416 Berrima Road, New Berrima

Biodiversity Development Assessment Report

Brickworks Land and Development

8 July 2020

Final

(02) 9868 1933 | PO Box 2474 Carlingford Court NSW 2118 | cumberlandecology.com.au

Report No. 19164RP1

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or commendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Version	Date Issued	Amended by	Details
1	17/03/2020	BF, TP. MP	Draft
2	28/05/2020	BF	Final
3	08/07/2020	BF	Revised Final

Approved by:	**David Robertson**
Position:	Director
Signed:	
Date:	8 July, 2020

Table of Contents

Glossary vi

1. Introduction 7
   - 1.1. Requirement for BDAR 7
   - 1.2. Purpose 7
   - 1.3. Project Description 8
   - 1.4. Information Sources 9
   - 1.5. Authorship and Personnel 10
   - 1.6. Further Assessment 11
2. Methodology 12
   - 2.1. Review of Existing Data 12
   - 2.2. Landscape Features 12
   - 2.3. Native Vegetation Survey 13
   - 2.4. Threatened Flora Species Survey 14
   - 2.5. Threatened Fauna Species Survey 15
   - 2.6. Weather Conditions 16
3. Landscape Features 17
   - 3.1. Assessment Area 17
   - 3.2. Landscape Features 17
   - 3.3. Native Vegetation Cover 18
4. Native Vegetation 19
   - 4.1. Native Vegetation Extent 19
   - 4.2. Plant Community Types 19
   - 4.3. Threatened Ecological Communities 24
   - 4.4. Vegetation Integrity Assessment 24
5. Threatened Species 26
   - Identifying Threatened Species for Assessment 26
   - 5.1. Ecosystem Credit Species 26
   - 5.2. Species Credit Species 29
6. Prescribed Impacts 33
7. Avoid and Minimise Impacts 35
   - 7.1. Avoid and Minimise Direct and Indirect Impacts on Native Vegetation and Habitat 35
   - 7.2. Avoid and Minimise Prescribed Impacts 36
8. Assessment of Impacts 37
   - 8.1. Impacts on Native Vegetation and Habitat 37
   - 8.2. Prescribed Impacts 39
   - 8.3. Uncertain Impacts 40
   - 8.4. Mitigation of Impacts to Native Vegetation and Habitat 40
   - 8.5. Mitigation of Prescribed Impacts 47

8.6. Use of Biodiversity Credits to Mitigate or Offset Indirect or Prescribed Impacts 47
9. Thresholds for Assessment 48
9.1. Introduction 48
9.2. Impacts on Serious and Irreversible Impact Entities 48
9.3. Impacts that Require an Offset 51
9.4. Impacts that do not Require an Offset 51
9.5. Impacts that do not Require Further Assessment 53
9.6. Application of the No Net Loss Standard 53
10. Conclusion 55
11. References 56

Table of Tables

Table 1 Personnel 10
Table 2 BAM plot survey requirement 14
Table 3 Targeted Surveys for Threatened Flora Species (Species Credit Species) 14
Table 4 Threatened Fauna Species Surveys 15
Table 5 Weather conditions during field surveys 16
Table 6 Plant community types within the Subject Land 19
Table 7 Vegetation zones within the Subject Land 25
Table 8 Predicted Ecosystem Credit Species 27
Table 9 Predicted Species Credit Species 30
Table 10 Prescribed Impacts of the Project 33
Table 11 Extent of vegetation impacts within the Subject Land 37
Table 12 Change in vegetation integrity score 37
Table 13 Indirect impacts of the Project 38
Table 14 Summary of mitigation measures for impacts to native vegetation and habitat 44
Table 15 Summary of impacts to native vegetation 52
Table 16 Summary of Ecosystem Credits Required 53
Table 17 Credits required for Species Credit Species 53
Table 18 Options for like for like Species Credit Species credits 54
Table 19 BAM Plot Data Recorded within the Subject Land 58

Table of Photographs

Photograph 1 PCT 944 within the Subject Land 21
Photograph 2 PCT 731 within the Subject Land 23

Table of Appendices

APPENDIX A : BAM Plot Data
APPENDIX B : Project Landscape Plan
APPENDIX C : BAMC Summary Credit Report

Table of Figures

Figure 1 Site map
Figure 2 Location map
Figure 3 Layout of the project
Figure 4 Field survey locations
Figure 5 Native vegetation extent within the Subject Land
Figure 6 Plant community types within the Subject Land
Figure 7 Threatened ecological communities within the Subject Land
Figure 8 Vegetation zones within the Subject Land
Figure 9 Species polygons and species credit species within the subject land
Figure 10 Extent of Southern Highlands Shale Woodland within a 10000 ha area surrounding the subject land
Figure 11 Thresholds for assessment

Glossary

Term / Abbreviation	Definition
AOBV	Area of Outstanding Biodiversity Value
Assessment area	Area of land within a 1500 m buffer around the outer boundary of the Subject Land
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOS	Biodiversity Offset Scheme
DAWE	Department of Agriculture, Water and Environment
DPIE	Department of Planning, Industry and the Environment
EEC	Endangered Ecological Community
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectares
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
NSW	New South Wales
MNES	Matters of National Environmental Significance
OEH	former NSW Office of Environment and Heritage
PCT	Plant Community Type
the Project	416 Berrima Road, New Berrima – Proposed Brickworks Plant
SAII	Serious and Irreversible Impact
SEPP	State Environmental Planning Policy
Subject Land	The land proposed as a development site (see **Figure 3**), including the area of complete clearing, APZs, and VMP Area/Riparian Corridor
TEC	Threatened Ecological Community
VMP	Vegetation Management Plan

1. Introduction

Cumberland Ecology was commissioned by Brickworks Land & Development to prepare a Biodiversity Development Assessment Report (BDAR) for the Bowral Bricks – New Factory at Chelsea Park, New Berrima NSW(the 'Project'). The Project involves the construction of a Brick Plant that will consist of a factory building, laboratory, office, raw materials shed, yard storage, export yard and container area, carpark, services, stormwater basin and drainage corridor. This BDAR will form part of the documentation to support an application for State Significant Development Consent under Division 4.1 of Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1. Requirement for BDAR

Secretary's Environmental Assessment Requirements (SEARs) were issued for the Project which require the preparation of a BDAR to support an application for State Significant Development Consent unless a BDAR waiver is sought and provided. A BDAR waiver was not sought for the Project and therefore a BDAR is required.

1.2. Purpose

The purpose of this BDAR is to document the findings of an assessment undertaken for the Project in accordance with Stage 1 (Biodiversity Assessment) and Stage 2 (Impact Assessment) of the Biodiversity Assessment Method (BAM). Specifically, the objectives of this BDAR are to:

- Identify the landscape features and site context (native vegetation cover) within the Subject Land and assessment area;
- Assess native vegetation extent, plant community types (PCTs), threatened ecological communities (TECs) and vegetation integrity (site condition) within the Subject Land;
- Assess habitat suitability for threatened species that can be predicted by habitat surrogates (ecosystem credits) and for threatened species that cannot be predicted by habitat surrogates (species credit species);
- Identify potential prescribed biodiversity impacts on threatened species;
- Describe measures to avoid and minimise impacts on biodiversity values and prescribed biodiversity impacts during project planning;
- Describe impacts to biodiversity values and prescribed biodiversity impacts and the measures to mitigate and manage such impacts;
- Identify the thresholds for the assessment and offsetting of impacts, including:
- Provide an impact assessment of potential entities of serious and irreversible impacts (SAII);
- Identify impacts for which an offset is required;
- Identify impacts for which no further assessment is required; and
- Describe the application of the no net loss standard, including the calculation of the offset requirement.

1.3. Project Description

1.3.1. Location

The Project is located at 416 Berrima Road, New Berrima, NSW, also known as Lot 1 DP785111 (hereafter referred to as the Study Area). The Study Area is located within the Wingecarribee Local Government Area (LGA). The closest regional centres are Berrima, located approximately 2 km north-west from the Study Area, and Moss Vale, located approximately 4 km south-east of the Study Area. The Study Area is bounded to the west by Berrima Road, and agricultural lands on the remaining borders. The Berrima rail line occurs parallel to the southern boundary.

A site map and location map have been prepared in accordance with the BAM and are presented in **Figure 1** and **Figure 2**, respectively.

1.3.2. Project Overview

The Project will facilitate the construction of a new Brick Plant with a 50 million bricks per annum capacity. The Project includes the demolition of existing buildings as well as the construction of the following:

- A 25,600m^2 factory building that is 12 -13 metres in height. Within the factory building there will be a lunchroom and amenities, factory managers office and control room;
- A 50m^2 laboratory for two people;
- Office suitable for ten people;
- A 4,800m^2 raw materials shed;
- A 32,000m^2 yard storage;
- A 6,000m^2 export yard and container area masonry paver hardstand;
- Carpark for 36 staff, two visitors and disabled parking;
- Accessway;
- Batters;
- Stormwater basin; and
- A 40 m wide drainage corridor to the south of the Brick Plant.

In addition to the above, the project requires services works relating to electricity, gas, water and sewer.

1.3.3. Identification of the Development Site Footprint

The layout of the Project is shown in **Figure 3**. The development site footprint comprises the area of land directly impacted by the Project including the existing buildings to be demolished and the proposed factory building, laboratory, office, raw materials shed, yard storage, export yard and container area, carpark, accessway, stormwater basin, drainage corridor, batters and services, and is referred to within this BDAR as the

Subject Land. The development site footprint includes all areas that are likely to be required to be cleared to facilitate the Project and therefore, for the purposes of this assessment, the development site footprint comprises both the construction footprint and the operational footprint of the project. The Subject Land includes areas which will be maintained as Asset Protection Zones (APZ); (all trees will be retained in these areas, however the ground layer dominated by exotic grasses will be mown), and an area in the south where realignment of ephemeral creeks will occur to form a riparian corridor.

Areas of the riparian corridor in which vegetation is to be removed (through creation of batters) have been included as impact areas in the BAM calculator. Some small areas of the riparian corridor will have all vegetation retained – these areas are not included as an impact in the BAM calculator. The entirety of the riparian corridor will be subject to a Vegetation Management Plan, which will guide the revegetation and restoration of vegetation in the area. This is shown in **Figure 3** as the VMP Area.

1.3.4. General Description of the Development Site

Vegetation within the Subject Land includes remnant canopy trees, planted vegetation and cleared areas. The Subject Land has had a history of agricultural development which has resulted in the degradation and clearing of the vast majority of the native vegetation present. Remnant canopy remaining within the Subject Land is dominated by *Eucalyptus macarthurii* (Camden Woollybutt). Planted areas within the Study Area include screening vegetation, windbreaks and garden vegetation.

The Subject Land occurs within the Hawkesbury–Nepean catchment and contains two surface drainage systems that flow in a southeast to northwest direction into Stony Creek, which eventually flows into the Wingecarribee River and the Wollondilly River.

The topography of the Subject Land is undulating with topographic high of 670 m Australian Height Datum (AHD) and a topographic low of 660 m AHD.

1.4. Information Sources

1.4.1. Databases

A number of databases were utilised during the preparation of this BDAR, including:

- NSW Department of Planning, Industry and Environment (DPIE) BioNet Atlas;
- DPIE Threatened Biodiversity Data Collection;
- DPIE BioNet Vegetation Classification database;
- Commonwealth Department of Agriculture, Water and the Environment (DAWE) Profile and Threat Database;
- DAWE Protected Matters Search Tool (PMST); and
- DAWE Directory of Important Wetlands in Australia.

