearmap (January, 2021) and © Department of Customer Service 2020

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

MONITORING SITES

FIGURE 2

H:\Projects\SLR\660-Srv\WCOL\630-MTL\630_30045_00000\Lynwood Quarry\Ecol06_SLR_Data\01_CAD\GIS\SLR\63030045_G2_MonitoringSites_01.mxd



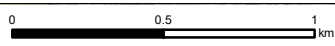
H:\Projects\SLR\660-Srv\WOL\630-NTL\630_30045_00000\Lynwood Quarry Ecot06 SLR Data\01_CAD\GIS\GIS\SLR\63030045_G3_Vegetation_01.mxd

LEGEND

- Site boundary (approx only)
- Vegetation Monitoring Plot
- Railway
- Major Watercourse

Vegetation Communities (Tozer, M.G et al. (2010) - VISID2230)

- Eastern Tablelands Dry Forest (p10)
- Tableland Grassy Box-Gum Woodland (p24)
- Tableland Hills Grassy Woodland (p23)
- Tableland Low Woodland (p9)
- Tableland Swamp Flats Forest (p520)
- Tableland Swamp Meadow (p57)



Scale: 1:25,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 10-Feb-2021
Project Number: 630.30045.00000



Data Source: NSW SS, 2020, Basemap supplied by ESRI and other sources
Aerial imagery supplied by Nearmap (January, 2021) and © Department of Customer Service 2020

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

VEGETATION COMMUNITIES

FIGURE 3

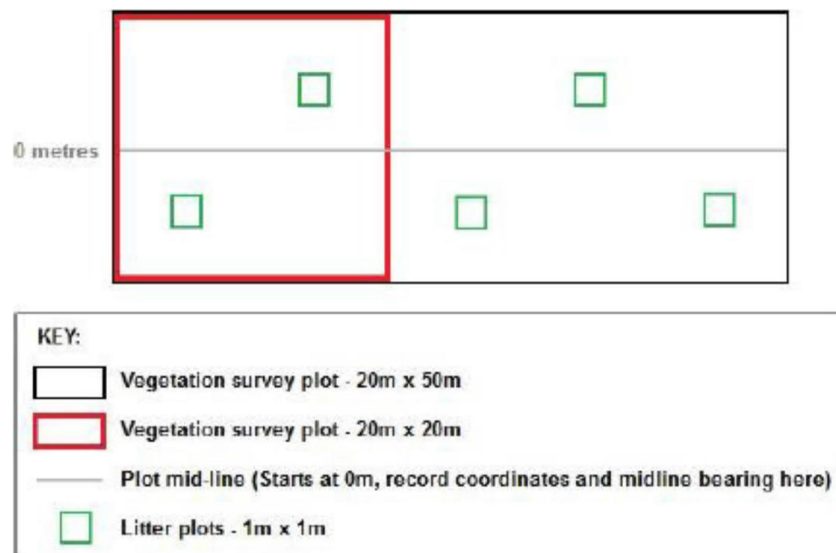
Table 2 Flora and Fauna Monitoring Sites

Management Area	Monitoring Site	Easting (MGA)	Northing (MGA)	Vegetation Map Unit (Tozer et al. 2010)
Cultural Heritage Management Area	R1 start	771155.1	6154011	Tableland Low Woodland (rp9)
	R1 end	771125.2	6153975	
Joarimin Creek Management Area	R2 start	772059.7	6155132	Tableland Grassy Box-Gum Woodland (rp24)
	R2 end	772065.7	6155178	
Habitat Management Area	R3 start	772844.6	6155654	Eastern Tablelands Dry Forest (p10)
	R3 end	772870.5	6155695	
	R4 start	773491.9	6156306	Tableland Grassy Box-Gum Woodland (rp24)
	R4 end	773453.6	6156296	

2.2.2 Vegetation Survey Techniques

Flora monitoring was completed during the spring survey period at each of the four permanent monitoring sites described above, following survey methods prescribed in the NSW Biodiversity Assessment Method (BAM) (DPIE 2020). This involved a 20 m by 20 m floristic plot to assess species composition and structure, and a 20 m by 50 m plot to assess vegetation function. The function attributes collected under the BAM include tree stem size, hollow-bearing tree counts, and ground cover (leaf litter, bare ground, cryptogram, and rock). The ground cover attributes are collected via five 1 m by 1 m plots along the midline, see Figure 4.

Figure 4 BAM Plot Layout



The BAM provides a repeatable assessment tool to compare vegetation and structural changes over time and to provide comparison for the areas of retained vegetation. All PCTs listed in the NSW BioNet Vegetation Classification database provide “benchmark” scores for these attributes to which comparison with the relevant plot data can be made. Due to the widespread use of this method in NSW, this method was chosen to provide a consistent, scientifically rigorous, and replicable method of assessing the health of the retained vegetation.

To categorise the vegetation at each BAM plot into a PCT, previous vegetation mapping and floristic data (Umwelt 2005), as well as current floristic composition data was compared to PCT's within the BioNet Vegetation Classification database. The PCT database was filtered using the Southern Highland IBRA Region and Bungonia Sub-region, followed by a close examination of floristics to match the vegetation at each plot.

The following vegetation characteristics were recorded within each BAM plot, as required by the Rehabilitation and Landscape Management Plan (Umwelt 2018):

- Floristic composition (including cover and abundance of species) and structure
- General health of vegetation
- Evidence of natural regeneration
- Occurrence and abundance of weed species
- Presence of threatened or other significant species
- Signs of disturbance, either by stock, feral animals, vehicles or humans
- Evidence of site management (eg fencing and weed control actions)

2.2.3 Fauna Survey Techniques

Fauna monitoring was undertaken at each of the monitoring sites during the winter and spring surveys utilising survey techniques and effort as detailed in Table 3.

Table 3 Fauna Survey Techniques and Effort

Technique	Description	Identification	Total Hours
Reptile and Amphibian Survey - diurnal	Searches through areas of likely habitat such as under rocks and logs, in bark at the base of trees, around water sources and in man-made features.	Visual observation and vocal calls	4 (1hr per site)
Bird Survey – diurnal	Slowly walking stratified transects within an approximate 2 ha area of the monitoring site. Visual observations made through SLR Digital cameras (Canon EOS) or binoculars.	Calls, flight patterns and visual observations	8 (1hr per site in Winter and Spring)
Spotlighting - diurnal	Conducted on foot using high-powered Head Torches (1000 Lumen). Targeted nocturnal amphibians, reptiles, birds and mammals within an approximate 2 ha area of each monitoring site.	Visual observation or vocal calls	4 (1hr per site)
Ultrasonic Bat-call Detection - nocturnal	Echolocation calls are detected and recorded using an Anabat SD2 Bat Detector/Recorder (Anabat detector). Anabat detectors are positioned at a 45 degree angle approximately one metre off the ground. All night Anabat detectors were positioned with a clear view of potential micro-bat flyways. They are automated and programmed to start recording one hour before dusk and to stop recording one hour after sunrise the following morning.	Analysis by Luke Forster (Trace Ecology).	96 (or two nights 6pm to 6am per site)
Infrared Cameras	Four infrared motion detection cameras (Reconyx Hyperfire) were left recording over night at each of the monitoring sites. Each camera is set onto a tree at a 45 degree angle towards the ground where cat food was placed as an attractant.	Analysis of photographic records	96 (or two nights 6pm to 6am per site)

2.3 Nest-box Monitoring Methods

A total of 50 nest boxes were inspected as part of the winter monitoring event. The locations of nest boxes are shown in Figure 5. This was completed by two qualified SLR ecologists, using a non-invasive remote camera inspection method to record the following details:

- Native fauna occupancy
- Presence of nests, eggs, or young
- Indirect signs of usage (eg scats, fur, feathers, egg fragments)
- Evidence of pest species (eg bees, exotic birds, such as Indian Miners)
- Nest box condition and maintenance requirements

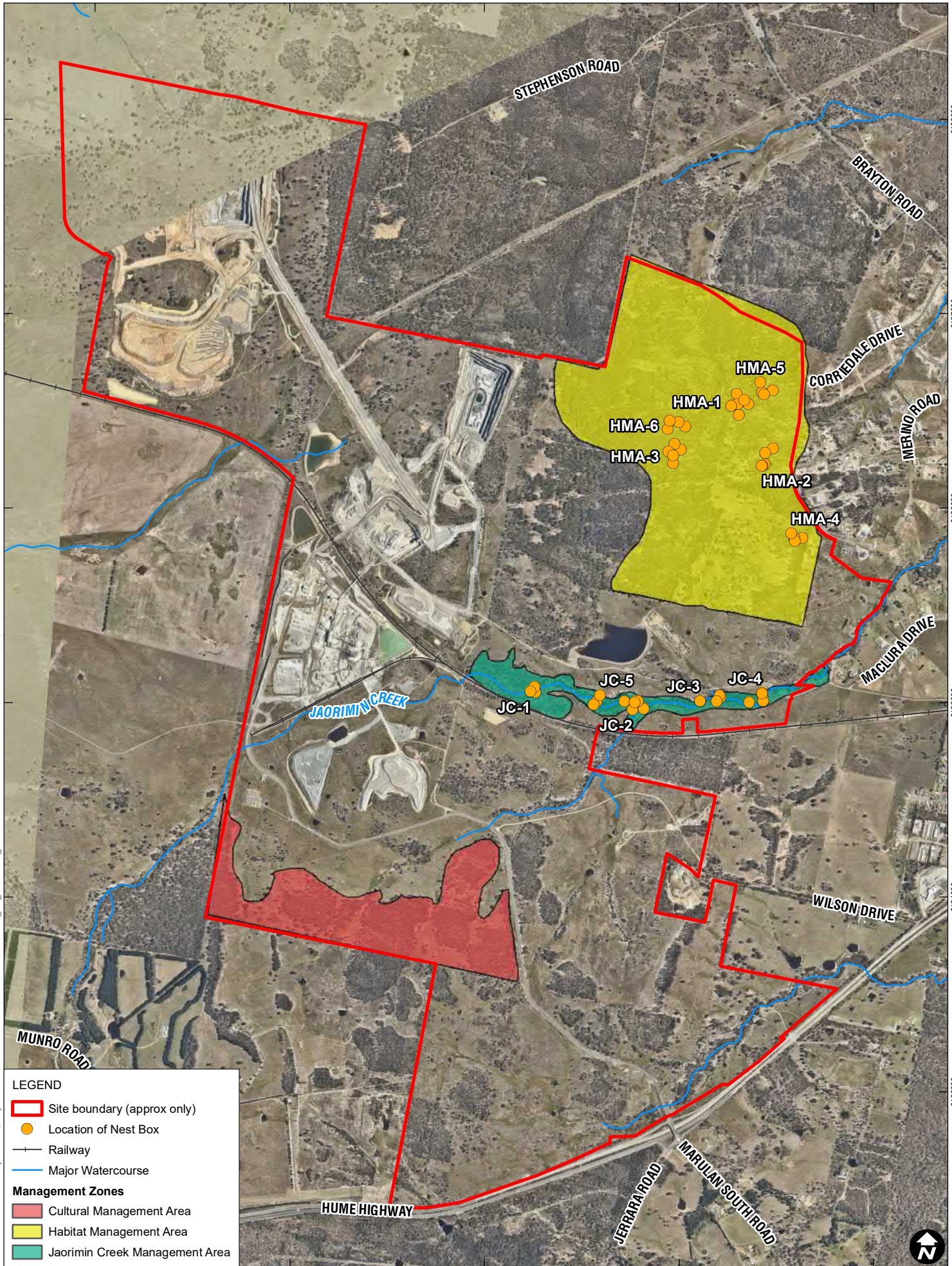
2.4 Hoary Sunray Monitoring Methods

Eleven Hoary Sunray monitoring sites have been established as detailed in Table 4 and Figure 6. Sites were selected randomly whilst in the field, aiming to include one plot within each of the patches of Hoary Sunray which had been previously mapped on the site (Umwelt 2013). Monitoring sites have been pegged using a metal star-picket at the centre of the plot, fitted with a yellow cap marked with the site reference.

Table 4 Hoary Sunray Monitoring Sites

Monitoring Site	Easting (MGA)	Northing (MGA)
Hoary Sunray 1 (HS1)	772565.1	6152919
Hoary Sunray 2 (HS2)	772620	6152739
Hoary Sunray 3 (HS3)	772245.9	6152606
Hoary Sunray 4 (HS4)	771609.9	6152464
Hoary Sunray 5 (HS5)	772046	6152762
Hoary Sunray 6 (HS6)	772158.6	6153676
Hoary Sunray 7 (HS7)	773014.4	6154255
Hoary Sunray 8 (HS8)	773071.2	6153755
Hoary Sunray 9 (HS9)	772905.5	6153843
Hoary Sunray 10 (HS10)	772401.6	6154880
Hoary Sunray 11 (HS11)	773440	6154894

At each monitoring site accurate counts of individuals of the Hoary Sunray were recorded within a 2m² plot using a series of 1m² quadrats laid out around the centre marker. Notes on disturbance and condition of the population at each site were made and a reference photo was taken of each 1m² quadrat. These data will be used to monitor population size and health over time.



LEGEND

- Site boundary (approx only)
- Location of Nest Box
- + Railway
- Major Watercourse

Management Zones

- Cultural Management Area
- Habitat Management Area
- Jaorimin Creek Management Area

Scale: 1:25,000 at A4
 Coordinate System: GDA 1994 MGA Zone 55
 Date Drawn: 09-Feb-2021
 Project Number: 630.30045.00000



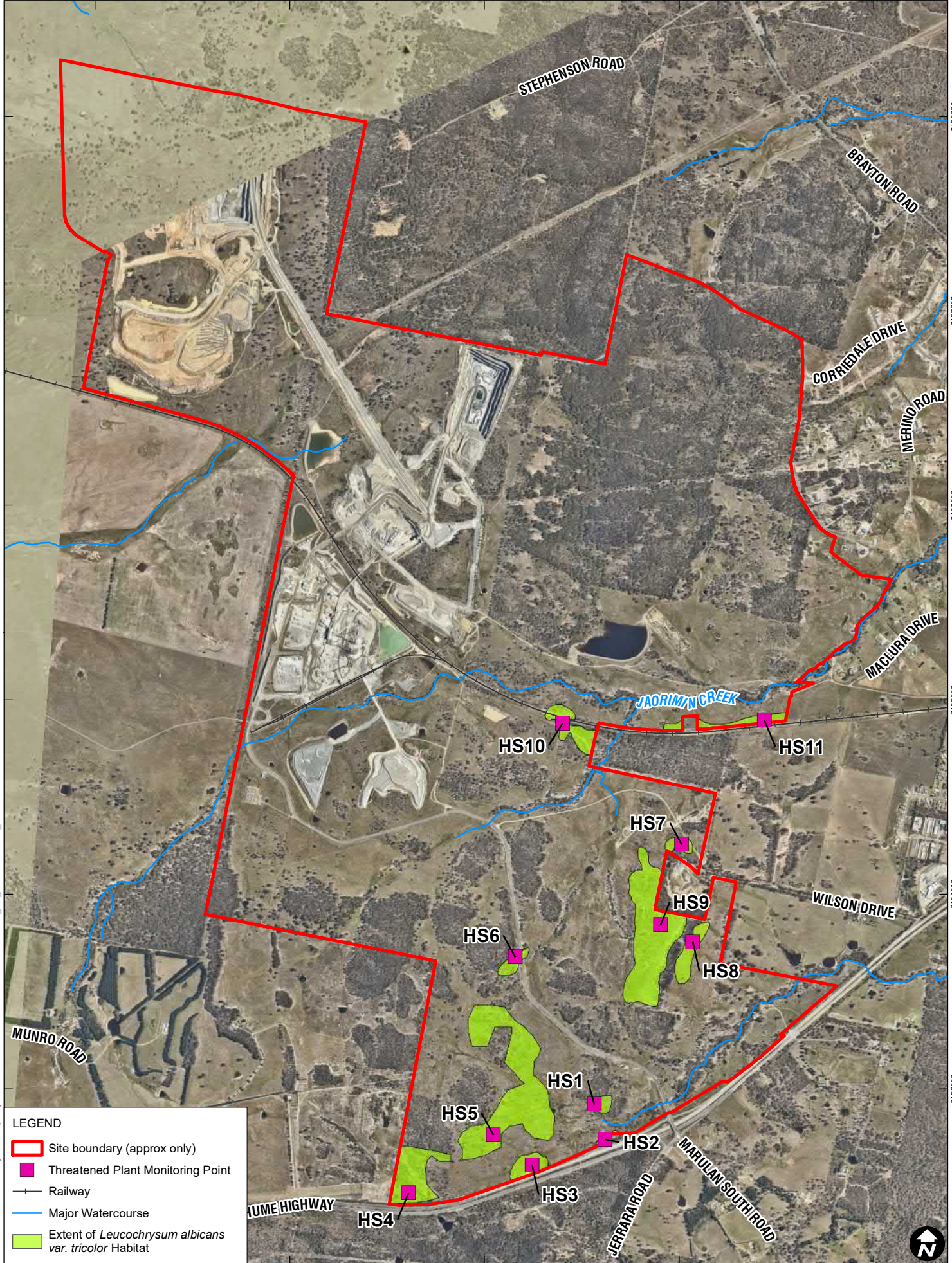
Data Source: NSW SS, 2020, Basemap supplied by ESRI and other sources
 Aerial imagery supplied by Nearmap (January, 2021) and © Department of Customer Service 2020

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

NEST BOX LOCATIONS

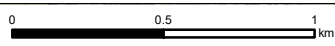
FIGURE 5

H:\Projects\SLR\660-Srv\WOL\630-MTL\630.30045.00000\Lynwood Quarry\Ecol06_SLR_Data\01_CAD\GIS\SLR\63030045_G4_NestBoxes_01.mxd



LEGEND

- Site boundary (approx only)
- Threatened Plant Monitoring Point
- Railway
- Major Watercourse
- Extent of *Leucochrysum albicans* var. *tricolor* Habitat



Scale: 1:25,000 at A4
 Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 10-Feb-2021
 Project Number: 630.30045.00000

H:\Projects\SLR\660-Srv\WCOL\630-NTL\630.30045.00000\Lynwood Quarry Ecotone SLR Data\01_CAD\GIS\SLR\63030045_G5_ThreatenedFlora_01.mxd



Data Source: NSW SS, 2020, Basemap supplied by ESRI and other sources
 Aerial imagery supplied by Nearmap (January, 2021) and © Department of Customer Service 2020

DISCLAIMER: All information within this document may be based on external sources. SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

HOARY SUNRAY MONITORING SITES

FIGURE 6

2.5 Survey Details

The current 2020 ecological monitoring involved winter and spring surveys as detailed in Table 5. Total fauna survey effort is included in Section 2.2.3.

Table 5 Details of the 2020 Ecological Monitoring

Date (2020)	Survey Technique	Weather Conditions*
03 August	Nest box inspections.	Temp -3.7°C (min) 14.2°C (max). Rain 0.2mm. Wind WNW 41km/hr 13:23 (max). Moon phase: third quarter to new moon. Sunrise 6:45am Sunset 5:17pm.
04 August	Dawn bird survey. Nest box inspections.	Temp -0.3°C (min) 12.5°C (max). Rain 0mm. Wind WNW 72km/hr 12:23 (max). Moon phase: third quarter to new moon. Sunrise 6:45am Sunset 5:17pm.
05 August	Dawn bird survey. Nest box inspections.	Temp -1.3°C (min) 7.8°C (max). Rain 0mm. Wind NW 76km/hr 13:06 (max). Moon phase: third quarter to new moon. Sunrise 6:44am Sunset 5:18pm.
30 November	Spotlighting. Anabat and Infrared Camera recording.	Temp 10.9°C (min) 22.4°C (max). Rain 0mm. Wind NE 39km/hr 11:45 (max). Moon phase: third quarter to new moon. Sunrise 5:37am Sunset 7:50pm.
01 December	Dawn bird survey. Floristic plots. Photo monitoring. Reptile and amphibian survey. Spotlighting. Anabat and Infrared Camera recording.	Temp 9.3°C (min) 34.4°C (max). Rain 0mm. Wind NW 72km/hr 15:52 (max). Moon phase: third quarter to new moon. Sunrise 5:37am Sunset 7:51pm.
02 December	Dawn bird survey. Reptile and amphibian survey. Hoary Sunray monitoring plots. Anabat and Infrared Camera recording.	Temp 11.5°C (min) 26.4°C (max). Rain 0.4mm. Wind WNW 39km/hr 03:42 (max). Moon phase: third quarter to new moon. Sunrise 5:37am Sunset 7:52pm.

* Weather data sourced from BOM (2021) weather station Goulburn Airport (20km SW of site) and www.timeanddate.com (Sydney 2020).

2.5.1 Survey Limitations

Survey efficacy is influenced by a range of factors. For this type of survey, such limitations are generally due to a single, short duration survey that does not account for seasonal variation. Given the short period of time spent on site, the detection of certain species may be affected by:

- Seasonal migration (particularly migratory birds)
- Seasonal flowering periods (some species are cryptic and are unlikely to be detected outside of the known flowering period)
- Seasonal availability of food, such as blossoms for some fauna
- Weather conditions during the survey period (some species may go through cycles of activity related to specific weather conditions, for example some reptiles and frogs can be inactive during cold weather)
- Species lifecycle (cycles of activity related to breeding)

2.5.2 SLR Permits and Licenses

The SLR ecology team operates under a Scientific Licence (licence number SL100176, issued under the BC Act), which authorises field staff to trap, capture, harm, hold and release plants and animals protected under the BC Act and National Parks and Wildlife Act 1974, as well as an Animal Research Authority (issued by the Secretary of the NSW Animal Care and Ethics Committee of DPIE), which allows trapping of animals in NSW for the purposes of animal research.

3 RESULTS

3.1 Flora and Fauna Monitoring Results

3.1.1 Vegetation Monitoring Results

The selected PCT for each site (which allows comparison to PCT benchmarks) is identified in Table 6. Whilst identical floristic matching was not possible due to the available PCTs for the region, SLR carefully selected the best-match community based on a range of factor (eg distribution, soils, and landscape factors), as well as consideration of floristics in previous site data (Umwelt 2005). BioNet Vegetation Classification profiles and benchmark values for each PCT are included in Appendix A.

Table 6 Identification of Plant Community Types at Monitoring Sites

Site	Key flora species in BAM plot	Closest PCT alignment (SLR)	PCT Floristics according to BioNet Vegetation Classification (DPIE 2020)
R1	<i>Eucalyptus agglomerata</i> , <i>E. dives</i> , <i>Brachyloma daphnoides</i> , <i>Lissanthe strigosa</i> , <i>Xanthorrhoea concava</i> , <i>Hardenbergia violacea</i> , <i>Lomandra filiformis</i> subsp. <i>coriacea</i> , <i>Opercularia diphylla</i> , <i>Rytidosperma tenuius</i> , <i>Goodenia hederacea</i> , <i>Microlaena stipoides</i> , <i>Einadia hastata</i>	PCT 888 Inland Scribbly Gum - Brittle Gum low woodland of the eastern tablelands, South Eastern Highlands Bioregion	<i>Eucalyptus rossii</i> , <i>E. mannifera</i> , <i>E. dives</i> , <i>E. macrorhyncha</i> , <i>Allocasuarina littoralis</i> , <i>Brachyloma daphnoides</i> , <i>Hibbertia obtusifolia</i> , <i>Melichrus urceolatus</i> , <i>Persoonia linearis</i> , <i>Dianella revoluta</i> , <i>Gonocarpus tetragynus</i> , <i>Goodenia hederacea</i> , <i>Joycea pallida</i> , <i>Lepidosperma gunnii</i> , <i>Lomandra obliqua</i> , <i>Patersonia sericea</i> , <i>L. filiformis</i> , <i>L. multiflora</i>
R2	<i>Eucalyptus globoidea</i> , <i>E. cinerea</i> , <i>E. eugenioides</i> , <i>Cassinia sifton</i> , <i>Acacia mearnsii</i> , <i>Jacksonia scoparia</i> , <i>Austrostipa densiflora</i> , <i>Microlaena stipoides</i> , <i>Wahlenbergia stricta</i> , <i>Solanum prinophyllum</i> , <i>Cheilanthes sieberi</i> , <i>Rytidosperma racemosum</i> , <i>Lachnagrostis filiformis</i> , <i>Poa sieberiana</i> , <i>Euchiton sphaericus</i> , <i>Chrysocephalum apiculatum</i> , <i>R. pallidum</i> , <i>Veronica plebeia</i>	PCT 1330 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion	<i>Eucalyptus melliodora</i> , <i>E. bridgesiana</i> , <i>E. blakelyi</i> , <i>E. dives</i> , <i>E. macrorhyncha</i> , <i>E. rubida</i> , <i>E. pauciflora</i> , <i>E. mannifera</i> , <i>E. viminalis</i> , <i>Lissanthe strigosa</i> , <i>Melichrus urceolatus</i> , <i>Bothriochloa macra</i> , <i>Gonocarpus tetragynus</i> , <i>Goodenia hederacea</i> , <i>Hydrocotyle laxiflora</i> , <i>Lomandra filiformis</i> subsp. <i>coriacea</i> , <i>Microlaena stipoides</i> , <i>Themeda triandra</i>
R3	<i>Eucalyptus agglomerata</i> , <i>E. cinerea</i> , <i>Allocasuarina littoralis</i> , <i>Cassinia sifton</i> , <i>C. aculeata</i> , <i>Lissanthe strigosa</i> , <i>Stypandra glauca</i> , <i>Gonocarpus tetragynus</i> , <i>Goodenia hederacea</i> , <i>Austrostipa densiflora</i> , <i>A. scabra</i> subsp. <i>falcata</i> , <i>Rytidosperma tenuius</i> , <i>Poa sieberiana</i> , <i>Hydrocotyle laxiflora</i> , <i>Poranthera microphylla</i> , <i>Pomax umbellata</i> , <i>Solanum prinophyllum</i> , <i>Cheilanthes sieberi</i> , <i>Wahlenbergia gracilis</i> , <i>W. stricta</i> , <i>Microtis unifolia</i> , <i>Hypericum gramineum</i> , <i>Euchiton involucratus</i> , <i>Coronidium scorpioides</i>	PCT 1150 Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion	<i>E. sieberi</i> , <i>E. agglomerata</i> , <i>E. globoidea</i> , <i>E. mannifera</i> , <i>Allocasuarina littoralis</i> , <i>Hibbertia obtusifolia</i> , <i>Persoonia linearis</i> , <i>Billardiera scandens</i> , <i>Goodenia hederacea</i> , <i>Lomandra obliqua</i> , <i>Microlaena stipoides</i> , <i>Pomax umbellata</i> , <i>Stypandra glauca</i>