1.4.2. Literature

This BDAR has utilised the results and/or spatial data from the following documents:

- Cumberland Ecology (Cumberland Ecology 2018): Masonry Plant – Berrima Road, Moss Vale: Ecological Impact Assessment;
- Eco Logical Australia (2003): Wingecarribee Biodiversity Strategy Phase 1. Vegetation Mapping, Threatened Species Database, Habitat Corridors, Conservation Assessment;
- Aquila Ecological Surveys (2010): New Berrima Clay/Shale Quarry. Fauna Assessment;
- Geoff Cunningham Natural Resource Consultants (2010): New Berrima Clay/Shale Quarry. Flora Assessment;
- Tozer *et al.* (2010): Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands;
- Wingecarribee Shire Council (2016): Biological Information. Proposed Berrima Road Deviation;
- Kevin Mills & Associates (2016): New Berrima Clay/Shale Quarry. Mandurama No. 524 Berrima Road, Moss Vale. Assessment of Causeway - Flora and Fauna;
- Opus and Wingecarribee Shire Council (2017): Berrima Road Deviation. Preliminary Environmental Investigation; and
- EMM (2017): Berrima Rail Project. Biodiversity Assessment Report.

1.4.3. Aerial Photography

The aerial imagery utilised in this BDAR is sourced from NearMap and is dated 29/09/2019.

1.5. Authorship and Personnel

This document has been prepared by Mikael Peck (BAM Accredited Assessor No: (BAAS19002). This document, and associated field surveys and Geographic Information Systems (GIS) mapping, was prepared with the assistance of additional personnel as outlined in **Table 1**. Notwithstanding the assistance of the additional personnel, the assessment presented within this document is Mikael Peck's.

Table 1 Personnel

Name	Tasks	Relevant Qualifications / Training	BAM Accredited Assessor No.
David Robertson	Document Preparation, Document Review	Doctor of Philosophy. Ecology, University of Melbourne, 1986 Bachelor of Science (Honours) in Ecology, University of Melbourne, 1980 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS17027

Mikael Peck	Document preparation	Master of Marine Science and Management. Macquarie University, 2013 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS19002
Katrina Wolf	Document review, field surveys	Bachelor of Science (Environmental). The University of Sydney, 2007 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS18010
Bryan Furchert	Field surveys and Document Preparation	Bachelor of Biodiversity and Conservation. Macquarie University, 2012 Diploma of Conservation and Land Management. TAFE NSW, 2008 BAM Accredited Assessor Training. Muddy Boots, 2017	BAAS18095
Timothy Playford	Document Review	Bachelor of Science (Honours) in Ecology, University of Adelaide, 2004 Bachelor of Environmental Management. Flinders University, 2003 BAM Accredited Assessor Training. Muddy Boots, 2018	
Michael Davis	GIS mapping	Bachelor of Biodiversity and Conservation. Macquarie University, 2016 BAM Accredited Assessor Training. Muddy Boots, 2017	-

1.6. Further Assessment

As individuals of the EPBC Act listed *Eucalyptus macarthurii* occur within the Subject Land a referral to the Commonwealth will be made in addition to this assessment under NSW legislation.

2. Methodology

2.1. Review of Existing Data

Existing information on biodiversity values within the assessment area was reviewed, which includes:

- Survey data that is held in the BioNet Atlas;
- The following existing ecological reports, including vegetation mapping:
    - Cumberland Ecology (2018): Masonry Plant – Berrima Road, Moss Vale: Ecological Impact Assessment
    - Eco Logical Australia (2003): Wingecarribee Biodiversity Strategy Phase 1. Vegetation Mapping, Threatened Species Database, Habitat Corridors, Conservation Assessment;
    - Aquila Ecological Surveys (2010): New Berrima Clay/Shale Quarry. Fauna Assessment;
    - Geoff Cunningham Natural Resource Consultants (2010): New Berrima Clay/Shale Quarry. Flora Assessment;
    - Tozer *et al.* (2010): Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands;
    - Wingecarribee Shire Council (2016): Biological Information. Proposed Berrima Road Deviation;
    - Kevin Mills & Associates (2016): New Berrima Clay/Shale Quarry. Mandurama No. 524 Berrima Road, Moss Vale. Assessment of Causeway - Flora and Fauna;
    - Opus and Wingecarribee Shire Council (2017): Berrima Road Deviation. Preliminary Environmental Investigation; and
    - EMM (2017): Berrima Rail Project. Biodiversity Assessment Report.

This existing information was considered and included, where appropriate, into survey design, vegetation mapping and reporting.

2.2. Landscape Features

Landscape features requiring consideration were initially determined via desktop assessment. Field surveys were subsequently undertaken on 12 and 16 March 2019 and 11 November 2019 and sought to verify the following landscape features:

- Rivers, streams and estuaries;
- Important and local wetlands;
- Karsts, caves, crevices, cliffs and areas of geological significance; and
- NSW BioNet Landscapes.

No amendments were required to be made to any of the previously identified landscape features following field surveys.

2.3. Native Vegetation Survey

2.3.1. Vegetation Mapping

Several vegetation mapping studies have been undertaken across the Subject Land and surrounds, including broad scale mapping Tozer *et al.* (2010), and mapping of the Study Area by Cumberland Ecology (2018), which is the most recent detailed vegetation mapping that included the Subject Land. The mapping by Cumberland Ecology (2018) was undertaken to support a separate Development Application (DA), but included survey of the Subject Land.

Cumberland Ecology conducted additional vegetation surveys on 11 November 2019 to revise and update the previous vegetation mapping undertaken by Cumberland Ecology within the Subject Land. The vegetation within the Subject Land was ground-truthed to examine and verify the mapping of the condition and extent of the different plant communities. Mapping of plant communities within the Subject Land was undertaken by random meander searches throughout each patch of vegetation, noting key characteristics of areas in similar broad condition states such as similar tree cover, shrub cover, ground cover, weediness or combinations of these.

Records of plant community boundaries were made using a hand-held Global Positioning System (GPS) and mark-up of aerial photographs. The resultant information was synthesised using Geographical Information Systems (GIS) to create a spatial database that was used to interpret and interpolate the data to produce a vegetation map of the Subject Land.

2.3.2. Vegetation Integrity Assessment

Vegetation integrity assessments were undertaken in the Subject Land in accordance with the BAM on 11 November 2019. Surveys included establishment of three 20 x 50 m plots within which the following data was collected:

- Composition for each growth form group by counting the number of native plant species recorded for each growth form group within each 20 m x 20 m plot;
- Structure of each growth form group as the sum of all the individual projected foliage cover estimates of all native plant species recorded within each growth form group within each 20 m x 20 m plot;
- Cover of 'High Threat Exotic' weed species within each 20 m x 20 m plot;
- Assessment of function attributes within each 20 m x 50 m plot, including:
    - Count of number of large trees;
    - Tree stem size classes, measured as 'diameter at breast height over bark' (DBH);
    - Regeneration based on the presence of living trees with stems <5 cm DBH;
    - The total length in metres of fallen logs over 10 cm in diameter;
- Assessment of litter cover within five 1 m x 1 m plots evenly spread within each 20 m x 50 m plot; and

- Number of trees with hollows that are visible from the ground within each 20 m x 50 m plot.

A total of 12 BAM plots have been undertaken by Cumberland Ecology within the Study Area, including three within the Subject Land, and their locations are shown in **Figure 4**. **Table 2** summarises the plot requirements of the BAM based on the size and number of vegetation zones in the Subject Land. As shown in this table, the minimum number of plots required by the BAM have been completed for each vegetation zone. The vegetation zones developed for this assessment have sought to capture the environmental variation of the PCTs identified within the Subject Land (see ***Section 4.2***).

Table 2 BAM plot survey requirement

Vegetation Zone	PCT	Condition	Area (ha)	Minimum Number of Plots Required	Number of Plots Completed
1	944	Low	2	2	1
2	731	Low	0.06	1	1

2.4. Threatened Flora Species Survey

2.4.1. Habitat Constraints

Desktop assessments and field surveys within the Subject Land included assessment of habitat constraints and microhabitats for predicted species credit flora species.

2.4.2. Targeted Species Survey

Targeted threatened flora surveys were undertaken within the Subject Land for species credit species that were assessed as candidate species credit species for further assessment (see ***Section 5.3***). **Table 3** provides a summary of the flora species credit species surveyed for within the Subject Land.

Table 3 Targeted Surveys for Threatened Flora Species (Species Credit Species)

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey within Subject Land	Survey Method
Eucalyptus macarthurii	Camden Woollybutt	Jan-Dec	15 March 2018, 11 November 2019	Random meander, plot survey

A random meander survey was undertaken within the Subject Land on 15 March 2018 and 11 November 2019, targeting *Eucalyptus macarthurii*. Surveys across the entire Study Area were undertaken for a separate DA in the west of the Study Area in 2018. The 2019 survey was undertaken specifically for the Subject Land and to collect the necessary data for this BDAR.

Due to the small area of potential habitat within the Subject Land, a random meander was deemed appropriate for the survey, and was supplemented with the required plot surveys. The random meander survey and plot surveys were undertaken by a botanist and ecologist. The locations of the random meanders and 2019 plots within the Subject Land are shown in **Figure 4**.

The targeted species was surveyed within the recommended survey period.

2.5. Threatened Fauna Species Survey

2.5.1. Habitat Constraints

Desktop assessments and field surveys within the Subject Land included assessment of habitat constraints and microhabitats for predicted species credit fauna species. This included desktop assessment of proximity of the Subject Land to features such as caves and waterways and field inspection of microhabitats including leaf litter, stick nests and hollowing-bearing trees.

2.5.2. Threatened Fauna Species Survey

With the exception of microchiropteran bat surveys, detailed targeted threatened fauna surveys were not undertaken within the Subject Land for species credit species that were assessed as candidate species credit species for further assessment (see ***Section 5.3***), with surveys limited to diurnal bird census and habitat surveys. These surveys were predominately undertaken in 2018 for a separate DA within the Study Area. The prior surveys were supplemented with a Random Meander Survey in November 2019 to confirm presence of habitat items previously recorded. **Table 4** provides a summary of the fauna species credit species surveyed for within the Subject Land. Details of each survey method utilised within the Subject Land are provided below.

Table 4 Threatened Fauna Species Surveys

Scientific Name	Common Name	Recommended Survey Period	Dates of Survey within Subject Land	Survey Method
Callocephalon fimbriatum	Gang-gang Cockatoo	Oct-Dec	13 February 2018 12 March 2018 15 March 2018 11 November 2019	Diurnal bird census (20 minutes – four locations within Study Area), incidental bird observation, Hollow Survey (all trees and stags in Study Area and Subject Land)
Calyptorhynchus lathami	Glossy Black-Cockatoo	Mar-Aug	13 February 2018 12 March 2018 15 March 2018	Diurnal bird census (20 minutes – four locations within

			11 November 2019	Study Area), incidental bird observation, Hollow Survey (all trees and stags in Study Area and Subject Land)
Myotis macropus	Southern Myotis	Oct-Jan	13 February 2018 (detectors deployed) 12 March 2018 15 March 2018 11 November 2019	Anabat© (two nights) and Songmeter© unit (four nights). Hollow Survey (all trees and stags in Study Area and Subject Land)

2.6. Weather Conditions

Weather conditions during the field surveys was appropriate for detection of target species credit species. A summary of weather conditions in the wider locality of the Subject Land (BOM Weather Station 068186 – Berrima West, and 68239 Moss Vale AWS) during the field survey is provided in **Table 5**. In the week prior to the commencement of field surveys in 2018, the maximum daily temperatures were between 25.7-35ºC, with a total of 8.8mm of rainfall falling over seven days. In the week prior to the commencement of field surveys in 2019, the average daily temperatures were between 15.3-23.1ºC, with a total of 7mm of rainfall falling over seven days.

Table 5 Weather conditions during field surveys

Date	Maximum Daily Temperature (°C)	Rainfall (mm)
13 February 2018	26.1	0
12 March 2018	24.2	0
15 March 2018	28.8	0
11 November 2019	26.1	0

3. Landscape Features

3.1. Assessment Area

The Subject Land is approximately 20.63 ha in size and is shown in **Figure 2**. As the project is being assessed as a site-based project, the assessment area comprises the area of land within a 1,500 m buffer around the outer boundary of the Subject Land. The assessment area is approximately 253.27 ha in size and is shown in **Figure 2**.

3.2. Landscape Features

Landscape features identified within the Subject Land and assessment area are outlined below. The extent of these features within the Subject Land is shown in **Figure 1** and the extent within the assessment area is shown in **Figure 2**.