Site	Key flora species in BAM plot	Closest PCT alignment (SLR)	PCT Floristics according to BioNet Vegetation Classification (DPIE 2020)
R4	Eucalyptus melliodora, E. blakelyi, Allocasuarina littoralis, Cassinia sifton, Lissanthe strigosa, Einadia nutans, Austrostipa densiflora, A. scabra subsp. falcata, Rytidosperma tenuius, Opercularia diphylla, Dichopogon strictus, Tricoryne elatior, Laxmannia gracilis, Euchiton sphaericus, Cotula australis, Oxalis radicata	PCT 1330 Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion	Eucalyptus melliodora, E. bridgesiana, E. blakelyi, E. dives, E. macrorhyncha, E. rubida, E. pauciflora, E. mannifera, E. viminalis, Lissanthe strigosa, Melichrus urceolatus, Bothriochloa macra, Gonocarpus tetragynus, Goodenia hederacea, Hydrocotyle laxiflora, Lomandra filiformis subsp. coriacea, Microlaena stipoides, Themeda triandra

A total of 62 native flora species were recorded during the 2020 flora surveys, including eight trees, eight shrubs, 27 forbs, 16 grasses (or grass-like species), one fern and two 'other' species. A total of 25 exotic flora species were recorded, three of which (*Nassella trichotoma*, *Rubus anglocandicans*, *Senecio madagascariensis*) are defined as High Threat Exotic (HTE) species under the BAM. Complete BAM Plot data, including notes on plot disturbance and management factors, is included in Appendix B.

A summary of the 2020 BAM Plot data and comparison to PCT benchmarks is provided in Table 7 and graphed in Appendix C.

Table 7 BAM Plot Data Comparisons to PCT Benchmark Data

Variable	R1	PCT 888	R2	PCT 1330	R3	PCT 1150	R4	PCT 1330
Tree count	2	5	3	4	3	5	3	4
Shrub count	2	10	4	7	4	13	3	7
Grass & grasslike count	5	7	7	9	5	7	7	9
Forb count	6	12	9	16	14	9	11	16
Fern count	0	1	1	1	1	1	0	1
Other count	2	2	0	2	0	2	0	2
Tree cover	35	43	15.1	25	30.2	48	20.6	25
Shrub cover	0.3	17	6.6	5	21.3	17	1.6	5
Grass & grasslike cover	1.8	27	26.5	37	30.8	18	1.1	37
Forb cover	1	7	6.3	9	52.3	5	1.3	9
Fern cover	0	0	0.1	0	0.2	0	0	0
Other cover	0.3	0	0	0	0	0	0	0
Total length of fallen logs	19	87	1.5	50	58	87	14	50
Litter cover	23	75	20	45	39	80	88	45
Number of large trees	0	3	0	3	0	3	1	3

 At or above PCT benchmark

3.1.2 Fauna Monitoring Results

A total of 69 fauna species were recorded during the 2020 monitoring surveys, including one frog, 17 mammals, and 51 birds. Some of these species were recorded opportunistically whilst travelling between monitoring sites, or whilst inspecting nest boxes.

The following five threatened species were recorded:

- Speckled Warbler *Chthonicola sagittata*, listed as vulnerable under the BC Act
- Large-eared Pied Bat *Chalinolobus dwyeri*, listed as vulnerable under the BC Act and EPBC Act
- Eastern False Pipistrelle *Falsistrellus tasmaniensis*, listed as vulnerable under the BC Act
- Large Bent-winged Bat *Miniopterus orianae oceanensis*, listed as vulnerable under the BC Act
- Southern Myotis *Myotis macropus*, listed as vulnerable under the BC Act

The following six exotic pest species were recorded:

- Common Myna *Acridotheres tristis*
- Starling *Sturnus vulgaris*
- Common Blackbird *Turdus merula*
- Cat *Felis catus*
- European Rabbit *Oryctolagus cuniculus*
- Fox *Vulpes vulpes*

A summary of fauna species composition per site is included in Table 8. A complete fauna species list is included in Appendix D.

Table 8 Fauna Species Composition per Monitoring Site

Fauna group	R1	R2	R3	R4
Total number of birds	19	18	20	20
Total number of frogs	0	0	0	1
Total number of mammals	11	7	9	7
Total number of reptiles	0	0	0	0
Total native	29	21	28	28
Total exotic	1	4	1	0
Total threatened species	3	1	4	2

3.2 Nest-box Monitoring Results

A total of 50 nest boxes were inspected during the winter monitoring event (See Appendix E for complete nest box inventory). Key results are summarised as follows:

- Eight nest boxes were occupied by native fauna, including: 6 Sugar Gliders *Petaurus breviceps*, one Brushtail Possum *Trichosurus vulpecula* and one Australian Wood Duck *Chenonetta jubata*.

- 41 of the 50 nest boxes contained nesting material, identified as being a mix of glider nests (leaf material), wood duck nest (bark and leaves with fragments of eggs) and bird nests (sticks and feathers).
- Two nest boxes were recorded as containing deceased Sugar Gliders. Both boxes were also occupied by either an inactive wasp nest or beehive.
- Six nest boxes were recorded as having pests. These were primarily inactive beehives and wasp nests.
- Nine nest boxes require maintenance including:
 - Two require the removal of deceased gliders; these also have inactive wasp nests/beehives requiring removal.
 - Four require inactive wasp nests/beehives to be removed.
 - Two require repositioning to a more stable branch or tree.
 - One requires a coat of paint due to fading of weather protective coating.

3.3 Hoary Sunray Monitoring Results

All populations previously mapped by Umwelt (2013) were identified as still present and within roughly the same bounds of the previous mapping, with the following exceptions or notes:

- A few additional small patches were observed in the north of the site, to the north of Joarimin Creek
- The large patches in the south of the site contained areas with little or no plants, and these patches may be able to be refined and re-mapped as a series of smaller patches

Results of the population counts, patch size and a population estimate for the site are included in Table 9. An extrapolation of the plot results estimates the population size at 30,980,340 plants. However, this is likely an over-estimate as some areas within the larger patches contained no plants, or very few plants. Increased sampling sites would result in better estimates. All Hoary Sunray Monitoring Data, including notes on disturbance and general health, is included in Appendix F.

Table 9 Hoary Sunray Counts and Extrapolated Population Estimate

Site ID	Number per 1m2	Patch Area (m ²)	Population estimate
HS1	101	7566.45	764211
HS2	36	2440.14	87845
HS3	33.5	18453.97	618207
HS4	104	53811.75	5596422
HS5	52	169143.2	8795446
HS6	150.5	9663.97	1454427
HS7	143	8764.42	1253312
HS8	25	21942.24	548556
HS9	65.5	130011.2	8515733
HS10	91.5	28452.84	2603434
HS11	39.5	18803.73	742747
Average/Total	76.5	469053.91	30980340

4 DISCUSSION

The general health of the retained vegetation at the monitoring sites is moderate, with natural regeneration occurring, particularly at sites R3 and R4. Comparison of vegetation to PCT benchmarks found most values to be below benchmark, apart from the following which were at or above benchmark:

- R1 - diversity and cover of 'other'
- R2 - diversity of 'fern', and cover of 'shrub' and 'other'
- R3 - diversity of 'forb' and 'fern', as well as cover of 'shrub', 'grass', 'forb', 'fern' and 'other'
- R4 - cover of 'fern', 'other' and 'litter'

Disturbances such as past clearing, cultivation, erosion, grazing (Kangaroos and cattle), evidence of fire, storm damage and weeds were observed at most retained vegetation monitoring sites but were determined to be inactive or minor in nature. No removal of firewood or coarse woody debris was recorded.

Fauna surveys detected a good assemblage of native species across the site, but the overwhelming majority of species recorded were birds and microchiropteran bats. One frog, 14 mammals and no reptiles were recorded. Spotlighting surveys detected very few nocturnal or arboreal species, detecting one frog (the Eastern Dwarf Frog), two birds (Kookaburra and Owlet nightjar), one native mammal (Eastern Grey Kangaroo) and three feral mammals (Fox, Cat and Rabbit). However, nest box inspections confirmed that Brushtail Possums and Sugar Gliders are present.

Anabats detected a good assemblage of microchiropteran bats (11 species) including four threatened species. Infrared cameras recorded the Eastern Grey Kangaroo, and it is thought that two of the cameras had technical issues at sites R2 and R4, as they returned no results.

One threatened species of bird was recorded, being the Speckled Warbler, which was sighted at R3 during spring morning bird surveys. Four threatened species of bats were detected being the Large-eared Pied Bat (recorded at R3 and R4), the Eastern False Pipistrelle (recorded at R1 and R3), Large Bent-winged Bat (recorded at all sites) and Southern Myotis (recorded at R1).

Nest box inspections found that most nest boxes showed evidence of usage (41 of 50), with eight being occupied during the survey. In regard to target species usage: the Squirrel Glider boxes were generally occupied by Sugar Gliders or their nesting materials; the Brushtail Possum boxes showed evidence of possum usage but were also being used by the Australian Wood Duck; the Ringtail Possum boxes were used by the Australian Wood Duck; the bat boxes were unsuccessful and showed no evidence of usage; the Owlet Nightjar boxes appeared to be used by gliders; and Rosella boxes all showed evidence of bird usage. In relation to maintenance six boxes require pest removal (two of which also require removal of deceased gliders), two require repositioning and one requires recoating/painting.

The Hoary Sunray population is in good health with a very large population estimated. Most plots showed minor weed presence and four sites (HS2, HS3, HS4, HS9) were noted as showing possible competition with native plants (*Cassinia* sp., *Leptospermum* sp., *Austrostipa* sp.) and weeds. Two Hoary Sunray monitoring sites which were also noted as being heavily grazed in the past (sites that are adjacent to the Marulan Waste Management Centre) have evidence of minor erosion and rubbish was being blow into HS8, evidently from the waste centre.

5 CONCLUSION AND RECOMMENDATIONS

The 2020 ecological monitoring of Holcim quarry has collected data with respect to:

- Condition of vegetation and fauna assemblages in areas of retained vegetation
- Usage and condition of nest boxes
- Counts and condition of populations of the Hoary Sunray

The areas of retained vegetation are generally in moderate to good condition and no immediate actions are necessary, other than control of Serrated Tussock grass which is already occurring across the site. Results of the BAM plot surveys can be used as benchmark for the areas of rehabilitation across the site, complemented by PCT benchmark comparisons. It is recommended that rehabilitation areas are surveyed using BAM plots and methods required by the Rehabilitation and Landscape Plan (Umwelt 2018) to determine whether any corrective action, or additional works are required.

Fauna results show a good assemblage of fauna species across the site. Feral pest monitoring is recommended due to records of rabbits, foxes and cats. The aim of the feral pest monitoring would be to determine whether there are large numbers or dens/burrows occurring on site and to implement control (shooting or baiting) where necessary and in liaison with the appropriate government departments and neighbouring property owners.

Nest box monitoring indicates a high rate of usage by native fauna and general good condition of most nest boxes. However, presence of feral bees and wasps was moderately common in squirrel glider boxes along Joarimin Creek and has evidently resulted in the death of two gliders. Removal of pests and ongoing monitoring of the boxes, particularly along Joarimin Creek, is recommended to prevent further impacts on the native fauna using the boxes. It is also recommended that two of the boxes are repositioned and one box receives a recoat/repaint.

Hoary Sunray populations are in good health and key factors for monitoring are the occurrence of weeds and native plants which could smother/outcompete the plants. It is also recommended that a remapping/map-refining exercise is incorporated into the next monitoring survey so that more accurate population estimates can be made. Additional survey sites could also be incorporated.

The rehab plan (Umwelt 2018) provides the following schedule regarding ecological monitoring:

- Retained vegetation is to be monitored at “Year 1 of Project and then every three years. If monitoring is positive for 3 consecutive periods, it can be extended to once every 10 years”.
- Fauna monitoring is to be undertaken at “Year 1 of Project and then every three years thereafter. If monitoring is positive for 3 consecutive periods, it can be extended to once every 10 years.”
- “Representative nest box monitoring will be undertaken annually for a period of 5 years. After the first 5 years, condition inspections of nest box condition will be undertaken once every 4 years”.

It is recommended that three yearly flora and fauna monitoring and annual nest box inspection are undertaken as per the schedule. It is also recommended that three yearly Hoary Sunray monitoring occurs alongside the flora and fauna monitoring. Thus, the next monitoring survey should be schedule for winter/spring 2023 and a nest box survey should be schedule for winter/spring 2021.