3.2.1. IBRA Bioregions and IBRA Subregions

The Subject Land and assessment area occur within the Sydney Basin Bioregion and within the Moss Vale Subregion.

3.2.2. Rivers, Streams and Estuaries

The Subject Land and assessment area occur within the Hawkesbury-Nepean River catchment. 1st order, 2nd order, and 5th order streams occur within the assessment area including Stony Creek and Wingecarribee River. Stony Creek runs through the Study Area in a south-north direction and a small ephemeral tributary of this creek is present within the Subject Land, in the south, and a tributary of it in turn in the east.

3.2.3. Important and Local Wetlands

No important wetlands listed in the Directory of Important Wetlands in Australia are present in the Subject Land and/or assessment area. No mapped areas of wetlands under the State Environmental Planning Policy (Coastal Management) 2018 are present in the Subject Land and/or assessment area.

3.2.4. Habitat Connectivity

The Subject Land does not form part of a regional biodiversity corridor, flyway for migratory species, riparian buffer or estuary, or a local corridor identified by council.

The Subject Land is generally isolated from large tracts of woodland, being located within a mostly cleared agricultural landscape. There is potential that small degraded areas of vegetation in the Subject Land could aid in dispersal of threatened species between surrounding isolated trees and more intact vegetation in surrounding Wingecarribee River to the north via Stony Creek.

3.2.5. Karsts, Caves, Crevices, Cliffs and Areas of Geological Significance

No karsts, caves, crevices, cliffs or areas of geological significance have been identified within the assessment area based on searches of available aerial imagery from NearMap, or topographic data available from SixMaps.

3.2.6. Areas of Outstanding Biodiversity Value

No Areas of Outstanding Biodiversity Value (AoBV) have been mapped within the Subject Land and/or assessment area.

3.2.7. BioNet NSW Landscapes

The Subject Land is located within the 'Moss Vale Highlands' BioNet NSW Landscape predominately, with a small area in the west within the "Nattai" landscape.

3.2.8. Soil Hazard Features

No soil hazard features have been identified within the Subject Land and/or assessment area based on the hydrological landscape and soil capability mapping in OEH's eSPADE and Acid Sulfate Soils Risk Mapping (OEH 2019).

3.3. Native Vegetation Cover

The native vegetation cover in the Subject Land and assessment area was determined through the use of GIS. To map native vegetation cover within the Subject Land and assessment area, this assessment utilised the detailed vegetation mapping prepared by Cumberland Ecology in conjunction with broadscale mapping by Tozer 2010. The native vegetation cover within the assessment area is shown in **Figure 2**. The assessment area is approximately 1030.96 ha in size, of which approximately 253.27 ha comprises native vegetation cover, which represents 24.75% of the assessment area. Therefore, the native vegetation cover value is assigned to the cover class of >10–30%.

4. Native Vegetation

4.1. Native Vegetation Extent

The Subject Land has been subject to detailed surveys by Cumberland Ecology for the purpose of this BDAR as well as for a separate development application within the Study Area. The native vegetation extent within the Subject Land was determined through aerial photograph interpretation and field surveys. The native vegetation extent within the Subject Land is shown in **Figure 5**. It occupies approximately 2.24 ha, which represents 10.9% of the Subject Land. The native vegetation extent within the Subject Land includes two native vegetation communities, with one naturally occurring, and one an artificial community consisting of planted eucalypts.

The remaining land within the Subject Land comprises cleared land, including exotic vegetation and buildings, totalling an area of approximately 18.44 ha. In accordance with Section 5.1.1.5 of the BAM, the areas of cleared land do not require further assessment, unless they are proposed for restoration as part of an offset, or provide habitat for species credit species.

4.2. Plant Community Types

Identification of the PCTs occurring within the Subject Land was guided by the results of the Cumberland Ecology surveys. The data collected during surveys of the Subject Land and surrounds was analysed in conjunction with a review of the PCTs held within the BioNet Vegetation Classification database. Consideration was given to the following:

- Occurrence within the Moss Vale IBRA subregion (or closest adjacent IBRA subregion);
- Vegetation formation;
- Alignment with TECs;
- Landscape position; and
- Upper, mid and ground strata species.

The analysis determined that the native vegetation within the Subject Land aligned with two PCTs held within the BioNet Vegetation Classification database. **Table 6** provides a summary of the PCTs identified within the Subject Land. The distribution of these PCTs within the Subject Land is shown in **Figure 6**. Detailed descriptions of these PCTs and the justification for PCT selection is provided in the sections below.

Table 6 Plant community types within the Subject Land

PCT #	PCT Name	Area (ha)
944	Mountain Grey Gum - Narrow-leaved Peppermint grassy woodland on shales of the Southern Highlands, southern Sydney Basin Bioregion	2.18
731	Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	0.06
Total		2.25

4.2.1. 944 Mountain Grey Gum – Narrow-leaved Peppermint grassy woodland on shales of the Southern Highlands, southern Sydney Basin Bioregion

Vegetation Formation: Wet Sclerophyll Forests (Grassy sub-formation)

Vegetation Class: Southern Tableland Wet Sclerophyll Forests

Percent Cleared Value: 84%

TEC Status: Endangered Ecological Community (EEC) – Southern Highlands Shale Woodlands in the Sydney Basin Bioregion

4.2.1.1. General Description

The canopy is nearly exclusively characterised by the endangered *Eucalyptus macarthurii* (Camden Woollybutt) with scattered occurrences of *Eucalyptus radiata* subsp. *radiata* (Narrow-leaved Peppermint). The community within the Subject Land lacks a shrub layer. No regeneration of native canopy species of a shrub size or smaller is present in any of the patches.

The ground layer across the Study Area has been heavily degraded by past agricultural land use. No native species were recorded in the layer in two BAM plots undertaken in November 2019. Very few native species are present in the ground layer in the wider Study Area which generally only occur as scattered grasses. Native species recorded include *Cynodon dactylon* (Common Couch), *Bothriochloa macra* (Red-leg Grass), and *Themeda triandra* (Kangaroo Grass). A small number of native forbs are present in some locations and include *Dysphania pumilio* (Small Crumbweed) and the cosmopolitan *Portulaca oleracea* (Pigweed).

The ground layer in all woodland patches is dominated by exotic species. Dominant species include the grasses *Dactylis glomerata* (Cocksfoot), *Festuca pratensis* (Meadow Fescue), and *Phalaris aquatica* (Phalaris). The exotic sedge *Carex divulsa* comprises a significant portion of the layer (this exotic species is not known to occur elsewhere in NSW), and exotic forbs such as *Hypochaeris radicata* (Catsear), *Cirsium vulgare* (Spear Thistle), and *Plantago lanceolata* (Lambs Tongues) are common.

This PCT is shown in **Photograph 1**.

Photograph 1 PCT 944 within the Subject Land



4.2.1.2. Condition States

Within the Subject Land, PCT 944 exists as one broad condition state that includes a native canopy over an exotic dominated understorey. Although there were minor variations observed within this vegetation zone, one broad condition state has been mapped as these variations were small enough not to warrant a separate vegetation zone.

4.2.1.3. Justification of PCT Selection

To assist in determining the selected PCT, the findings of the following documents were reviewed:

- Cumberland Ecology (2018) which mapped vegetation within the Study Area and Subject Land as PCT 944; and
- EMM (2017) which mapped vegetation to the south of the Study Area as PCT 731 and PCT 1191.

The BioNet Vegetation Classification was consulted, with filters using canopy species and occurrence within the Moss Vale IBRA subregion to determine a list of potential PCTs. A review was also undertaken of Tozer *et al.* (2010) and the final determination of Southern Highlands Shale Woodlands in the Sydney Basin Bioregion, which was considered as a potential TEC for PCT 944.

Based on the existing available information of the Subject Land and surrounds, it was determined that the vegetation within the Subject Land would most likely be associated with PCT 944 as this is the only PCT that contains the canopy species *Eucalyptus radiata* subsp. *radiata* recorded within the Subject Land, and it includes the dominant canopy species *Eucalyptus macarthurii* as an associated threatened species.

4.2.1.4. Alignment with Threatened Ecological Communities

The community across the Subject Land is consistent with the EEC Southern Highlands Shale Woodland as described in the final determination (NSW Scientific Committee 2001) for the community as listed under the BC Act, due to a canopy of the characteristic species *Eucalyptus macarthurii* and *Eucalyptus radiata* subsp. *radiata*. The presence of further characteristic canopy species, present as scattered paddock trees across the Study Area, such as *Eucalyptus mannifera* (Brittle Gum) and *Eucalyptus pauciflora* (Snow Gum), indicates the community was in the past more widespread and diverse in composition across the Study Area. The ground layer was entirely exotic within two plots within the Subject Land, however and characteristic ground layer species such as the grasses *Rytidosperma racemosum* var. *racemosum* and *Themeda triandra* are present in small numbers within the Study Area.

As a precautionary approach trees in a woodland formation and scattered remnant trees across the Subject Land have been mapped as conforming to the BC Act listing of the EEC. Paragraph 6 of the final determination states:

Disturbed Southern Highlands Shale Woodlands remnants are considered to form part of the community including areas where the vegetation would respond to assisted natural regeneration, such as where the natural soil and associated seedbank is still at least partially intact.

It is likely that restoration of the EEC within the Subject Land would require herbicide control over a long period of the entire ground layer due to the complete dominance of exotic species, and replanting of the shrub layer and ground layers in their entirety. The community is unlikely to respond to assisted natural regeneration – it would require extensive work and expense to restore the community. If not managed at all the community is likely to further degrade over time as aging trees senesce and are not replaced by seedling regeneration. As a precautionary approach, the community has been considered to conform to the TEC within the BAM calculator, despite being degraded to the extent it is unlikely to respond to assisted natural regeneration.

4.2.2. 731 Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion

Vegetation Formation: Grassy Woodlands

Vegetation Class: Southern Tableland Grassy Woodland

Percent Cleared Value: 80%

TEC Status: Not listed

4.2.2.1. General Description

This PCT occurs as a small patch, a planted windrow, in the north of the Subject Land and is characterised entirely by a canopy of planted *Eucalyptus cinerea* subsp. *cinerea* (Argyle Apple) and several planted *Eucalyptus scoparia* (Wallangarra White Gum). The ground layer is entirely exotic and includes *Lolium perenne* (Perennial Ryegrass), *Bromus catharticus* (Praire Grass) and *Festuca pratensis* (Meadow Fescue).

This PCT is shown in **Photograph 2**.

The planted vegetation within the Subject Land does not comprise a naturally occurring PCT, but has been included in the mapped extent of native vegetation as it contains plant species native to NSW.

Photograph 2 PCT 731 within the Subject Land



4.2.2.2. Condition States

Within the Subject Land, PCT 731 exists in one condition state that includes a native planted canopy over an exotic understorey. Therefore, one condition state and vegetation zone has been applied to the PCT.

4.2.2.3. Justification of PCT Selection

The BioNet Vegetation Classification was consulted, with filters using canopy species and occurrence within the Sydney Basin IBRA region and Moss Vale IBRA subregion to determine a list of potential PCTs. A review of relevant mapping was not undertaken as the vegetation present has been planted and would not naturally occur within the Subject Land or Study Area. The BioNet Vegetation Classification identified PCT 653, PCT 731 and PCT 778.

Based on the existing available information of the Subject Land and surrounds, and consideration of the BioNet Vegetation Classification, it was determined that the planted vegetation within the Subject Land best-fit PCT 731 as this is the only PCT that is dominated by a canopy of *Eucalyptus cinerea* subsp. *cinerea* (Argyle Apple), as is the occurrence within the Subject Land.

4.2.2.4. Alignment with Threatened Ecological Communities

This community within the Subject Land does not conform to a TEC.

4.3. Threatened Ecological Communities

One PCT identified within the Subject Land has been assessed as being associated with a TEC. This PCT is 944, which is associated with the TEC Southern Highlands Shale Woodlands

4.4. Vegetation Integrity Assessment

The native vegetation identified within the Subject Land was assigned to vegetation zones based on PCTs and broad condition state of the vegetation. Patch sizes were subsequently assigned for each vegetation zone. The extent of vegetation zones and patch size classes within the Subject Land are shown in **Figure 8**.

Each vegetation zone was assessed using survey plots/transects (see ***Section 2.3.2***) to determine the vegetation integrity score. Plot/transect data utilised within the BAM Calculator (BAMC) to determine the vegetation integrity score is provided in **Appendix A**. Field data sheets are provided separately to this document.

Vegetation zones, patch sizes and vegetation integrity scores for the Subject Land are summarised in **Table 7**.

Table 7 Vegetation zones within the Subject Land

Vegetation Zone	PCT #	PCT Name	Condition Name	Area (ha)	Patch Size Class	Composition Condition Score	Structure Condition Score	Function Condition Score	Vegetation Integrity Score
1	944	Mountain Grey Gum – Narrow-leaved Peppermint grassy woodland on shales of the Southern Highlands, southern Sydney Basin Bioregion	Low	2	>101 ha	0.7	19.4	7.4	4.7
2	731	Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	Low	0.06	>101 ha	4.3	11.6	22.7	10.4

5. Threatened Species

Identifying Threatened Species for Assessment

The BAM Calculator generates a list of threatened species requiring assessment utilising a number of variables. The following criteria have been utilised to predict the threatened species requiring further assessment:

- IBRA subregion: Moss Vale;
- Associated PCTs: 944 and 731;
- Percent native vegetation cover in the assessment area: 24.75%;
- Patch size: >100ha; and
- Credit type: Ecosystem and/or species.

Based on the above variables, the BAM Calculator generated a list of 19 ecosystem credit species and 18 species credit species. Ecosystem credit species and species credit species are assessed further in ***Section 5.2*** and ***Section 5.3***, respectively.

5.1. Ecosystem Credit Species

Table 8 lists the predicted ecosystem credit species for the vegetation zones within the Subject Land, and whether they have been retained within the assessment following consideration of habitat constraints, geographic limitations, vagrancy and quality of microhabitats. Only three species have been removed from the assessment, based on the absence of habitat constraints.

Table 8 Predicted Ecosystem Credit Species

Scientific Name	Common Name	Relevant PCTs	Retained in Assessment?	Justification if Not Retained
Fauna				
Artamus cyanopterus cyanopterus	Dusky Woodswallow	944, 731	Yes	-
Callocephalon fimbriatum	Gang-gang Cockatoo	944, 731	Yes	-
Calyptorhynchus lathami	Glossy Black-Cockatoo	944, 731	No	*Allocasuarina* and *Casuarina* species absent from Subject Land.
Daphoenositta chrysoptera	Varied Sittella	944, 731	Yes	-
Dasyurus maculatus	Spotted-tailed Quoll	944, 731	Yes	-
Glossopsitta pusilla	Little Lorikeet	731	Yes	-
Hieraaetus morphnoides	Little Eagle (Foraging)	944, 731	Yes	-
Lophoictinia isura	Square-tailed Kite	731	Yes	-
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	944, 731	Yes	-
Miniopterus orianae oceanensis	Large Bent-winged Bat (Foraging)	944, 731	Yes	-
Neophema pulchella	Turquoise Parrot	731	Yes	-
Ninox connivens	Barking Owl (Foraging)	731	Yes	-
Ninox strenua	Powerful Owl (Foraging)	944, 731	Yes	-
Petroica boodang	Scarlet Robin	944, 731	Yes	-
Petroica phoenicea	Flame Robin	944, 731	Yes	-

Scientific Name	Common Name	Relevant PCTs	Retained in Assessment?	Justification if Not Retained
Phascolarctos cinereus	Koala (Foraging)	944, 731	No	Species is a large, distinctive and well known mammal that requires large areas of habitat not present within the Subject Land. Few BioNET records (7) within 10 km of the Subject Land. Tree clumps within Subject Land are isolated from other tree clumps by large open areas which would leave the species vulnerable to attack from predators such as wild and domestic dogs and as such habitat is extremely unlikely to be utilised.
Pteropus poliocephalus	Grey-headed Flying-fox	944, 731	Yes	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	944, 731	Yes	-
Varanus rosenbergi	Rosenberg's Goanna	944, 731	No	Habitat required for species, termite mounds, not present .

5.2. Species Credit Species

Table 9 lists the predicted species credit species for the vegetation zones within the Subject Land, and whether they have been retained within the assessment following consideration of habitat constraints, geographic limitations, vagrancy and quality of microhabitats.

A total of 3 flora species and 15 fauna species have been predicted for the Subject Land. Of these, one flora species and three fauna species have been retained for further assessment and have been targeted during surveys outlined in ***Section 2.4*** and ***Section 2.5***, respectively.

Of the species that have been retained for further assessment the flora species *Eucalyptus macarthurii* is associated with PCT 944 and prior to commencement of the preparation was already known to occur as a dominant canopy species by Cumberland Ecology due to past surveys of the Study Area in 2018.

Two bird species, the Gang-gang Cockatoo and Glossy Black Cockatoo, have been retained for further assessment as 18 hollow trees are present within the Subject Land in PCT 944, and hollows up to 15cm in diameter are present (potential nesting habitat).

One microchiropteran bat species, the Southern Myotis has also been retained for further assessment, as Stony Creek contains suitable foraging habitat for the species, and some patches of PCT 944 with hollow trees suitable for roosting occur within 200 m of foraging habitat.

Table 9 Predicted Species Credit Species

Scientific Name	Common Name	Retained in Assessment?	Justification if Not Retained
Flora			
Eucalyptus macarthurii	Paddys River Box, Camden Woollybutt	Yes	-
Persoonia mollis subsp. *revoluta*		No	The species is associated with Hawkesbury Sandstone soils. Soils within the site are Wianamatta shales. Site is degraded by agriculture to the extent a native shrub layer is not present.
Pterostylis pulchella	Waterfall Greenhood	No	This species is known from only five locations, and the known habitat is limited to escarpments, in the proximity of waterfalls, or damp areas on ridges. The site does not contain or occur on ridgetop habitat or escarpments.
Fauna			
Callocephalon fimbriatum	Gang-gang Cockatoo (Breeding)	Yes	-
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	Yes	-
Cercartetus nanus	Eastern Pygmy-possum	No	No BioNet records within 10km of the Subject Land. Species has a preference for heathy habitats not present within the Subject Land.
Chalinolobus dwyeri	Large-eared Pied Bat	No	Habitat constraint absent from the Subject Land - i.e. No Cliffs and not within 2 km of rocky areas containing caves, overhands, escarpments, outcrops, or crevices, or within 2 km of old tunnels or mines.

Scientific Name	Common Name	Retained in Assessment?	Justification if Not Retained
Hieraaetus morphnoides	Little Eagle (Breeding)	No	Habitat constraint absent from the Subject Land - i.e. No nests within large trees, trees not within functional native vegetation community (no native ground layer or shrub layer - very low vegetation integrity score).
Lophoictinia isura	Square-tailed Kite	No	No nest trees located within Subject Land.
Miniopterus orianae oceanensis	Large Bent-winged Bat	No	Habitat constraint absent from the Subject Land – i.e. no caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding present.
Myotis macropus	Southern Myotis	Yes	-
Ninox connivens	Barking Owl	No	Habitat constraint absent from the Subject Land – i.e. living or dead trees with hollow greater than 20 cm diameter.
Ninox strenua	Powerful Owl	No	Habitat constraint absent from the Development Site – i.e. no hollow bearing trees with hollows greater than 20 cm diameter and greater than 4 m above the ground. Species is predominately associated with forest habitat, and roosts in dense foliage, site contains only highly degraded open woodland.
Petaurus norfolcensis	Squirrel Glider	No	Species requires mature or old growth woodland or forest with abundant hollows for refuge and nest sites - these habitat features are not present within the Subject Land.

Scientific Name	Common Name	Retained in Assessment?	Justification if Not Retained
Phascolarctos cinereus	Koala	No	Habitat constraint absent - Development Site does not contain abundant feed trees. Few BioNet records within 10 km of Subject Land (7). Tree clumps within site generally separated by open space, which would leave koalas vulnerable to predators such as wild or domestic dogs.
Pseudophryne australis	Red-crowned Toadlet	No	Species is associated with ephemeral drainage lines below sandstone ridgetops. This habitat is not present within the Subject Land.
Pteropus poliocephalus	Grey-headed Flying Fox	No	No camp present within Subject Land or Study Area.

6. Prescribed Impacts

Prescribed impacts are identified in Clause 6.1 of the *Biodiversity Conservation Regulation 2017*. Prescribed impacts are those that are additional to the clearing of native vegetation and associated habitat. These include:

- Development on the habitat of threatened species or ecological communities associated with:
  - karst, caves, crevices, cliffs, rock outcrops and other geological features of significance;
  - human-made structures;
  - non-native vegetation;
- Development on areas connecting threatened species habitat, such as movement corridors
- Development on water quality, water bodies and hydrological processes that sustain threatened species and TECs (including from subsidence or upsidence from underground mining)
- Wind turbine strikes on protected animals
- Vehicle strikes on threatened species or on animals that are part of a TEC.

An assessment of the relevance of these prescribed impacts to the project is provided in **Table 10**.

Table 10 Prescribed Impacts of the Project

Prescribed Impact	Relevance to the Project
Karst, caves, crevices, cliffs, rock outcrops and other geological features of significance	Not relevant. Features are not present within the Subject Land.
Human-made structures	Not relevant. Three buildings currently exist within the Subject Land that will all be removed by the project. None of the building are considered to comprise habitat for threatened species.
Non-native vegetation	Non-native vegetation occurs at scattered locations within the Subject Land, but it is not considered to comprise habitat for threatened species. Suitable habitat in the form of non-native and native vegetation will be retained within the Study Area. Some exotic species present could comprise foraging habitat for the Grey-headed Flying-fox, however the species forages on a wide variety of native and non-native species and the removal of small areas of vegetation is likely to have minimal impact on the species.
Habitat connectivity	Not relevant. The Subject Land has been largely cleared as a result of historic agricultural land uses and contains remnant native vegetation that largely exists as canopy trees above a highly modified and exotic dominated understorey. The vegetation within the Subject Land does not have connectivity to other areas of habitat, nor does it provide stepping-stone habitat to other areas as all areas to the east, south and west of the subject consist of scattered woodland within agricultural lands.

Waterbodies, water quality and hydrological processes	One first order and one second order stream is present within the Subject Land. These streams are ephemeral drainage lines that flow into Stony Creek to the northwest of the Subject Land. Both streams will be impacted by the Project; however, a stormwater basin and drainage corridor are proposed that are expected to maintain current surface water flows across the Subject Land and ultimately into Stony Creek. A VMP is to guide the restoration of the drainage corridor draining into Stony Creek with native vegetation.
Wind turbine strikes	Not relevant. Project does not comprise a wind farm development.
Vehicle strikes	Not relevant. Although the Project includes the construction of an access driveway to the brickworks factory, no impacts to threatened species are predicted, as terrestrial threatened fauna are not likely to currently utilise the site, and threatened fauna is likely to be limited to birds and bats if present which are unlikely to be impacted by vehicle strikes.

7. Avoid and Minimise Impacts

7.1. Avoid and Minimise Direct and Indirect Impacts on Native Vegetation and Habitat

7.1.1. Project Location

The development footprint has been situated within the Study Area to allow for the construction and operational requirements of the project while minimising impacts to areas containing biodiversity values.

In determining the location of the development footprint, the project has sought to avoid and minimise direct impacts on native vegetation and habitat by:

- Locating the development footprint primarily in areas comprising cleared land, exotic vegetation and planted vegetation;
- Locating the development footprint in areas that will impact only on the peripherals of scattered patches of native vegetation, comprising PCT 944 and PCT 731 (or planted native trees assigned to this PCT);
- Locating the development footprint outside of Stony Creek;
- Retaining areas of native vegetation, comprising PCT 944;
- Situating the development footprint to remove the minimal number of trees of the threatened species *Eucalyptus macarthurii* possible; and
- Maintaining stepping-stone habitat within the rural landscape through the retention of trees across the Study Area that primarily comprise the EEC Southern Highlands Shale Woodland, consisting nearly entirely of the threatened *Eucalyptus macarthurii*.