6 REFERENCES

- BOM 2021, 'Climate Data Online', Australian Government Bureau of Meteorology, Available at: <http://www.bom.gov.au/climate/data/index.shtml?bookmark=200&view=map> [January 2021].
- DPIE 2020, 'Biodiversity Assessment Method', Department of Planning Industry and Environment, Paramatta, NSW, Available at: <https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-assessment-method> [February 2021]
- DPIE 2021, 'BioNet Vegetation Classification', Available at: [February 2021]
- Tozer et al. 2010, 'Southeast NSW Native Vegetation Classification and Mapping - SCIVI VIS_ID 2230 20030101', Bioregional Assessment Source Dataset, NSW Department of Environment, Climate Change and Water.
- Umwelt 2005, 'Ecological Assessment, Proposed Lynwood Quarry, Marulan', Umwelt (Australia) Pty Limited.
- Umwelt 2013, 'Lynwood Quarry - Box Gum Woodland Management Plan', Umwelt (Australia) Pty Limited, Teralba, NSW.
- Umwelt 2018, 'Lynwood Quarry Rehabilitation and Landscape Management Plan Revision 2', Umwelt (Australia) Pty Limited, Toronto, NSW.

APPENDIX A

BioNet Vegetation Classification Profile and Benchmark Data

BioNet Vegetation Classification - Community Profile Report

Plant Community Type ID (PCT ID): 888

PCT Name: Inland Scribbly Gum - Brittle Gum low woodland of the eastern tablelands, South Eastern Highlands Bioregion

Classification Confidence Level: 5-Very Low

Vegetation Description: Other Diagnostics Features: Low woodland or open forest with open understorey of sclerophyll shrubs and ground layer of sedges, grass and forbs.; LandscapePosition: Occurs on sandy loams mainly derived from fine-grained sedimentary rocks on low ridges of the tableland between 550 and 800m from Moss Vale to Braidwood.

Variation and Natural Disturbance:

Vegetation Formation: Dry Sclerophyll Forests (Shrubby sub-formation);

Vegetation Class: Southern Tableland Dry Sclerophyll Forests;

IBRA Bioregion(s): South East Corner; South Eastern Highlands; Sydney Basin;

IBRA Sub-region(s): South East Coastal Ranges; Murrumbateman; Bungonia; Crookwell; Kybeyan-Gourock; Monaro; Burragarang; Moss Vale; Ettrema;

LGA: Not Assessed

Lithology: Not Assessed

Landform Pattern: Not Assessed

Landform Element: Not Assessed

Emergent species: None

Upper Stratum Species: Eucalyptus rossii; Eucalyptus mannifera; Eucalyptus dives; Eucalyptus macrorhyncha;

Mid Stratum Species: Allocasuarina littoralis; Brachyloma daphnoides; Hibbertia obtusifolia; Melichrus urceolatus; Persoonia linearis;

Ground Stratum Species: Dianella revoluta var. revoluta; Gonocarpus tetragynus; Goodenia hederacea; Joycea pallida; Lepidosperma gunnii; Lomandra obliqua; Patersonia sericea; Lomandra filiformis; Lomandra multiflora;

Diagnostic Species: Not Assessed

Fire Regime:

TEC Assessed: No associated TEC

TEC List: Not Assessed

Associated TEC Comments: 20170315: There are currently no TECs associated with this PCT.

PCT Percent Cleared: 60.00

PCT Definition Status: Approved

Community Condition Benchmarks			
Vegetation Class	Southern Tableland Dry Sclerophyll Forests	Southern Tableland Dry Sclerophyll Forests	Southern Tableland Dry Sclerophyll Forests
IBRA	South Eastern Highlands	South East Corner	Sydney Basin
Benchmark Calculation Level	Class/IBRA	Class/IBRA	Class/IBRA
Tree Richness	5	5	5
Shrub Richness	10	13	15
Grass and Grass Like Richness	7	7	7
Forb Richness	12	10	13
Fern Richness	1	1	1
Other Richness	2	3	3
Tree Cover	43.0	36.0	68.0
Shrub Cover	17.0	40.0	39.0
Grass and Grass Like Cover	27.0	22.0	23.0
Forb Cover	7.0	5.0	6.0
Fern Cover	0.0	0.0	0.0
Other Cover	0.0	1.0	1.0
Total length of fallen logs	87	85	85
Litter Cover	75	74	74
Number of Large Trees	3.0	3.0	3.0
Large Tree Threshold Size	50	50	50

BioNet Vegetation Classification - Community Profile Report

Plant Community Type ID (PCT ID): 1330

PCT Name: Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion

Classification Confidence Level: 5-Very Low

Vegetation Description: Other Diagnostics Features: Woodland with a sparse shrub layer and dense grassy groundcover.;

LandscapePosition: Occurs on loamy soils on undulating terrain between 500 and 900m on the tablelands.

Variation and Natural Disturbance:

Vegetation Formation: Grassy Woodlands;

Vegetation Class: Southern Tableland Grassy Woodlands;

IBRA Bioregion(s): NSW South Western Slopes; South East Corner; South Eastern Highlands; Sydney Basin;

IBRA Sub-region(s): Inland Slopes; South East Coastal Ranges; Murrumbateman; Bungonia; Kanangra; Crookwell; Oberon; Bathurst; Orange; Hill End; Bondo; Kybeyan-Gourock; Monaro; Wollemi; Burragorang; Capertee Valley; Capertee Uplands;

LGA: Not Assessed

Lithology: Not Assessed

Landform Pattern: Not Assessed

Landform Element: Not Assessed

Emergent species: None

Upper Stratum Species: Eucalyptus melliodora; Eucalyptus bridgesiana; Eucalyptus blakelyi; Eucalyptus dives; Eucalyptus macrorhyncha; Eucalyptus rubida subsp. rubida; Eucalyptus pauciflora; Eucalyptus mannifera; Eucalyptus viminalis;

Mid Stratum Species: Lissanthe strigosa; Melichrus urceolatus;

Ground Stratum Species: Bothriochloa macra; Gonocarpus tetragynus; Goodenia hederacea; Hydrocotyle laxiflora; Lomandra filiformis subsp. coriacea; Microlaena stipoides var. stipoides; Themeda australis;

Diagnostic Species: Not Assessed

Fire Regime:

TEC Assessed: Has associated TEC

TEC List: Listed BC Act,CE: White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (Equivalent); Listed EPBC Act,CE: White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (Equivalent);

Associated TEC Comments:

PCT Percent Cleared: 94.00

PCT Definition Status: Approved

Community Condition Benchmarks				
Vegetation Class	Southern Tableland Grassy Woodlands	Southern Tableland Grassy Woodlands	Southern Tableland Grassy Woodlands	Southern Tableland Grassy Woodlands
IBRA	South Eastern Highlands	South East Corner	NSW South Western Slopes	Sydney Basin
Benchmark Calculation Level	Class/IBRA	Class/IBRA	Class/IBRA	Class/IBRA
Tree Richness	4	4	4	5
Shrub Richness	7	8	6	10
Grass and Grass Like Richness	9	9	8	10
Forb Richness	16	14	10	16
Fern Richness	1	1	1	1
Other Richness	2	3	1	3
Tree Cover	25.0	22.0	41.0	39.0
Shrub Cover	5.0	13.0	2.0	12.0
Grass and Grass Like Cover	37.0	33.0	27.0	32.0
Forb Cover	9.0	8.0	8.0	9.0
Fern Cover	0.0	0.0	0.0	0.0
Other Cover	0.0	1.0	0.0	1.0
Total length of fallen logs	50	50	50	50
Litter Cover	45	45	45	45
Number of Large Trees	3.0	3.0	3.0	3.0
Large Tree Threshold Size	50	50	50	50

BioNet Vegetation Classification - Community Profile Report

Plant Community Type ID (PCT ID): 1150

PCT Name: Silvertop Ash - Blue-leaved Stringybark shrubby open forest on ridges, north east South Eastern Highlands Bioregion

Classification Confidence Level: 5-Very Low

Vegetation Description: Other Diagnostics Features: Open forest with an open understorey of sclerophyll shrubs and ground layer of sedges and forbs.; LandscapePosition: Occurs on sandy loams on ridges on the eastern margin of the tableland between 550 and 900m altitude.

Variation and Natural Disturbance:

Vegetation Formation: Dry Sclerophyll Forests (Shrubby sub-formation);

Vegetation Class: South East Dry Sclerophyll Forests;

IBRA Bioregion(s): South Eastern Highlands; Sydney Basin;

IBRA Sub-region(s): Bungonia; Kanangra; Crookwell; Monaro; Burratorang; Moss Vale; Ettrema;

LGA: Not Assessed

Lithology: Not Assessed

Landform Pattern: Not Assessed

Landform Element: Not Assessed

Emergent species: None

Upper Stratum Species: Eucalyptus sieberi; Eucalyptus agglomerata; Eucalyptus globoidea; Eucalyptus mannifera;

Mid Stratum Species: Allocasuarina littoralis; Hibbertia obtusifolia; Persoonia linearis;

Ground Stratum Species: Billardiera scandens; Goodenia hederacea; Lomandra obliqua; Microlaena stipoides var. stipoides; Pomax umbellata; Stypantra glauca;

Diagnostic Species: Not Assessed

Fire Regime:

TEC Assessed: No associated TEC

TEC List: Not Assessed

Associated TEC Comments: 20170315: There are currently no TECs associated with this PCT.

PCT Percent Cleared: 40.00

PCT Definition Status: Approved

Community Condition Benchmarks		
Vegetation Class	South East Dry Sclerophyll Forests	South East Dry Sclerophyll Forests
IBRA	South Eastern Highlands	Sydney Basin
Benchmark Calculation Level	Class/IBRA	Class/IBRA
Tree Richness	5	5
Shrub Richness	13	20
Grass and Grass Like Richness	7	8
Forb Richness	9	9
Fern Richness	1	2
Other Richness	2	4
Tree Cover	48.0	71.0
Shrub Cover	17.0	39.0
Grass and Grass Like Cover	18.0	15.0
Forb Cover	5.0	4.0
Fern Cover	0.0	1.0
Other Cover	0.0	1.0
Total length of fallen logs	87	45
Litter Cover	80	65
Number of Large Trees	3.0	3.0
Large Tree Threshold Size	50	50

APPENDIX B

BAM Plot Data

Table B1 BAM Plot Composition Attributes - Floristics (400m² plot)

Growth Form/ HTE status	Scientific Name	R1 2020		R2 2020		R3 2020		R4 2020	
		Cover	Abun	Cover	Abun	Cover	Abun	Cover	Abun
Shrub	<i>Acacia mearnsii</i>	0	0	0.5	2	0	0	0	0
-	<i>Aira caryophyllea</i>	0	0	0	0	0	0	0.1	3
Tree	<i>Allocasuarina littoralis</i>	0	0	0	0	0.1	1	0.1	3
Grass & grasslike	<i>Aristida vagans</i>	0	0	0	0	0	0	0.1	1
Grass & grasslike	<i>Austrostipa densiflora</i>	0.1	1	25	1000	25	200	0.5	20
Grass & grasslike	<i>Austrostipa scabra</i> subsp. <i>falcata</i>	0	0	0	0	5	50	0.1	10
Shrub	<i>Brachyloma daphnoides</i>	0.1	2	0	0	0	0	0	0
Grass & grasslike	<i>Carex inversa</i>	0	0	0	0	0	0	0.1	1
Shrub	<i>Cassinia aculeata</i>	0	0	0	0	1	2	0	0
Shrub	<i>Cassinia sifton</i>	0	0	5	12	20	50	0.5	10
-	<i>Centaurium erythraea</i>	0	0	0.1	1	0.1	2	0	0
Fern	<i>Cheilanthes sieberi</i>	0	0	0.1	10	0.2	10	0	0
Forb	<i>Chrysocephalum apiculatum</i>	0	0	0.1	3	0	0	0	0
-	<i>Cirsium vulgare</i>	0	0	0.1	5	0	0	0	0
-	<i>Conyza bonariensis</i>	0	0	0.2	10	0.1	2	0.1	1
Forb	<i>Coronidium scorpioides</i>	0	0	0	0	0.1	2	0	0
Forb	<i>Cotula australis</i>	0	0	0	0	0	0	0.1	2
Forb	<i>Crassula sieberiana</i>	0.1	1	0	0	0	0	0.1	10
Forb	<i>Dianella longifolia</i>	0	0	0.1	1	0	0	0	0
Forb	<i>Dichopogon strictus</i>	0	0	0	0	0	0	0.1	20
Grass & grasslike	<i>Echinopogon caespitosus</i>	0	0	0	0	0.1	1	0	0
-	<i>Echium plantagineum</i>	0	0	0.1	1	0	0	0	0
Forb	<i>Einadia hastata</i>	0.1	3	0	0	0	0	0.1	1
Forb	<i>Einadia nutans</i>	0	0	0	0	0	0	0.1	2
Grass & grasslike	<i>Entolasia stricta</i>	0.1	1	0	0	0	0	0	0
Tree	<i>Eucalyptus agglomerata</i>	25	5	0	0	30	20	0	0
Tree	<i>Eucalyptus blakelyi</i>	0	0	0	0	0	0	0.5	5
Tree	<i>Eucalyptus cinerea</i>	0	0	5	2	0.1	1	0	0
Tree	<i>Eucalyptus eugenioides</i>	0	0	0.1	1	0	0	0	0
Tree	<i>Eucalyptus dives</i>	10	3	0	0	0	0	0	0
Tree	<i>Eucalyptus globoidea</i>	0	0	10	3	0	0	0	0
Tree	<i>Eucalyptus melliodora</i>	0	0	0	0	0	0	20	10
Forb	<i>Euchiton involucratus</i>	0	0	0	0	0.1	5	0	0
Forb	<i>Euchiton sphaericus</i>	0	0	5	500	0	0	0.1	2
-	<i>Facelis retusa</i>	0	0	0	0	0.1	1	0	0
-	<i>Gamochaeta calviceps</i>	0	0	0.1	10	0.1	10	0.1	1
Forb	<i>Goodenia hederacea</i>	0.1	10	0	0	0.1	10	0	0
Forb	<i>Gonocarpus tetragynus</i>	0.1	1	0	0	10	50	0	0
Other	<i>Hardenbergia violacea</i>	0.1	3	0	0	0	0	0	0

Growth Form/ HTE status	Scientific Name	R1 2020		R2 2020		R3 2020		R4 2020	
		Cover	Abun	Cover	Abun	Cover	Abun	Cover	Abun
Forb	<i>Hydrocotyle laxiflora</i>	0	0	0	0	5	100	0	0
Forb	<i>Hypericum gramineum</i>	0	0	0	0	0.1	20	0	0
-	<i>Hypochaeris radicata</i>	0.1	1	0	0	0	0	0.1	6
Shrub	<i>Jacksonia scoparia</i>	0	0	1	2	0	0	0	0
Grass & grasslike	<i>Juncus sarophorus</i>	0	0	0	0	0	0	0.1	3
Shrub	<i>Kunzea parvifolia</i>	0	0	0	0	0	0	0.1	1
Grass & grasslike	<i>Lachnagrostis filiformis</i>	0	0	0.1	5	0	0	0	0
-	<i>Lactuca serriola</i>	0	0	0.1	1	0	0	0	0
Forb	<i>Laxmannia gracilis</i>	0	0	0	0	0	0	0.1	5
-	<i>Lepidium africanum</i>	0	0	0.1	1	0	0	0	0
Shrub	<i>Lissanthe strigosa</i>	0.2	2	0.1	1	0.2	3	1	4
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	1	40	0	0	0	0	0	0
Grass & grasslike	<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	0	0	0	0	0	0	0.1	1
Grass & grasslike	<i>Lomandra multiflora</i>	0	0	0.1	1	0	0	0	0
-	<i>Lysimachia arvensis</i>	0	0	0.2	15	0.1	10	0	0
Grass & grasslike	<i>Microlaena stipoides</i>	0.1	5	1	50	0	0	0	0
Forb	<i>Microtis unifolia</i>	0	0	0	0	0.1	40	0	0
HTE	<i>Nassella trichotoma</i>	0	0	0	0	0	0	0.1	2
Shrub	<i>Olearia viscidula</i>	0	0	0	0	0.1	1	0	0
-	<i>Onopordum acanthium</i>	0	0	0	0	0.1	1	0	0
Forb	<i>Opercularia diphylla</i>	0.5	10	0	0	0	0	0.3	20
Forb	<i>Oxalis radicata</i>	0	0	0.1	15	5	100	0.1	5
-	<i>Paronychia brasiliensis</i>	0	0	1	100	0	0	0.1	4
-	<i>Plantago lanceolata</i>	0	0	0.1	10	0.1	10	0	0
Grass & grasslike	<i>Poa sieberiana</i>	0	0	0.1	5	0.2	5	0	0
Forb	<i>Pomax umbellata</i>	0	0	0	0	1	100	0	0
Forb	<i>Poranthera microphylla</i>	0	0	0	0	5	50	0	0
HTE	<i>Rubus anglocandicans</i> (R. <i>fruticosus</i>)	0	0	0.1	1	0	0	0	0
-	<i>Rumex acetosella</i>	0.5	20	5	500	0	0	0.1	3
Grass & grasslike	<i>Rytidosperma pallidum</i>	0	0	0.1	2	0	0	0	0
Grass & grasslike	<i>Rytidosperma racemosum</i>	0	0	0.1	10	0	0	0	0
Grass & grasslike	<i>Rytidosperma tenuius</i>	0.5	10	0	0	0.5	20	0.1	5
HTE	<i>Senecio madagascariensis</i>	0	0	0	0	0	0	0.1	2
Forb	<i>Senecio quadridentatus</i>	0	0	0.1	20	0	0	0	0
-	<i>Solanum nigrum</i>	0	0	0.1	10	0	0	0.1	2
Forb	<i>Solanum prinophyllum</i>	0	0	0.2	20	0.5	15	0	0
-	<i>Sonchus olearceus</i>	0	0	0.1	1	0.1	5	0.1	1
Forb	<i>Stypantra glauca</i>	0	0	0	0	25	50	0	0
-	<i>Taraxacum officinale</i>	0	0	5	500	0.5	50	0	0
Forb	<i>Tricoryne elatior</i>	0	0	0	0	0	0	0.1	15

Growth Form/ HTE status	Scientific Name	R1 2020		R2 2020		R3 2020		R4 2020	
		Cover	Abun	Cover	Abun	Cover	Abun	Cover	Abun
-	Trifolium arvense	0	0	0.5	50	0	0	0	0
-	Trifolium campestre	0	0	0.1	1	0	0	0	0
-	Trifolium glomeratum	0	0	0.2	20	0	0	0	0
Forb	Veronica plebeia	0	0	0.1	2	0	0	0	0
-	Vulpia myuros	0	0	0	0	0	0	0.1	1
Forb	Wahlenbergia gracilis	0.1	1	0.1	20	0.2	50	0	0
Forb	Wahlenbergia stricta	0	0	0.5	50	0.1	20	0.1	10
Other	Xanthorrhoea concava	0.2	10	0	0	0	0	0	0

Table B2 BAM Plot Structure Attributes - Count of Native Richness and Sum of Cover (400m² plot)

Growth Form/ HTE status	Count of Native Richness				Sum of Cover of native vascular plants			
	R1 2020	R2 2020	R3 2020	R4 2020	R1 2020	R2 2020	R3 2020	R4 2020
Tree	2	3	3	3	35	15.1	30.2	20.6
Shrub	2	4	4	3	0.3	6.6	21.3	1.6
Grass & grasslike	5	7	5	7	1.8	26.5	30.8	1.1
Forb	6	9	14	11	1	6.3	52.3	1.3
Fern	0	1	1	0	0	0.1	0.2	0
Other	2	0	0	0	0.3	0	0	0
High Threat Exotic	NA	NA	NA	NA	0	0.1	0	0.2

Table B3 BAM Plot Function Attributes – Tree Stems and Hollows (1000m² plot)

DBH (cm)	Number of tree stems				Number of tree stems with hollows			
	R1 2020	R2 2020	R3 2020	R4 2020	R1 2020	R2 2020	R3 2020	R4 2020
>80	0	0	0	1	0	0	0	0
50 to 79	2	1	2	2	0	0	0	0
30 to 49	7	7	16	3	0	1	13	0
20 to 29	9	6	7	5	0	0	2	0
10 to 19	7	8	4	13	0	0	0	0
5 to 9	0	2	3	10	0	0	0	0
<5	5	0	1	23	0	0	0	0

Table B4 BAM Plot Function Attributes - Ground Cover Other (1m² plots)

Distance	Litter				Bare ground				Cryptogram				Rock			
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4
5	40	30	70	95	40	0	5	0	0	0	0	0	20	40	0	0
15	30	5	50	100	50	5	0	0	0	5	0	0	10	0	0	0
25	35	30	40	70	50	0	5	20	0	0	0	10	10	15	0	0
35	5	20	20	80	5	0	10	20	0	0	5	0	90	0	5	0
45	5	15	15	95	85	0	15	5	0	0	0	0	5	0	0	0
Average	23	20	39	88	46	1	7	9	0	1	1	2	27	11	1	0

Table B5 BAM Plot Function Attributes - Length of Logs (1000m² plot)

	R1 2020	R2 2020	R3 2020	R4 2020
Length of logs (m)	19	1.5	58	14

Table B6 BAM Plot Disturbance and Management Notes – Severity and Age Codes (1000m² plot)

Factor	Severity Code				Age Code			
	R1	R2	R3	R4	R1	R2	R3	R4
Clearing (inc logging)	2	1	2	2	NR	O	NR	NR
Cultivation (inc pasture)	0	1	0	0	-	O	-	-
Soil erosion	1	0	0	1	NR	-	-	R
Firewood/CWD removal	0	0	0	0	-	-	-	-
Grazing (native/stock)	1	1	1	1	R	R	R	R
Fire damage	0	1	1	1	-	O	NR	NR
Storm damage	1	1	2	1	R	NR	NR	NR
Weediness	1	1	1	1	R	R	R	R
Other (stock, feral animals, vehicle, human)	1	2	0	0	NR	NR	-	-
Site management (fencing, weed control)	0	1	0	0	-	NR	-	-
General Heath	2	2	2	2	-	-	-	-
Regeneration	1	1	2	2	R	R	R	R

KEY: Severity: 0 = no evidence, 1=light/low, 2=moderate, 3=severe/good Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Table B7 BAM Plot Disturbance and Management Notes – Observations (1000m² plot)

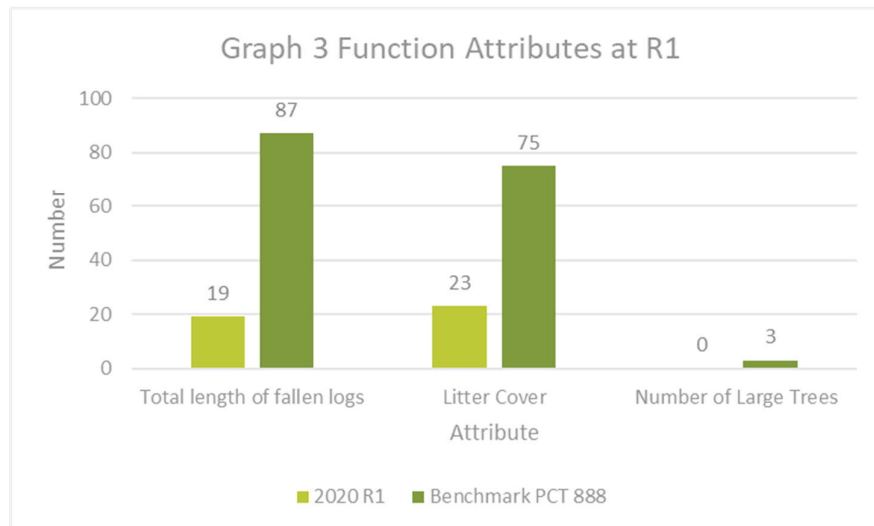
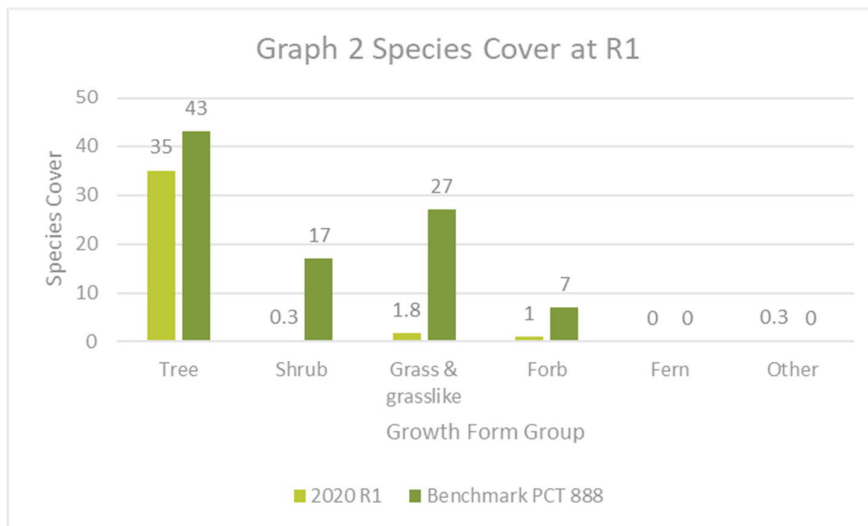
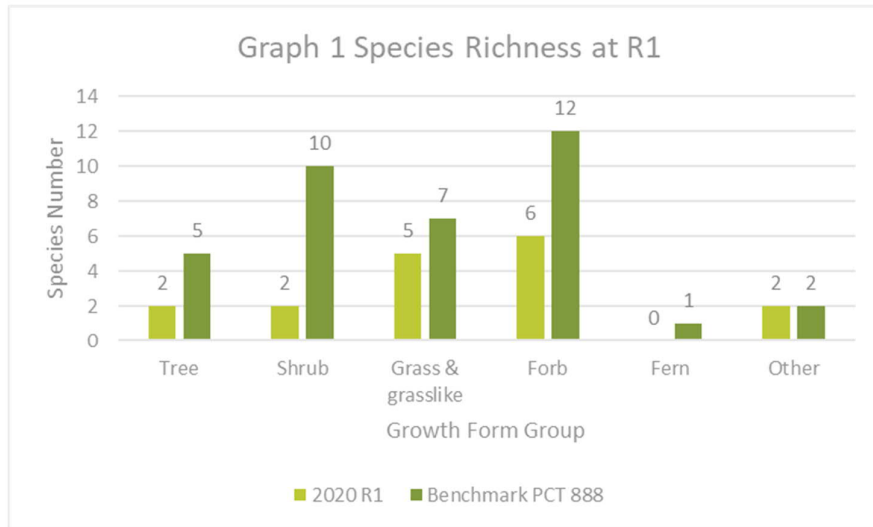
Factor	Observational Evidence			
	R1	R2	R3	R4
Clearing	Cut stumps and limbs	None	None	None
Cultivation	None	Clovers and pasture grasses	None	None
Soil erosion	Minor sheet erosion	None	None	Minor sheet erosion
Firewood removal	Cut limbs on ground	None	None	None
Grazing	Kangaroo	Kangaroo, stock grazing	Kangaroos, stock grazing	Goat droppings, Kangaroos
Fire damage	None	Light, epicormic growth	Charring, epicormic growth	Charring on eucalypts
Storm damage	Some dead trees	Broken branches/trees	Broken branches/trees	None
Weediness	Annuals and Serrated Tussock seed heads	None	Annuals and Tussock Grass	
Other	Logging only	None	None	None
Site management	None	Area has been fenced off	None	None
General Heath	None	Tree dieback, hollows, minimal regeneration	None	None
Regeneration	None	Little to no regeneration	Canopy and shrubs	Canopy and shrubs