7.1.2. Project Design

In determining the design of the development footprint, the project has sought to avoid and minimise direct impacts on native vegetation and habitat by:

- Locating the development footprint primarily in areas comprising cleared land, exotic vegetation and planted vegetation;
- Locating the stormwater basin and drainage corridor primarily within exotic vegetation;
- Largely avoiding areas of native vegetation located between the brick factory and the drainage corridor;
- Drainage design maintains existing overland flow characteristics and hydrology to Stony Creek within the Study Area; and
- Avoiding the use of bulk earthworks across the Study Area and limiting the width of batters so as to retain areas of native vegetation.

7.2. Avoid and Minimise Prescribed Impacts

Waterbodies, water quality and hydrological processes has been identified as a prescribed impact for the Project. In determining the location and design of the development footprint, the Project has sought to avoid and minimise direct impacts to waterbodies, water quality and hydrological processes by:

- Locating the development footprint outside of Stony Creek, the most significant tributary within the Study Area;
- Locating the development footprint in areas containing first and second order ephemeral drainage lines that only provide surface water to Stony Creek during periods of heavy rain; and
- Designing a drainage corridor in the south of the development footprint in order to maintain existing hydrological processes of the Study Area.

8. Assessment of Impacts

8.1. Impacts on Native Vegetation and Habitat

8.1.1. Direct Impacts

The direct impact resulting from the proposed development is the loss of vegetation and associated habitat within the Subject Land. **Table 11** identifies the proposed impacts to vegetation within the Subject Land. In addition to removal of areas of PCTs, there will be a direct impact to the threatened tree species *Eucalyptus macarthurii* with 16 individuals removed.

Impacts to habitat of species credit species is confined predominately to removal of patches of woodland with suitably sized hollows in trees and stags for the Gang-gang Cockatoo and Glossy Black Cockatoo, and the removal of patches of woodland with suitably sized hollows within 200 m of permanent water for the Southern Myotis. Threatened species polygons are shown in **Figure 9**.

Table 11 Extent of vegetation impacts within the Subject Land

Vegetation Zone	PCT #	PCT Name	BC Act Status	Area (ha)
1	944	Mountain Grey Gum - Narrow-leaved Peppermint grassy woodland on shales of the Southern Highlands, southern Sydney Basin Bioregion	EEC	2
2	731	Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	Not listed	0.06
Total				**2.06**

8.1.2. Change in Vegetation Integrity Score

Table 12 details the change in vegetation integrity score for each vegetation zone. Within Vegetation Zone 1, comprising PCT 944, two management zones have been identified. One management zone comprises areas of PCT 944 within the Subject Land that will be totally cleared, and the second management zone is areas of PCT 944 that will be managed within an APZ, involving the be retention of vegetation with a managed ground layer. PCT 731 comprises a single management zone and occurs entirely in the area in which all vegetation will be removed.

Table 12 Change in vegetation integrity score

Vegetation Zone	PCT #	PCT Name	Management Zone	Current VI Score	Future VI Score	Change in VI Score
1	944	Mountain Grey Gum - Narrow-leaved Peppermint grassy woodland on shales of the Southern Highlands,	Complete Removal (CR)	4.7	0	-4.7

Vegetation Zone	PCT #	PCT Name	Management Zone	Current VI Score	Future VI Score	Change in VI Score
		southern Sydney Basin Bioregion				
1	944	Mountain Grey Gum - Narrow-leaved Peppermint grassy woodland on shales of the Southern Highlands, southern Sydney Basin Bioregion	Asset Protection Zone (APZ)	4.7	1.9	-2.8
2	731	Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	-	10.4	0	-10.4

The Biodiversity Risk Weighting for both PCT 944 and PCT 731 is 2.

8.1.3. Indirect Impacts

Table 14 outlines the indirect impacts to native vegetation and habitat. Due to the existing highly modified nature of the vegetation both within and adjacent to the Subject Land, the indirect impacts of the project are not considered to be significant.

Table 13 Indirect impacts of the Project

Indirect Impact	Nature	Extent	Duration	Threatened Entities Likely Affected	Consequences
Inadvertent impacts on adjacent habitat or vegetation	Construction activities may result in inadvertent impacts on retained vegetation, such as increase sedimentation.	Retained vegetation within Study Area and VMP Area.	Short term (during construction)	Southern Highlands Shale Woodlands and *Eucalyptus macarthurii*	Reduced condition of the adjoining TEC and mortality of threatened species individuals.
Reduced viability of adjacent habitat due to edge effects	Modification of vegetation extent within the Subject Land may increase edge effects.	Retained vegetation within Study Area and VMP Area.	Potential long-term	Southern Highlands Shale Woodlands	Reduced condition of the adjoining TEC.

Indirect Impact	Nature	Extent	Duration	Threatened Entities Likely Affected	Consequences
Reduced viability of adjacent habitat due to noise, dust or light spill	The construction activities associated with the project are likely to increase the noise, dust and light above current levels within the Subject Land.	Retained vegetation within Study Area and North Rocks Park.	Short term (during constructio n)	Ecosystem credit species	Short term disruption of fauna habitat usage during construction.
Transport of weeds and pathogens from the site to adjacent vegetation	A number of high threat exotic weeds are known to occur within the Subject Land and may be inadvertently spread to retained vegetation.	Retained vegetation within Study Area and VMP Area	Potential long-term	Southern Highlands Shale Woodlands	Reduced condition of the adjoining TEC.
Loss of breeding habitats	The project will result in the removal of 18 hollow-bearing trees.	PCT 944 (Areas shown as Complete Clearance in **Figure 3**)	Long-term	Hollow-dependent ecosystem credit species (e.g. microchiroptera n bats) and species credit species (i.e. threatened birds and bats)	Reduction in available breeding habitat of hollow-dependent fauna and increased competition for hollows outside of the Subject Land

8.2. Prescribed Impacts

The project has been assessed as resulting in one prescribed impact, waterbodies, water quality and hydrological processes (see **Chapter 6**). An assessment of this prescribed impact is provided below.

8.2.1. Waterbodies, Water Quality and Hydrological Processes

8.2.1.1. Nature

Two ephemeral streams occur in the Subject Land (**Figure 1**). A first order stream occurs in the east, and a second stream occurs in the south of the Subject Land. Both streams are proposed to be realigned and to have channelling works undertaken to ensure drainage issues do not affect the proposed Brickworks Plant. These streams currently occur within paddocks dominated by exotic grasses.

8.2.1.2. Extent

The extent to which streams will be directed is detailed in **Figure 1** (original alignment of stream) and in the landscape plan prepared for the site by SBA (2019) in **Appendix B** (future stream alignment).

8.2.1.3. Duration

The realignment of the streams is considered to be a long-term impact.

8.2.1.4. Threatened Entities Affected

The realignment of these ephemeral streams is not considered likely to affect any threatened entities as none are likely to be reliant on intermittently damp streams within degraded paddocks.

8.2.1.5. Consequences

The project will result in a change in direction of flow of surface water across the site in weather events. This is not expected to have any significant impact on biodiversity values of the Study Area and surrounds. The revegetation of the riparian corridor of the second order stream in the south of the Subject Land is expected to increase species richness of Southern Highlands Shale Woodlands species within the Study Area. The Study Area is currently extremely depauperate in native species.

8.3. Uncertain Impacts

The project is considered unlikely to result in any uncertain impacts.

8.4. Mitigation of Impacts to Native Vegetation and Habitat

A range of mitigation measures have been developed for the project to mitigate the impacts to native vegetation and habitat that are unable to be avoided. These include a range of measures to be undertaken before and during construction to limit the impact of the project. Each mitigation measure is discussed in detail below, and a summary is provided in **Table 15**.

8.4.1. Weed Management

In order to minimise the spread of weeds throughout the Subject Land and adjoining areas, appropriate weed control activities will be undertaken prior to vegetation clearing in accordance with the South East Local Land Services Area and is subject to the South East Regional Strategic Weed Management Plan 2017 – 2022 (LLS: South East 2017) under the NSW *Biosecurity Act 2015*.

The *Biosecurity Act 2015* and regulations provide specific legal requirements for state level priority weeds and high risk activities, as provided in the Appendices of the South East Regional Strategic Weed Management Plan 2017 – 2022 (LLS: South East 2017). In order to comply with the objectives of the South East Regional Strategic Weed Management Plan, it is recommended the following measures be implemented as part of weed management for the Subject Land.

i. Prevention

Appropriate construction site hygiene measures will be implemented to prevent entry of new weeds to the area such as the cleaning of equipment prior to entering the Subject Land.

ii. Eradication

Initial weed management will be carried out within the Subject Land according to best-practice methods under the direction of a suitably qualified bush regenerator. The targeted species will be those listed under Appendices 1 and 2 of the South East Regional Strategic Weed Management Plan 2017 – 2022 (LLS: South East 2017) in the eradication management stream. Initial weed treatment will include eliminating woody species and targeting large dominant infestations of exotic herbs. This may be achieved via a combination of manual weed removal and herbicide use.

Best-practice bush regeneration should undertake measures to avoid adverse impacts to retained vegetation within the Study Area, including not over clearing (remove only targeted species), employment of minimal disturbance techniques to avoid soil and surrounding vegetation disturbance, and replacement of disturbed mulch/leaf-litter.

iii. Containment

Follow-up monitoring and maintenance should be undertaken in the Study Area following vegetation clearing activities, to contain any re-emergence of weed species.

8.4.2. Delineation of Clearing Limits

The current limits of clearing will be marked either by high visibility tape on trees or metal/wooden pickets, fencing or an equivalent boundary marker that will be installed prior to clearing. To avoid unnecessary or inadvertent vegetation and habitat removal or impacts on fauna, disturbance must be restricted to the delineated area and no stockpiling of equipment, machinery, soil or vegetation will occur beyond this boundary.

8.4.3. Tree Protection Measures

Trees retained within the Study Area will be subject to tree protection measures to be prepared by the Project arborist. These are likely to include:

- Inductions to communication tree protection measures;
- Installation of fences around specified tree protection zones; and
- All tree work is to be carried out by a suitably qualified and insured Arborist.

Due to the occurrence of a number of the threatened *Eucalyptus macarthurii* in close proximity to the development footprint (Allied Tree Consultancy 2020) with the potential to be impacted due to damage to roots, the project arborist will be consulted regarding construction methods and tree protection measures to specifically protect these trees from construction impacts which would result in mortality in the short or long term.

8.4.4. Pre-clearance Surveys

In order to minimise impacts to fauna species during construction, pre-clearance surveys will be conducted in all areas of vegetation that are required to be cleared. Pre-clearing surveys will be undertaken within one week of clearing activities by a qualified ecologist.

Habitat features to be identified include:

- Hollow-bearing trees;
- Hollow-bearing logs; and
- Nests within tree canopy or shrubs.

Such features have the potential to contain native species. All habitat features will be identified, recorded and flagged with fluorescent marking tape and trees will have an "H" spray painted with marking paint on two sides of the tree.

8.4.5. Staging of Clearing

The clearing will be conducted using a two-stage clearing process as follows:

Stage 1: Clearing will commence following the identification of potential habitat features by a qualified ecologist. Hollow-bearing trees marked during pre-clearing will not be cleared during the first stage; however all vegetation around these trees will be cleared to enable isolation of the feature. Other habitat features, such as hollow-bearing logs, can be removed during Stage 1 only if done under supervision by a qualified ecologist. Identified hollow-bearing trees will be left at a minimum overnight after Stage 1 clearing to allow resident fauna to voluntarily move from the area.

Stage 2: After hollow-bearing trees have been left overnight, the trees will be cleared using the following protocols:

- Trees marked as containing hollows will be shaken by machinery prior to clearing to encourage any animals remaining to leave the hollows and move on;
- Use a bulldozer or excavator to start pushing the tree over. Move the bulldozer over the roots and continue gently pushing the tree over;
- Remove branches with hollows and sections of trunk and set aside for immediate transfer to a storage area for placement within retained vegetation; and
- All hollows will be investigated by an ecologist for the presence of fauna following felling of the tree.

The felled habitat tree will be left overnight to allow any remaining fauna time to leave the hollows and move on.

The two-stage clearing process enables fauna to feel secure whilst clearing occurs around their tree, and allows them a chance to self-relocate upon nightfall, when foraging typically occurs. Fauna are not likely to re-inhabit trees, as they are not likely to feel secure in their tree with all trees around it cleared.

Provisions will be made to protect any native fauna during clearing activities by the following means:

- All staff working on the vegetation clearing will be briefed about the possible fauna present and should avoid injuring any present;

- Animals disturbed or dislodged during the clearance but not injured will be assisted to move to adjacent bushland or other specified locations; and
- If animals are injured during the vegetation clearance, appropriate steps will be taken to humanely treat the animal (either taken to the nearest veterinary clinic for treatment, or if the animal is unlikely to survive, it will be humanely euthanized).

Provision of a report following the completion of clearing works will be provided detailing the total number and species of individuals recorded and details of their release/health.

8.4.6. Habitat Feature Salvage

18 hollow-bearing trees have been identified within the Subject Land. Following felling, hollows that are intact will be removed from felled trees and attached to remaining trees in the VMP Area and Study Area. Any hollow that is unable to be salvaged, shall be replaced by a nest box of a similar size.

8.4.7. Sedimentation Control Measures

The project may result in erosion and transport of sediments as a result of soil disturbance during construction. In order to prevent this impact, construction activities will be undertaken in accordance with "The Blue Book" (Landcom 2004). These include implementation of the following measures:

- Installation of sediment control fences;
- Covering soil stockpiles; and
- Avoiding soil disturbance prior to heavy rainfall.

8.4.8. Vegetation Management Plan

A VMP has been prepared to guide the restoration of the TEC Southern Highlands Shale Woodlands throughout a 40m wide riparian corridor along the southern boundary of the Subject Land. All weeds will be removed from areas in which canopy species are to be retained, and native species planted to restore a native shrub layer and ground layer. In areas in which earthworks are required to facilitate the redirection of the streams, complete revegetation will be undertaken of species consistent with all structural layers. The VMP has been prepared in accordance with the document *Guidelines for Vegetation Management Plans on Waterfront Land* (NSW Office of Water 2012).

Table 14 Summary of mitigation measures for impacts to native vegetation and habitat

Mitigation Measure	Proposed Techniques	Timing	Frequency	Responsibility	Risk of Failure	Risk and Consequences of Residual Impacts
Weed management	Appropriate weed control activities will be undertaken in accordance with the South East Regional Strategic Weed Management Plan 2017 – 2022 (LLS: South East 2017).	Construction	Prior to construction, following vegetation clearing	Contractor	High	Spread of weeds throughout the Study Area and surrounding land.
Delineation of clearing limits	Clearing limits marked either by high visibility tape on trees of metal/wooden pickets, fencing or an equivalent boundary marker. Disturbance, including stockpiling, restricted to clearing limits.	Construction	Once	Contractor	High	Unnecessary damage to trees to be retained, including threatened species *Eucalyptus macarthurii*.
Tree protection measures	Inductions to communication tree protection measures. Installation of fences around specified tree protection zones. All tree work is to be carried out by a suitably qualified and insured Arborist. Arborist to be consulted on all construction works in close proximity to *Eucalyptus macarthurii* individuals to be retained.	Construction	Throughout construction period	Contractor	High	Unnecessary damage to trees to be retained.

Mitigation Measure	Proposed Techniques	Timing	Frequency	Responsibility	Risk of Failure	Risk and Consequences of Residual Impacts
Pre-clearance survey	Pre-clearance surveys will be conducted in all areas of vegetation that are required to be cleared. Pre-clearing surveys will be undertaken within one week prior to clearing (no earlier). Habitat features will be marked during the pre-clearing survey.	Construction	Once	Contractor	Moderate	Increased and unnecessary mortality of native fauna.
Staging of clearing	Vegetation clearing will be conducted using a two-stage clearing process. Animals disturbed or dislodged during the clearance but not injured will be assisted to move to adjacent bushland or other specified locations If animals are injured during the vegetation clearance, appropriate steps will be taken to humanely treat the animal (either taken to the nearest veterinary clinic for treatment, or if the animal is unlikely to survive, it will be humanely euthanized)	Construction	Once	Contractor	High	Increased and unnecessary mortality of native fauna.
Habitat feature salvage	Hollow to be removed within the Subject Land to be salvaged and attached to a retained tree. Should the structural integrity of the hollow not be maintained during the removal process, a single next box will be installed within retained vegetation.	Construction	Once	Contractor	Moderate	Reduction in available breeding habitat of hollow-dependent fauna and increased competition for

Mitigation Measure	Proposed Techniques	Timing	Frequency	Responsibility	Risk of Failure	Risk and Consequences of Residual Impacts
						hollows outside of the Subject Land.
Sedimentation control	Construction activities will be undertaken in accordance with "The Blue Book" (Landcom 2004). These include implementation of the following measures: • Installation of sediment control fences; • Covering soil stockpiles; and • Avoiding soil disturbance prior to heavy rainfall	Construction	Throughout construction period	Contractor	High	Sedimentation into retained and adjoining vegetation.

8.5. Mitigation of Prescribed Impacts

The following mitigation measures, described in ***Section 8.4***, are relevant to the prescribed impact of waterbodies, water quality and hydrological processes:

- Delineation of clearing limits;
- Vegetation Management Plan; and
- Sedimentation control.

No additional mitigation measures are proposed for prescribed impacts.

8.6. Use of Biodiversity Credits to Mitigate or Offset Indirect or Prescribed Impacts

Due to the small scale of indirect and prescribed impacts, the project does not propose to use additional biodiversity credits to mitigate or offset these impacts.

9. Thresholds for Assessment

9.1. Introduction

The assessment thresholds that must be considered include the following:

- Impacts on an entity that is at risk of a serious and irreversible impact;
- Impacts for which the assessor is required to determine an offset requirement;
- Impacts for which the assessor is not required to determine an offset requirement; and
- Impacts that do not require further assessment by the assessor.

The following sections outline these assessment thresholds and their relevance to the project.

9.2. Impacts on Serious and Irreversible Impact Entities

One SAII entity, Southern Highlands Shale Woodlands, will be impacted by the project. The location of the Southern Highlands Shale Woodlands in relation to the Subject Land is shown in **Figure 7**. Approximately 0.54 ha of Southern Highlands Shale Woodlands will be removed within the Subject Land, and a further 1.46 ha will be modified as it will be retained in Asset Protection Zones which will be mown. The ground layer in the APZ areas is currently comprised nearly entirely of exotic species, so the main impacts will be a reduction in litter/log cover.

Section 10.2.2 of the BAM requires the provision of additional information regarding SAII entities that are TECs. The additional information is required to assist the consent authority to evaluate the nature of an impact on an entity at potential risk of a serious and irreversible impact. The additional information requirements are shown as italicised text below, with responses supplied beneath in plain text. The information presented below indicates that the project is unlikely to result in a significant and irreversible impact to the TEC.

(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII

The actions and measures taken to avoid impacts to Southern Highlands Shale Woodlands include amendments to the location of construction footprints, amending the design of construction footprints and wholly containing disturbance to within the Subject Land or cleared land. Mitigation measures proposed to be undertaken during construction have also been designed to minimise indirect impacts to the retained area of Southern Highlands Shale Woodlands within the Subject Land.

(b) the area (ha) and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone

Approximately 2 ha of Southern Highlands Shale Woodlands will be directly impacted within the Development Footprint. Approximately 0.18 ha of Southern Highlands Shale Woodlands occurs within the Subject Land and will be retained under a Vegetation Management Plan (VMP) within a riparian corridor, and has potential to be indirectly impacted. Within the Subject Land, the Southern Highlands Shale Woodlands has a current vegetation integrity score of 4.7.

(c) a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact

There is currently no defined threshold for this SAII entity. No thresholds are currently defined for TECs within the Sydney Basin IBRA bioregion and Cumberland Ecology understands that the EES does not intend to determine any of these thresholds at the current time.

(d) the extent and overall condition of the potential TEC within an area of 1000ha, and then 10,000ha, surrounding the proposed development footprint

Within an area of 1,000 ha surrounding the Subject Land, approximately 42.96 ha of Southern Highlands Shale Woodlands is mapped as occurring. This was derived using the broad scale vegetation mapping project of Southeast NSW by Tozer et al. (2010) in conjunction with the finer scale mapping of the Subject Land and Study Area by Cumberland Ecology for this BDAR and a previous Ecological Impact Assessment. The condition of Southern Highlands Shale Woodlands within an area of 1,000 ha surrounding the Subject Land is expected to be in a similar condition in agricultural areas surrounding the site, or better in the case of patches in areas that have undergone less intensive agriculture/pasture improvement, to that within the Subject Land .

Within an area of 10,000 ha surrounding the Subject Land, approximately 335.46 ha of Southern Highlands Shale Woodlands has been mapped. This was derived using the broad scale vegetation mapping project of Southeast NSW by Tozer et al. (2010) clipped to include a 10,000 ha area surrounding the Subject Land. The condition of Southern Highlands Shale Woodlands within an area of 10,000 ha surrounding the Subject Land is expected to be variable, with much of it in better condition than that within the Subject Land which is comprised of exotic species in the ground layer (with a low vegetation integrity score of 5.5) and larger patches such as those between the township of New Berrima and Berrima Road to the north are expected to be in good condition. The extent of Southern Highlands Shale Woodlands within an area of 10,000 ha surrounding the Subject Land is shown in **Figure 10**

(e) an estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the proposed development has been taken into consideration

Approximately 7551.61 ha of Southern Highlands Shale Woodlands is mapped as occurring within the Moss Vale IBRA subregion. This value is derived from mapped areas included within Tozer et al. (2010). The project will result in the removal of approximately 0.54 ha of Southern Highlands Shale Woodlands within the Subject Land, which represents 0.0084% of the extent within the Moss Vale IBRA subregion. The current extent of Southern Highlands Shale Woodlands amounts to less than 5% of the original distribution (NSW Scientific Committee 2011b).

The current distribution of Southern Highlands Shale Woodlands is severely fragmented, and much of the remaining area of the community consists of small, isolated fragments (NSW Scientific Committee 2011a). The overall condition of Southern Highlands Shale Woodlands across the Sydney Basin bioregion is unlikely to change as a result of the project, as the condition present within the Subject Land is highly modified and is an extremely small area, and larger patches of the community in better condition will remain, with some of these patches occurring in conservation reserves such as Cecil Hoskins Nature Reserve. Additionally, a VMP is to be prepared for a riparian corridor within the Subject Land which will guide the revegetation of this area of the

site with Southern Highlands Shale Woodlands species, and the restoration of the community in some areas in which the canopy will be retained.

(f) an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion

A total of approximately 7551.61 ha of Southern Highlands Shale Woodlands occurs within the Moss Vale IBRA subregion, of which approximately 16.4 ha occurs in the reserve system.

A total of approximately 75.38 ha of Southern Highlands Shale Woodlands occurs within the reserve system within the Sydney Basin IBRA bioregion.

(g) the development, clearing or biodiversity certification proposal's impact on:

(i) abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns

The project will not involve changes to groundwater levels. Surface water patterns will be modified slightly with the realignment of a first and second order stream, however as these are ephemeral streams, and the majority of the TEC within the Subject Land and Study Area does not currently occur immediately adjacent to these streams, it is not expected that the existing streams and associated surface water patterns are integral to the persistence of the TEC. The project is unlikely to have any impact on abiotic factors critical to the long-term survival of the TEC, within the Subject Land. Soils associated with small areas of the TEC to be retained within the VMP Area will also be retained.