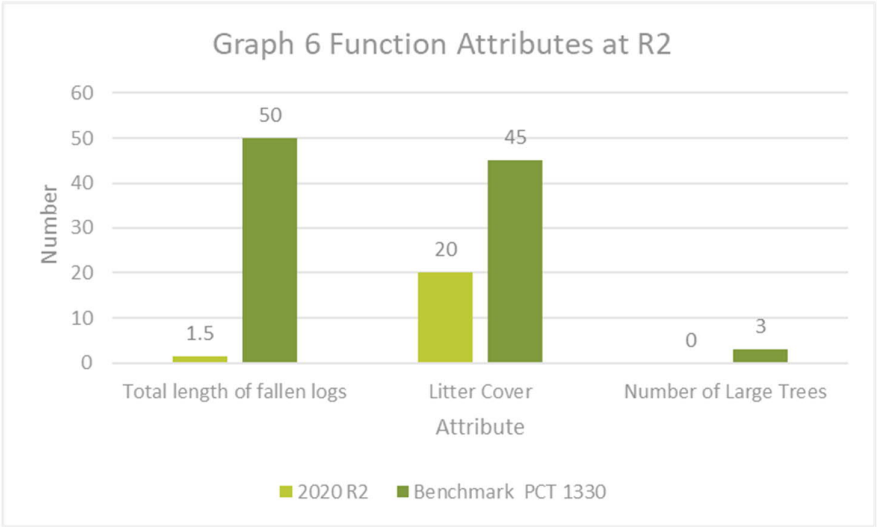
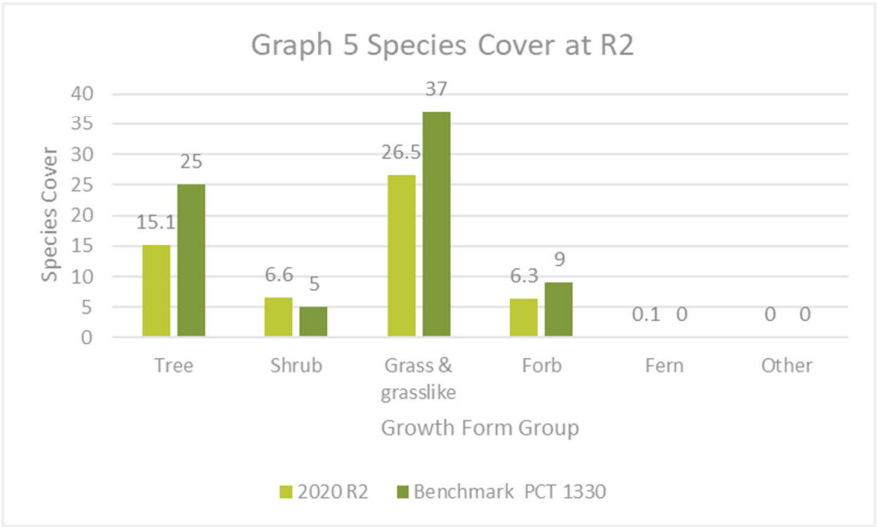
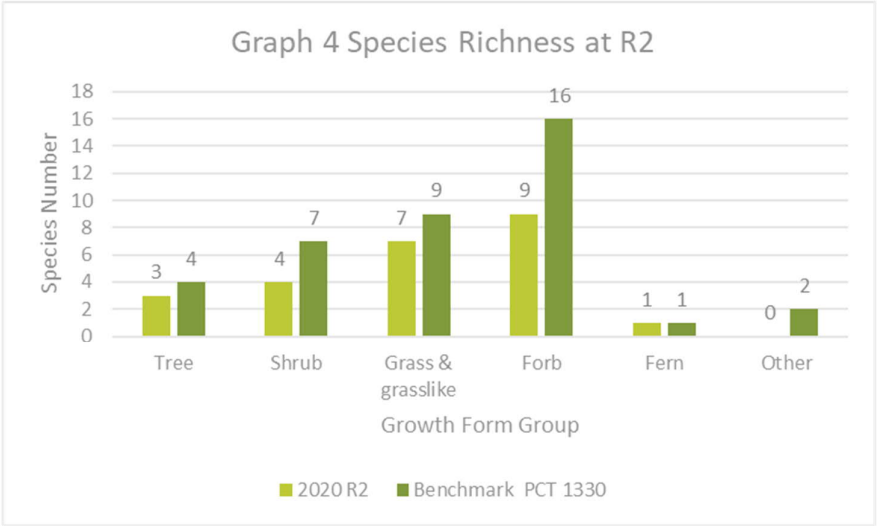
Table B8 BAM Plot Photographs from start and end of 50 m transect

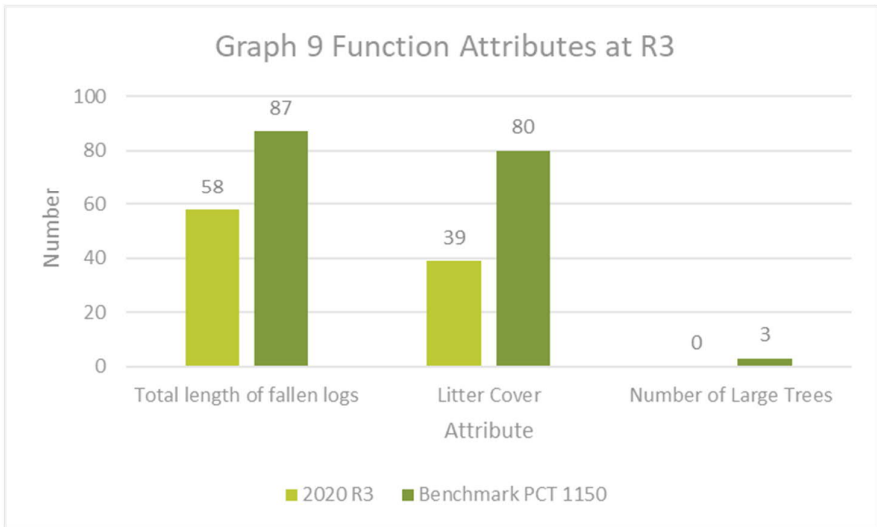
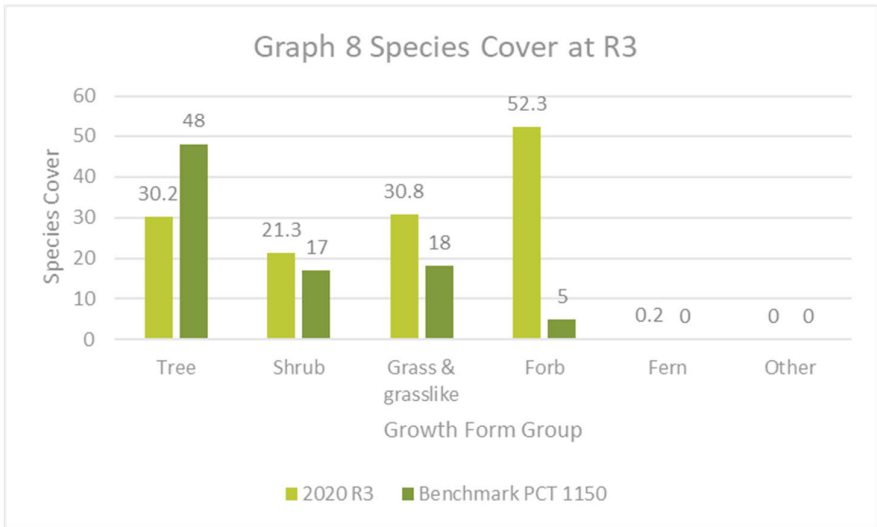
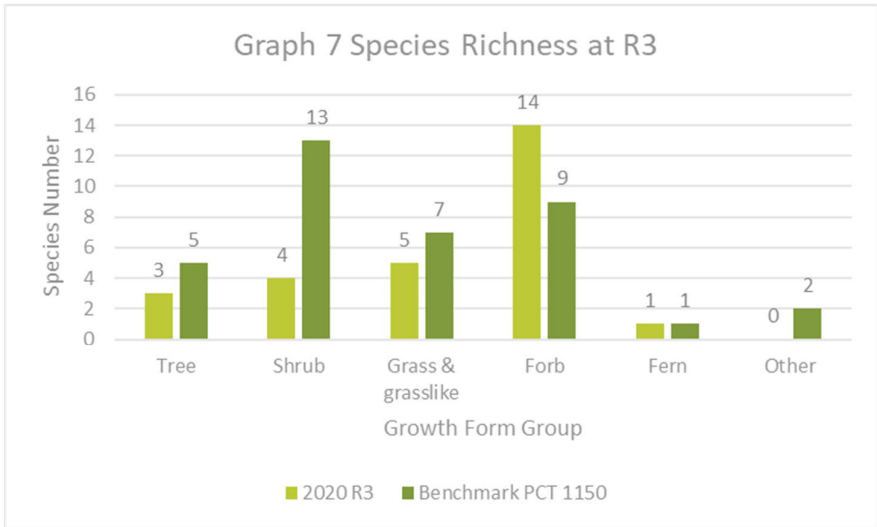
Site	Start of Transect	End of Transect
R1		
R2		
R3		
R4		

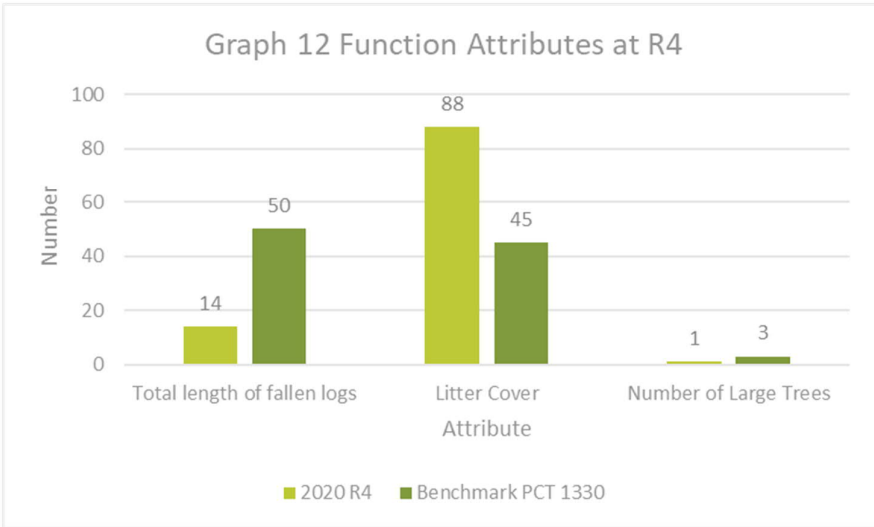
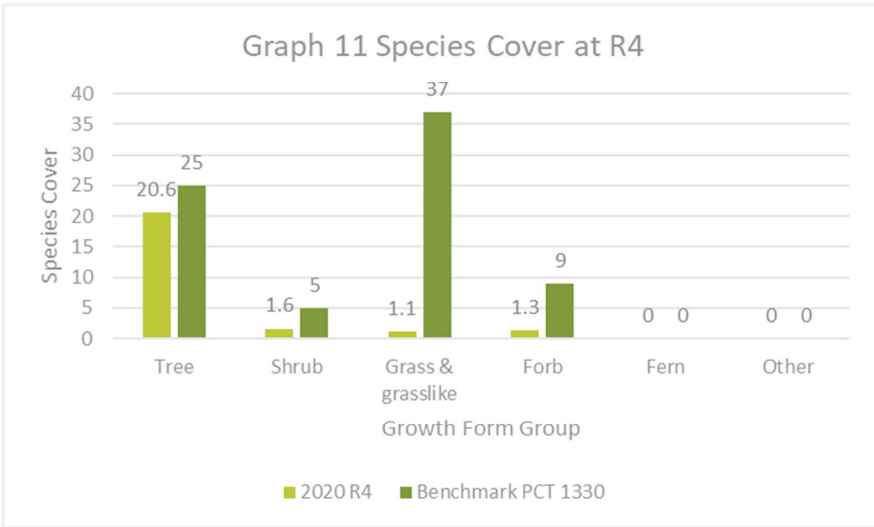
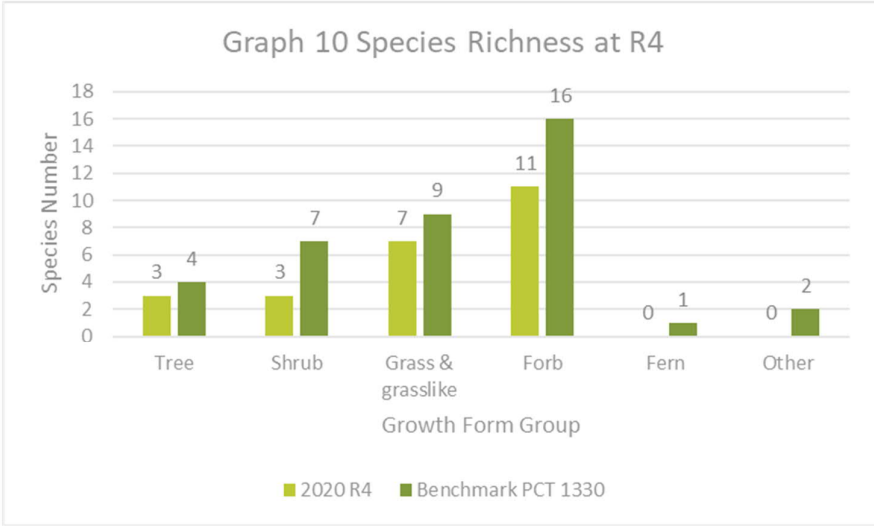
APPENDIX C