(ii) characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants

The project will result in the removal of 0.54 ha of Southern Highlands Shale Woodlands, comprising an area of canopy trees with an absent midstorey and ground layer dominated almost exclusively by exotic grass species. Within the 0.54 ha of the community within these areas of the Subject Land, a substantial change will occur to the composition of the community, as it will be entirely removed. A further 1.46 ha will be managed as an APZ, however no functionally important or characteristic species will be impacted as the areas to be mown are comprised nearly entirely of exotic species. Under the Landscape Plan prepared by SBA (2019) the species composition of these areas will be improved, as although the areas will be mown, they will be seeded with Southern Highlands Shale Woodland ground layer species and additional southern highlands shrub and canopy species will be planted.

(iii) the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the potential TEC

The Southern Highlands Shale Woodlands within the Subject Land has previously been modified as a result of previous clearing and long term historical grazing and pasture improvement. A suite of invasive flora species, including high threat exotics, are known to occur within this community within the Subject Land (dominating

the ground layer), and there is little potential for an increase of such species in areas of retained Southern Highlands Shale Woodlands within the Subject Land due to the current poor condition of the vegetation. The project is considered unlikely to result in the regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in areas of retained Southern Highlands Shale Woodlands as the project consists of construction of a Brickworks Plant and land use is predicted to be limited in the Subject Land to manufacturing bricks. The quality and integrity of the remaining areas of the TEC surrounding the Subject Land, is unlikely to be significantly impacted, due to the modified nature of the surrounding vegetation.

(h) direct or indirect fragmentation and isolation of an important area of the potential TEC

Southern Highlands Shale Woodlands is considered to be severely fragmented, due to past agricultural clearing and rural development (NSW Scientific Committee 2011b). The removal of 0.54 ha of Southern Highlands Shale Woodlands will not significantly increase fragmentation or isolation of an important area of the TEC, as it requires clearing of already isolated patches within an agricultural landscape. Although the project will increase the amount of overall fragmentation on a small scale, it will not result in the isolation of important areas of habitat. Larger, more intact areas of the community within the Study Area providing habitat connectivity will be retained.

(i) the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.

Mitigation measures to be implemented for the project will assist in minimising potential impacts to retained Southern Highlands Shale Woodlands within the Subject Land and Study Area. Revegetation of the community within a riparian corridor under a VMP will also result in improvement of the occurrence of the community within the Subject Land as it will include planting of species consistent with the community in all structural layers – the community currently exists as trees only. This riparian corridor will provide a more intact biodiversity corridor through the Study Area, than currently exists.

9.3. Impacts that Require an Offset

9.3.1. Threatened Species (Species Credit Species)

Due to habitat present in the form of trees with hollows in areas requiring complete vegetation removal, two fauna species require purchase of biodiversity credits (see **Table 17**). These species are the Gang-gang Cockatoo, and the Glossy Black Cockatoo.

One threatened flora species will also require the purchase of biodiversity credits to offset, *Eucalyptus macarthurii*, due to the proposed removal of 16 individuals.

Biodiversity credits required are detailed further in **Section 9.5**.

9.4. Impacts that do not Require an Offset

9.4.1. Native Vegetation

In accordance with the BAM, a project requires offsets for the clearing of native vegetation if the following criteria are met:

- A vegetation zone that has a vegetation integrity score ≥15 where the PCT is representative of an EEC or CEEC; and
- A vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or is representative of a vulnerable ecological community.

The PCTs and vegetation zones assessed for offsets are documented in **Table 15**. These areas are mapped in **Figure 10**. As all PCTs had a Vegetation Integrity Score of <15 offsets are not required for vegetation communities, however offsets are required for three species credit species (see **Section 9.3.2**). . Within the BAM calculator impacts to the 2 ha of PCT 944 have been separated into separate management zones;, Approximately 0.54 ha comprises management zone titled Complete Removal (CR) in which all vegetation will be removed, and approximately 1.46 ha comprises the management zone titled Asset Protection Zone (APZ) in which some management will occur of the ground layer.

It is noted that the Department of Planning, Industry and Environment published a revised version of the BAM that was on public exhibition until 16 October 2019, which included a module to assess planted native vegetation. As the revised version of the BAM is not finalised, this BDAR has been based on the current advice for planted vegetation, which is to assign to a best-fit PCT.

Table 15 Summary of impacts to native vegetation

Vegetation Zone	PCT #	PCT Name	Condition Name	Area (ha)	Patch Size Class	Vegetation Integrity Score
1	944	Mountain Grey Gum – Narrow-leaved Peppermint grassy woodland on shales of the Southern Highlands, southern Sydney Basin Bioregion	Low	2	101 ha	4.7
2	731	Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	Low	0.06	101 ha	10.4

9.4.2. Threatened Species (Species Credit Species)

One threatened species credit species, the fauna species the Southern Myotis (*Myotis macropus*) was assessed as having habitat within areas of vegetation to be removed in the Subject Land. Due to the small area of habitat to be removed, this did not generate a requirement for an offset in the BAM calculator (see **Table 17**).

9.5. Impacts that do not Require Further Assessment

9.5.1. Exotic Vegetation

All areas identified as 'Cleared/Exotic Vegetation' that occur within the Subject Land do not require an offset. These areas comprise approximately 18.44 ha, as shown on **Figure 11**.

9.6. Application of the No Net Loss Standard

The BAM sets a standard that will result in no net loss of biodiversity values where the impacts on biodiversity values are avoided, minimised and mitigation, and all residual impacts are offset by retirement of the required number of biodiversity credits.

No ecosystem credits are required, as detailed in **Table 16**.

The species credit requirement for the project is summarised in **Table 17**. Like for like options for species credits are summarised in **Table 18**.

A credit summary report from the BAMC has been included in **Appendix C**.

Table 16 Summary of Ecosystem Credits Required

Vegetation Zone	TEC	Approximate Area (ha)	Vegetation Integrity Loss	Credits Required
944_Low	Yes	2	3.3	0
731_Low	No	0.06	10.4	0
Total	**-**	**2.06**	**-**	**0**

Table 17 Credits required for Species Credit Species

Species	Approximate Area or Count	Biodiversity Risk Weighting	Credits Required
Callocephalon fimbriatum/Gang-gang Cockatoo	0.54 ha	2	1
Calyptorhynchus lathami / Glossy Black-Cockatoo	0.54 ha	2	1
Eucalyptus macarthurii/Paddys River Box, Camden Woollybutt	16 individuals	2	32
Myotis macropus / Southern Myotis	0.1	2	0
Total	**-**	**-**	**34**

Table 18 Options for like for like Species Credit Species credits

Species	In the below IBRA subregions
Callocephalon fimbriatum/Gang-gang Cockatoo	Any in NSW
Calyptorhynchus lathami / Glossy Black-Cockatoo	Any in NSW
Eucalyptus macarthurii/Paddys River Box, Camden Woollybutt	Any in NSW
Myotis macropus / Southern Myotis	Any in NSW

10. Conclusion

The assessment of impacts detailed in this BDAR requires the following biodiversity credits to be retired (as detailed in **Chapter 9** and **Appendix C**) or equivalent payment into the Biodiversity Conservation Trust, or equivalent funding to be made to a Biodiversity Conservation Action as detailed in Clause 6.5 of the Biodiversity Conservation Regulation 2015, which details the ancillary rules for biodiversity offsetting under the BAM:

- *Callocephalon fimbriatum* – 1 credit;
- *Calyptorhynchus lathami* – 1 Credit; and
- *Eucalyptus macarthurii* – 32 credits.

These Species Credit Species credits are the only biodiversity credits required. Due to the highly degraded nature of the vegetation communities present within the Subject Land no Ecosystem credits are required.

As required and directed by the BAM, offsetting will be undertaken by purchasing the aforementioned biodiversity credits and retiring them, or where credits are not available by making an equivalent payment into the Biodiversity Conservation Trust, or if not feasible, equivalent funding will be made to a Biodiversity Conservation Action.

Further measures to mitigate the biodiversity impacts within the Subject Land (as detailed in **Chapter 8)** are:

- Weed Management
- Delineation of Clearing Limits
- Tree Protection Measures
- Pre-clearance Surveys
- Staging of Clearing
- Habitat Feature Salvage
- Sedimentation Control Measures; and
- Preparation of a Vegetation Management Plan.

11. References

Allied Tree Consultancy. 2020. Arboricultural Impact Assessment Report: No. 416 and 524 Berrima Road, Moss Vale.

Aquila Ecological Surveys. 2010. New Berrima Clay/Shale Quarry. Fauna Assessment. Aquila Ecological Surveys, Cowan.

Cumberland Ecology. 2018. Masonry Plant - Berrima Road, Moss Vale: Ecological Impact Assessment. Epping, NSW.

Eco Logical Australia. 2003. Wingecarribee Biodiversity Strategy Phase 1. Vegetation Mapping, Threatened Species Database, Habitat Corridors, Conservation Assessment. Eco Logical Australia, Sutherland.

EMM. 2017. Berrima Rail Project. Biodiversity Assessment Report. EMM Consulting, St Leonards.

Geoff Cunningham Natural Resource Consultants. 2010. New Berrima Clay/Shale Quarry. Flora Assessment. Geoff Cunningham Natural Resource Consultants Pty Ltd, Killara.

Kevin Mills & Associates. 2016. New Berrima Clay/Shale Quarry. Mandurama No. 524 Berrima Road, Moss Vale. Assessment of Causeway - Flora and Fauna. Kevin Mills & Associates Pty Limited, Jamberoo.

Landcom. 2004. Managing Urban Stormwater: Soils and Construction ("Blue Book"), Fourth Edition, NSW Government, Parramatta.

LLS: South East, editor. 2017. South East Regional Strategic Weed Management Plan 2017 - 2022. Local Land Services NSW.

NSW Office of Water. 2012. Controlled Activities on Waterfront Land: Guidelines for vegetation management plans on waterfront land.

NSW Scientific Committee. 2001. Southern Highlands shale woodlands in the Sydney Basin Bioregion - endangered ecological community listing. Office of Environment and Heritage, Hurstville.

NSW Scientific Committee. 2011a. Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing - Final Determination. NSW Office of Environmnet and Heritage, Hurstville.

NSW Scientific Committee. 2011b. Southern Highlands Shale Woodlands in the Sydney Basin Bioregion - Determination to make a minor amendment to Part 3 of Schedule 1 of the Threatened Species Conservation Act. Office of Environment and Heritage, Hurstville.

OEH. 2019. eSPADE.*in* OEH, editor.

Opus, and Wingecarribee Shire Council. 2017. Berrima Road Deviation. Preliminary Environmental Investigation. Opus International Consultants (Australia) Pty Ltd and Wingecarribee Shire Council.

SBA. 2019. Landscape Documentation for Development Application - Proposed Brickworks Plant, 416 and 524 Berrima Road, Moss Vale, NSW 2577. SBA.

Tozer, M. G., K. Turner, D. A. Keith, D. Tindall, C. Pennay, C. Simpson, B. MacKenzie, P. Beukers, and S. Cox. 2010. Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. Cunninghamia **11**:359-406.

Wingecarribee Shire Council. 2016. Biological Information. Proposed Berrima Road Deviation. Wingecarribee Shire Council.