BAM Plot Attribute Comparison Graphs









APPENDIX D

Fauna Species List

Table D1 Fauna Species List - Birds

Status	Scientific Name	Common Name	Observation Type	R1	R2	R3	R4
Native	<i>Rhipidura leucophrys</i>	Willie Wagtail	Sighted	✓			✓
Native	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	Sighted				✓
Native	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill	Sighted				✓
Native	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	Sighted			✓	
Exotic	<i>Acridotheres tristis</i>	Common Myna	Sighted	✓	✓		
Native	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	Spotlighted				✓
Native	<i>Alisterus scapularis</i>	Australian King-Parrot	Sighted		✓		
Native	<i>Anas superciliosa</i>	Pacific Black Duck	Sighted		✓		
Native	<i>Anthochaera carunculata</i>	Red Wattlebird	Sighted	✓			
Native	<i>Anthus novaeseelandiae</i>	Australian Pipit	Sighted				
Native	<i>Aquila audax</i>	Wedge-tailed Eagle	Sighted		✓		
Native	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	Sighted				✓
Native	<i>Cacomantis pallidus</i>	Pallid Cuckoo	Sighted				✓
Native	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-cockatoo	Sighted	✓			
Native	<i>Chenonetta jubata</i>	Australian Wood Duck	Sighted, nest box			✓	✓
Native	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	Sighted			✓	✓
Native	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo Shrike	Sighted				
Native	<i>Corcorax melanorhamphos</i>	White-winged Chough	Sighted				✓
Native	<i>Cormobates leucophaea</i>	White throated Treecreeper	Sighted			✓	✓
Native	<i>Corvus coronoides</i>	Australian Raven	Sighted	✓	✓	✓	
Native	<i>Corvus orru</i>	Torresian Crow	Sighted	✓		✓	✓
Native	<i>Cracticus tibicen</i>	Australian Magpie	Sighted	✓	✓	✓	
Native	<i>Cracticus torquatus</i>	Grey Butcherbird	Sighted	✓		✓	✓
Native	<i>Cygnus atratus</i>	Black Swan	Sighted				
Native	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	Spotlighted	✓			✓
Native	<i>Elsayornis melanops</i>	Black-fronted Dotterel	Sighted				
Native	<i>Eolophus roseicapilla</i>	Galah	Sighted	✓	✓	✓	
Native	<i>Eopsaltria australis</i>	Eastern Yellow Robin	Sighted				✓
Native	<i>Grallina cyanoleuca</i>	Magpie Lark	Sighted	✓	✓	✓	✓
Native	<i>Gymnorhina tibicen</i>	Australian Magpie	Sighted	✓	✓	✓	✓
Native	<i>Hirundo neoxena</i>	Welcome Swallow	Sighted	✓			
Native	<i>Lichmera indistincta</i>	Brown Honeyeater	Sighted			✓	
Native	<i>Malurus cyaneus</i>	Superb Fairy-wren	Sighted				
Native	<i>Malurus lamberti</i>	Variegated Fairy-wren	Sighted				✓
Native	<i>Manorina melanocephala</i>	Noisy Miner	Sighted	✓	✓	✓	✓
Native	<i>Neochmia temporalis</i>	Red-browed Finch	Sighted				
Native	<i>Ocyphaps lophotes</i>	Crested Pigeon	Sighted		✓	✓	✓
Native	<i>Pachycephala rufiventris</i>	Rufous Whistler	Sighted			✓	
Native	<i>Pardalotus punctatus</i>	Spotted Pardalote	Sighted		✓	✓	
Native	<i>Philemon corniculatus</i>	Noisy Friarbird	Sighted	✓		✓	

Status	Scientific Name	Common Name	Observation Type	R1	R2	R3	R4
Native	<i>Platycercus elegans</i>	Crimson Rosella	Sighted			✓	
Native	<i>Platycercus eximius</i>	Eastern Rosella	Sighted	✓	✓		
Native	<i>Psephotus haematonotus</i>	Red-rumped Parrot	Sighted	✓	✓		
Vulnerable	<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	Sighted			✓	
Native	<i>Rhipidura leucophrys</i>	Willy Wagtail	Sighted	✓			
Native	<i>Smicromis brevirostris</i>	Weebill	Sighted		✓		
Native	<i>Strepera graculina</i>	Pied Currawong	Sighted	✓	✓	✓	✓
Exotic	<i>Sturnus vulgaris</i>	Starling	Sighted		✓		
Native	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	Sighted				
Exotic	<i>Turdus merula</i>	Common Blackbird	Sighted		✓		
Native	<i>Vanellus miles</i>	Masked Lapwing	Sighted				

Table D2 Fauna Species List - Mammals

Status	Scientific Name	Common Name	Observation type	R1	R2	R3	R4
Native	<i>Austronomus australis</i>	White-striped Free-tail Bat	Anabat (confident)	✓	✓	✓	✓
Vulnerable	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Anabat (probable)			✓	✓
Native	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	Anabat (confident)	✓	✓	✓	✓
Native	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	Anabat (confident)	✓	✓	✓	✓
Vulnerable	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Anabat (confident)	✓		✓	
Exotic	<i>Felis catus</i>	Cat	Spotlighted				
Native	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	Spotlighted, IR camera	✓		✓	✓
Vulnerable	<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	Anabat (confident)	✓	✓	✓	✓
Native	<i>Mormopterus</i> sp.	Unidentified Mastiff Bat	Anabat (confident)	✓			✓
Vulnerable	<i>Myotis macropus</i>	Southern Myotis	Anabat (confident)	✓			
Native	<i>Nyctophilus</i> sp.	Unidentified Long-eared Bat	Anabat (confident)	✓	✓	✓	
Exotic	<i>Oryctolagus cuniculus</i>	European Rabbit	Spotlighted		✓	✓	
Native	<i>Petaurus breviceps</i>	Sugar Gliders	Nest box				
Native	<i>Trichosurus vulpecula</i>	Brush-tail Possum	Nest box				
Native	<i>Vespadelus darlingtoni</i>	Large Forest Bat	Anabat (confident)	✓	✓		
Native	<i>Vespadelus vulturinus</i>	Little Forest Bat	Anabat (confident)	✓			
Exotic	<i>Vulpes Vulpes</i>	Fox	Spotlighted				

Table D3 Fauna Species List - Frogs

Status	Scientific Name	Common Name	Observation type	R1	R2	R3	R4
Native	<i>Litoria fallax</i>	Eastern Dwarf Frog	Spotlighted				✓

APPENDIX E

Nest Box Inventory

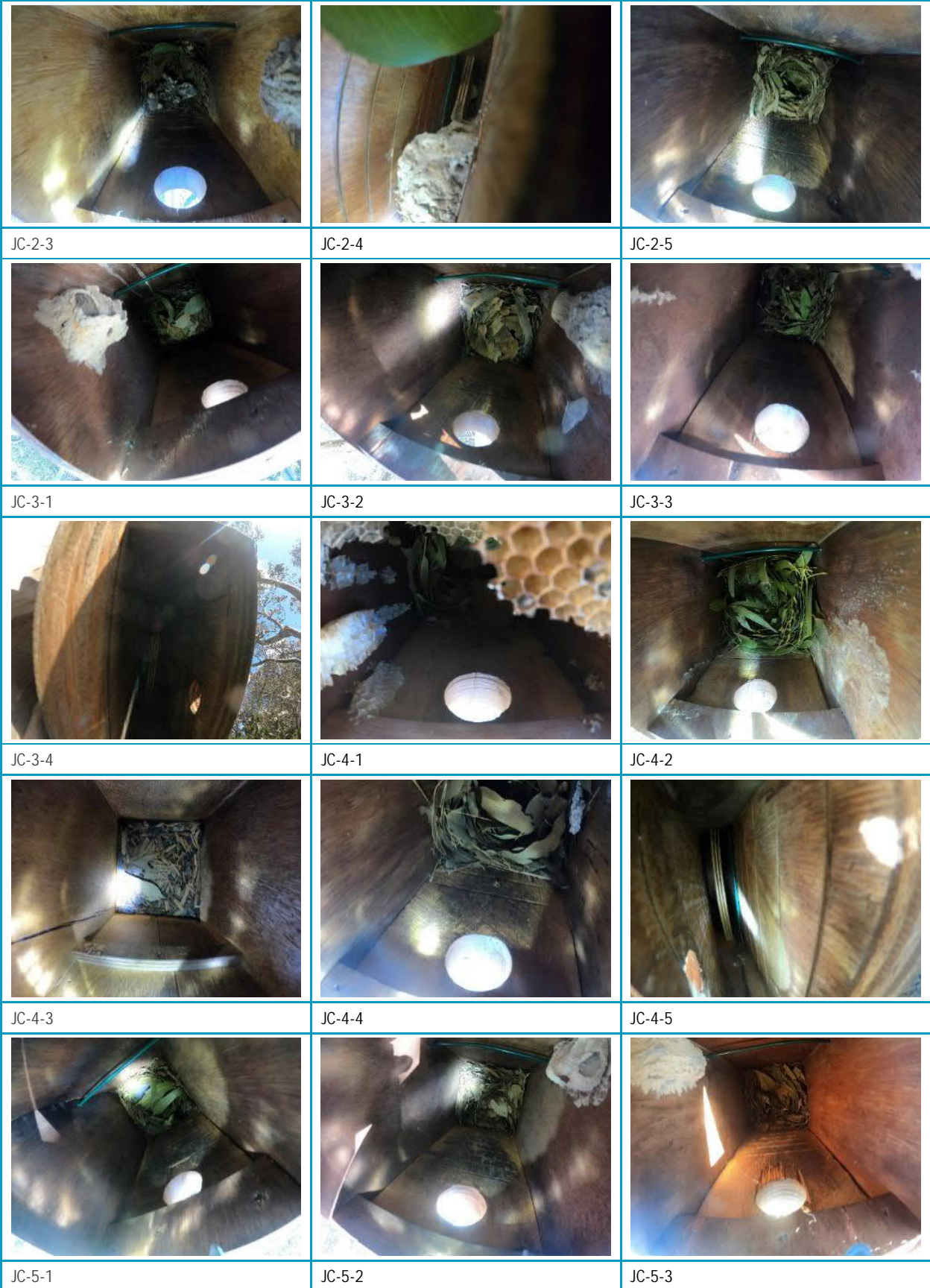
Table E1 Results of Nest Box Inspection

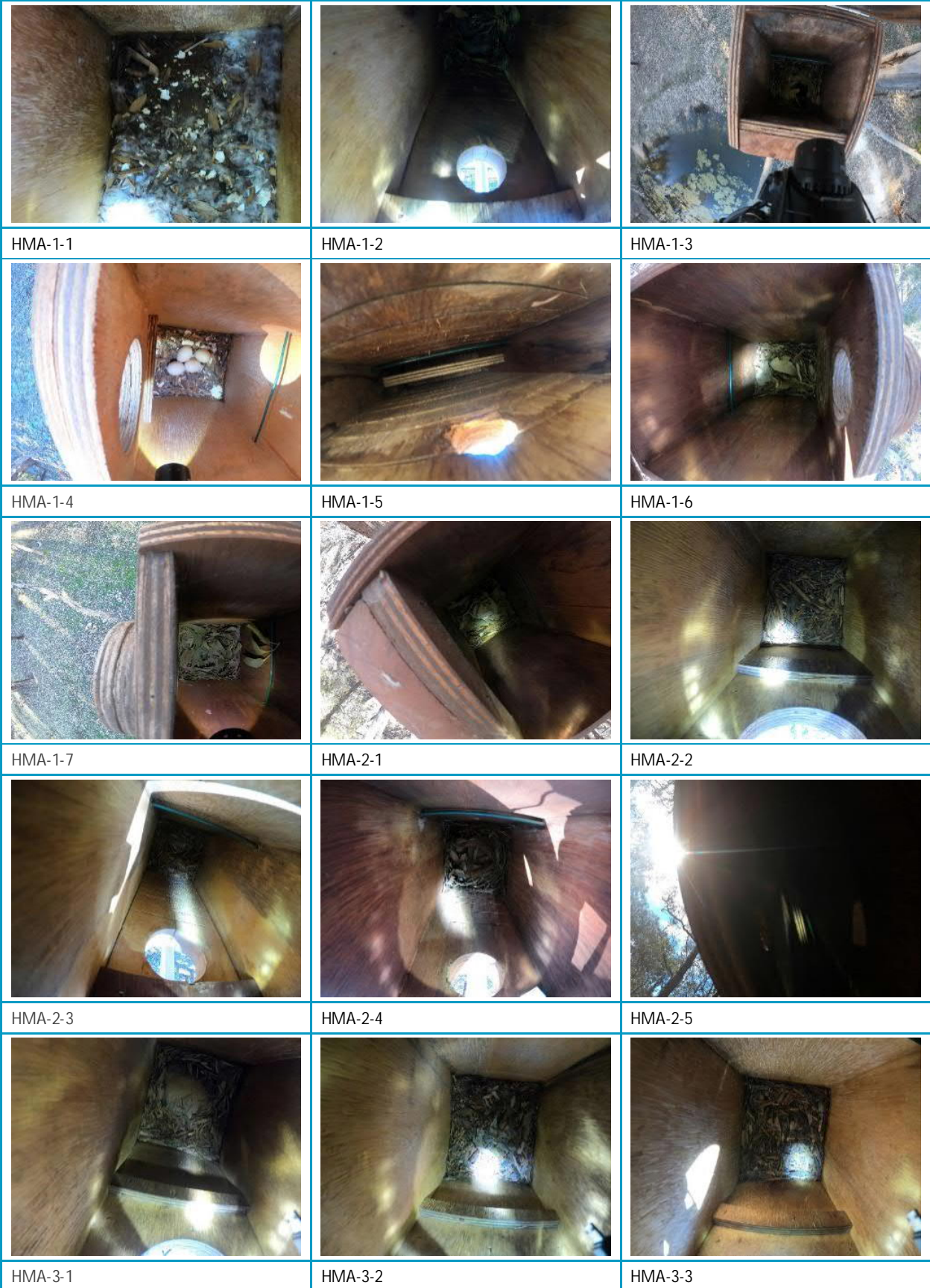
Box ID	Box Type	Native Fauna Occupancy (Y/N)				Pests (Y/N)	Repair (Y/N)	Comment (species present, signs of use, repair etc..)
		Fauna	Nest	Eggs	Young			
JC-1-1	Squirrel Glider	N	Y	N	N	N	N	Nest (leaf material)
JC-1-2	Squirrel Glider	N	Y	N	N	N	N	Nest (leaf material), poo/urine stains
JC-1-3	Squirrel Glider	Y	Y	N	N	N	N	Sugar Glider and nest (leaf material)
JC-1-4	Micro-Bat	N	N	N	N	N	N	-
JC-2-1	Brushtail Possum	N	Y	N	N	N	N	Nest (minimal leaf material), scats. Possible use by possum.
JC-2-2	Squirrel Glider	Y	Y	N	N	N	N	Sugar Glider and nest (leaf material)
JC-2-3	Squirrel Glider	N	Y	N	N	Y	Y	Nest (leaf material). Deceased glider and inactive wasp nest need to be removed.
JC-2-4	Micro-Bat	N	N	N	N	Y	Y	Inactive wasp nest to be removed. Box is in dense foliage, move to different tree.
JC-2-5	Squirrel Glider	N	Y	N	N	N	N	Nest (leaf material), animal scratches and chew marks at the entrance to box
JC-3-1	Squirrel Glider	N	Y	N	N	Y	Y	Nest (leaf material). Inactive wasp nest to be removed.
JC-3-2	Squirrel Glider	N	Y	N	N	Y	Y	Nest (leaf material). Inactive wasp nest to be removed.
JC-3-3	Squirrel Glider	N	Y	N	N	Y	Y	Nest (leaf material) and deceased Sugar Glider. Remove inactive beehive and glider.
JC-3-4	Micro-Bat	N	N	N	N	N	Y	Requires paint and re-positioning
JC-4-1	Squirrel Glider	N	N	N	N	Y	Y	Inactive beehive to be removed.
JC-4-2	Squirrel Glider	N	Y	N	N	N	N	Nest (leaf material)
JC-4-3	Brushtail Possum	N	Y	N	N	N	N	Nest (leaf material), possum poo present in nest box.
JC-4-4	Squirrel Glider	N	Y	N	N	N	N	Nest (leaf material)
JC-4-5	Micro-Bat	N	N	N	N	N	N	-
JC-5-1	Squirrel Glider	Y	Y	N	N	N	N	Sugar Glider and nest (leaf material), scats and urine on side of box
JC-5-2	Squirrel Glider	N	Y	N	N	N	N	Nest (leaf material)
JC-5-3	Squirrel Glider	N	Y	N	N	N	N	Nest (leaf material)
HMA-1-1	Brushtail Possum	N	Y	N	N	N	N	Egg Fragments and feathers
HMA-1-2	Squirrel Glider	Y	Y	N	N	N	N	Sugar Glider
HMA-1-3	Squirrel Glider	Y	Y	N	N	N	N	Sugar Glider
HMA-1-4	Ringtail Possum	N	Y	Y	N	N	N	Bird nest and eggs (probable Wood Duck)
HMA-1-5	Micro-Bat	N	N	N	N	N	Y	Requires repositioning
HMA-1-6	Owlet Nightjar	N	Y	N	N	N	N	Nest (leaf material)
HMA-1-7	Owlet Nightjar	Y	Y	N	N	N	N	Sugar Glider and nest (leaf material)
HMA-2-1	Squirrel Glider	N	Y	N	N	N	N	Nest (leaf material)
HMA-2-2	Brushtail Possum	N	Y	N	N	N	N	Inactive nest (nest and egg fragments)
HMA-2-3	Rosella	N	Y	N	N	N	N	Inactive bird nest, bark and feathers
HMA-2-4	Owlet Nightjar	N	Y	N	N	N	N	Possible glider nest (leaf material)
HMA-2-5	Micro-Bat	N	N	N	N	N	N	








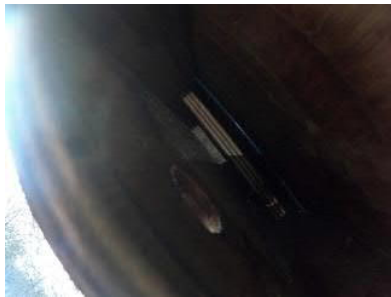






Box ID	Box Type	Native Fauna Occupancy (Y/N)				Pests (Y/N)	Repair (Y/N)	Comment (species present, signs of use, repair etc..)
		Fauna	Nest	Eggs	Young			
HMA-3-1	Ringtail Possum	N	Y	N	N	N	N	Possible inactive Wood Duck nest
HMA-3-2	Brushtail Possum	N	Y	N	N	N	N	Partial Wood Duck nest present
HMA-3-3	Brushtail Possum	N	Y	N	N	N	N	Inactive Wood Duck nest
HMA-3-4	Owlet Nightjar	N	Y	N	N	N	N	Birds nest with stringybark bark and feathers
HMA-3-5	Rosella	N	Y	N	N	N	N	Birds nest with stringybark bark and feathers
HMA-4-1	Brushtail Possum	Y	Y	N	N	N	N	Brushtail Possum
HMA-4-2	Rosella	N	Y	N	N	N	Y	Feather and bark lined nest. Box is on unstable branch, requires repositioning.
HMA-4-3	Squirrel Glider	N	Y	N	N	N	N	Glider nest (leaf material)
HMA-4-4	Micro-Bat	N	N	N	N	N	N	
HMA-5-1	Owlet Nightjar	N	Y	N	N	N	N	Glider nest (leaf material)
HMA-5-2	Micro-Bat	N	N	N	N	N	N	
HMA-5-3	Rosella	N	Y	N	N	N	N	Nest (leaf material). High nest box >4 m
HMA-5-4	Squirrel Glider	N	Y	N	N	N	N	Glider nest (leaf material)
HMA-6-1	Ringtail Possum	Y	Y	Y	N	N	N	Australian Wood Duck and well feathered nest with eggs.
HMA-6-2	Brushtail Possum	N	Y	N	N	N	N	Australian Wood Duck nest with egg fragments
HMA-6-3	Ringtail Possum	N	Y	N	N	N	N	Australian Wood Duck nest with egg fragments
HMA-6-4	Brushtail Possum	N	Y	N	N	N	N	Partial nest of bark and leaves

Table E2 Photograph Thumbnails of Nest Box Inspections







		
HMA-3-4	HMA-3-5	HMA-4-1
		
HMA-4-2	HMA-4-3	HMA-4-4
		
HMA-5-1	HMA-5-2	HMA-5-3
		
HMA-5-4	HMA-6-1	HMA-6-2
		
HMA-6-3	HMA-6-4	

APPENDIX F

Hoary Sunray Monitoring Data

Table F1 Hoary Sunray Counts at (4m² plot)

Site ID	% Cover estimate	Number of plant clumps				
		Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	Total
HS1	60	39	52	61	50	202
HS2	30	14	21	13	24	72
HS3	25	17	19	14	17	67
HS4	60	43	60	69	36	208
HS5	15	32	24	20	28	104
HS6	70	77	64	79	81	301
HS7	65	83	86	57	60	286
HS8	20	17	16	10	7	50
HS9	35	42	31	25	33	131
HS10	60	43	48	52	40	183
HS11	20	30	29	13	7	79


NOTE Plants are counted as clumps. Bare soil around the plant = new clump.

Table F2 Hoary Sunray Health and Disturbance Impact Notes

Site ID	Erosion		Grazing		Weediness		General Health	General Notes
	Severity	Age	Severity	Age	Severity	Age		
HS1	0	-	0	-	0	-	Good	None
HS2	0	-	0	-	1	R	Good	Possible competition with natives (Cassinia sp.) and weeds
HS3	0	-	0	-	1	R	Good	Possible competition with natives (Leptospermum sp., Austrostipa sp.) and weeds.
HS4	0	-	0	-	1	R	Good	Possible competition with natives (Leptospermum sp., Austrostipa sp.) and weeds.
HS5	0	-	0	-	0	-	Good	None
HS6	0	-	0	-	1	R	Good	Minor weeds at road edge.
HS7	1	R	3	O	1	R	Good	Minor weeds. Bare ground. Minor sheet erosion. Heavily grazed in past.
HS8	1	R	3	O	1	R	Good	Minor weeds. Bare ground. Minor sheet erosion. Grazing and rubbish blown in from tip.
HS9	0	-	0	-	1	R	Good	Possible competition with natives (Leptospermum sp., Cassinia sp.) and weeds. Kangaroo tracks present.
HS10	0	-	0	-	1	R	Good	Edge effects. Plot in telegraph line easement and at edge of track.
HS11	0	-	0	-	1	R	Good	Edge effects. Plot at edge of rail and old track. Serrated Tussock present.

KEY: Health (indicated by vigour, leaf browning, size of clumps): Poor, moderate, good. Severity: 0 = no evidence, 1=light/low, 2=moderate, 3=severe/good Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Table F3 Photograph Thumbnails of Hoary Sunray Monitoring Plots

Site	Quadrant 1 (top LHS)	Quadrant 2 (top RHS)	Quadrant 3 (bottom RHS)	Quadrant 4 (bottom LHS)
HS1				
HS2				
HS3				
HS4				

Site	Quadrant 1 (top LHS)	Quadrant 2 (top RHS)	Quadrant 3 (bottom RHS)	Quadrant 4 (bottom LHS)
HS5				
HS6				
HS7				
HS8				

Site	Quadrant 1 (top LHS)	Quadrant 2 (top RHS)	Quadrant 3 (bottom RHS)	Quadrant 4 (bottom LHS)
HS9				
HS10				
HS11				

ASIA PACIFIC OFFICES

BRISBANE

Level 2, 15 Astor Terrace
Spring Hill QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

MACKAY

21 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

PERTH

Ground Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

AUCKLAND

Level 4, 12 O'Connell Street
Auckland 1010
New Zealand
T: 0800 757 695

CANBERRA

GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

MELBOURNE

Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

SYDNEY

Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

NELSON

6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

DARWIN

Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

NEWCASTLE

10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

TOWNSVILLE

12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

GOLD COAST

Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

NEWCASTLE CBD

Suite 2B, 125 Bull Street
Newcastle West NSW 2302
Australia
T: +61 2 4940 0442

WOLLONGONG

Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000