APPENDIX A :
BAM Plot Data

Table 19 BAM Plot Data Recorded within the Subject Land

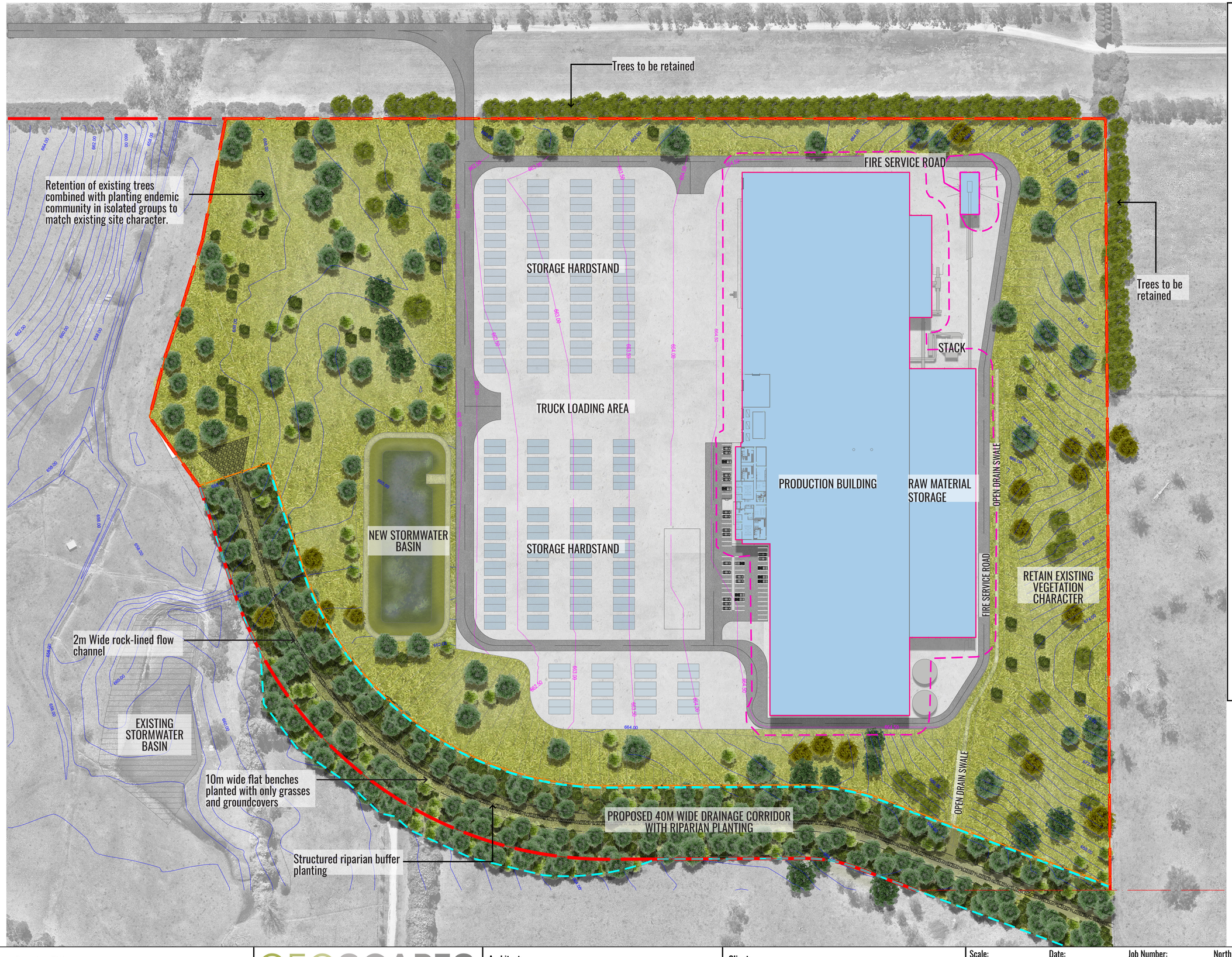
BAM GFG	Family	Scientific Name	Common Name	NSW Status	Comm. Status	Nat.	Exo.	HTW	Plot 1		Plot 2		Plot 3	
									C	A	C	A	C	A
Tree (TG)	Myrtaceae	*Eucalyptus cinerea*	Argyle Apple	Not Listed	Not Listed	YES					10.0	4		
Tree (TG)	Myrtaceae	*Eucalyptus macarthurii*	Paddys River Box, Camden Woollybutt	Endangered	Endangered	YES			25.0	6			20.0	3
Tree (TG)	Myrtaceae	*Eucalyptus scoparia*	Wallangarra White Gum	Endangered	Vulnerable	YES					3.0	1		
	Asteraceae	*Carduus nutans subsp. nutans*	Nodding Thistle	Not Listed	Not Listed		YES				0.1	3	0.1	20
	Asteraceae	*Cirsium vulgare*	Spear Thistle	Not Listed	Not Listed		YES				0.2	10	0.2	4
	Asteraceae	*Hypochaeris radicata*	Catsear	Not Listed	Not Listed		YES		0.1	10	0.1	5		
	Asteraceae	*Silybum marianum*	Variegated Thistle	Not Listed	Not Listed		YES		0.1	30	0.1	10		
	Asteraceae	*Taraxacum officinale*	Dandelion	Not Listed	Not Listed		YES		0.1	5			0.1	3
	Brassicaceae	*Hirschfeldia incana*	Buchan Weed	Not Listed	Not Listed		YES		0.3	200	0.1	20	0.1	10
	Brassicaceae	*Lepidium africanum*	Common Peppercress	Not Listed	Not Listed		YES		0.1	2	0.1	5	0.1	10

BAM GFG	Family	Scientific Name	Common Name	NSW Status	Comm. Status	Nat.	Exo.	HTW	Plot 1		Plot 2		Plot 3	
									C	A	C	A	C	A
	Cyperaceae	*Carex divulsa*		Not Listed	Not Listed		YES		5.0	1,000	5.0	500	5.0	500
	Fabaceae (Faboideae)	*Medicago polymorpha*	Burr Medic	Not Listed	Not Listed		YES		0.1	20			0.1	5
	Malvaceae	*Malva parviflora*	Small-flowered Mallow	Not Listed	Not Listed		YES		0.1	10	1.0	200	0.1	20
	Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	Not Listed	Not Listed		YES		0.1	100	0.1	50	0.1	50
	Poaceae	*Bromus catharticus*	Praire Grass	Not Listed	Not Listed		YES		20.0	3,000	60.0	6,000	50.0	5,000
	Poaceae	*Bromus hordeaceus*	Soft Brome	Not Listed	Not Listed		YES				0.1	10		
	Poaceae	*Cenchrus clandestinus*	Kikuyu Grass	Not Listed	Not Listed		YES	YES	10.0	1,000			2.0	200
	Poaceae	*Dactylis glomerata*	Cocksfoot	Not Listed	Not Listed		YES		10.0	1,000			20.0	2,000
	Poaceae	*Festuca pratensis*	Meadow Fescue	Not Listed	Not Listed		YES		10.0	1,000	1.0	100	3.0	300
	Poaceae	*Lolium perenne*	Perennial Ryegrass	Not Listed	Not Listed		YES		20.0	2,000	10.0	1,000	5.0	500
	Poaceae	*Nassella trichotoma*	Serrated Tussock	Not Listed	Not Listed		YES	YES	0.1	50	1.0	100	0.1	5
	Poaceae	*Phalaris aquatica*	Phalaris	Not Listed	Not Listed		YES		10.0	1,000	1.0	100	5.0	500

BAM GFG	Family	Scientific Name	Common Name	NSW Status	Comm. Status	Nat.	Exo.	HTW	Plot 1		Plot 2		Plot 3	
									C	A	C	A	C	A
	Polygonaceae	*Polygonum aviculare*	Wireweed	Not Listed	Not Listed		YES						0.1	2
	Scrophulariaceae	*Verbascum virgatum*	Twiggy Mullein	Not Listed	Not Listed		YES		0.1	10				
	Urticaceae	*Urtica urens*	Small Nettle	Not Listed	Not Listed		YES				0.1	1		

Table Key: GFG = Growth Form Group, Nat. = Native, Exo. = Exotic, HTW = High Threat Weed, C = Cover (%), A = Abundance

APPENDIX B :
Project Landscape Plan



LEGEND

- SITE BOUNDARY
- FENCE TO ARCHITECT'S DETAILS
- EXISTING PASTURE LAND TO BE RETAINED
- PROPOSED HARDSTAND
- PROPOSED INDICATIVE FLOW SPREADER. REFER TO CIVIL DWGS.
- 40M RIPARIAN CORRIDOR BUFFER SETBACK
- ASSET PROTECTION ZONE BOUNDARY AS PER BUSHFIRE REPORT

Drawing Title:

Overall Landscape Plan

DWG No: **LDA-01**

GEOSCAPES LANDSCAPE ARCHITECTS
Suite 215, 284 Victoria Ave, Chatswood NSW 2067 Ph. (02) 9411 1485
www.geoscapes.com.au
ABN 84 620 205 781 ACN 620 205 781

Architect: SBA ARCHITECTS

Client: WILLOW TREE PLANNING

Scale: 1:1000 @ A1, 1:2000 @ A3

Date: 24.04.20

Job Number: 190722

North:

Project: PROPOSED BRICKWORKS PLANT
416 and 524 Berrima Road, Moss Vale, NSW 2577

Revision — FOR SSD APPROVAL

Rev	Date	Description	Drawn	Checked
D	03.04.20	FOR SSD	SW	BG
E	22.04.20	FOR SSD	SW	BG
F	24.04.20	FOR SSD - UPDATED FLOW SPREADER	SW	BG

APPENDIX C :

BAMC Summary Credit Report

BAM Credit Summary Report

Proposal Details

Assessment Id
00019529/BAAS17027/20/00020511

Proposal Name
New Berrima Brickworks

BAM data last updated *
05/05/2020

Assessor Name

Report Created
28/05/2020

BAM Data version *
26

Assessor Number

BAM Case Status
Finalised

Date Finalised
28/05/2020

Assessment Revision
0

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion								
2	731_Low	10.4	0.1	0.25	High Sensitivity to Potential Gain	2.00		0
							Subtotal	**0**

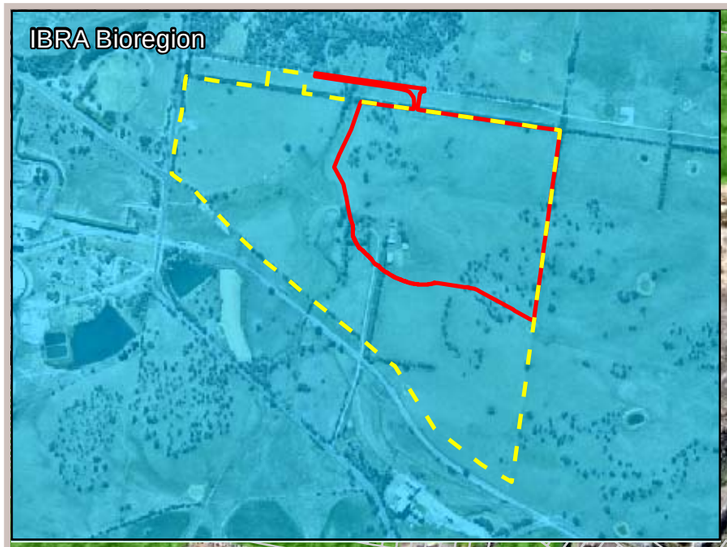
BAM Credit Summary Report

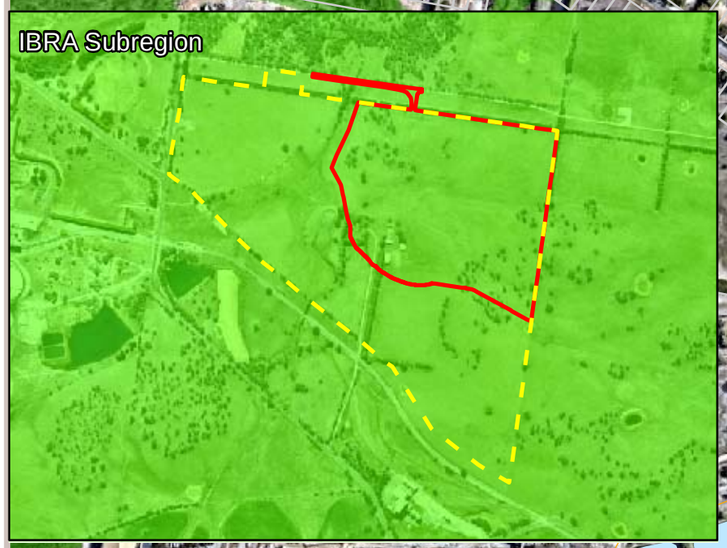
Mountain Grey Gum - Narrow-leaved Peppermint grassy woodland on shales of the Southern Highlands, southern Sydney Basin Bioregion								
1	944_Low	3.3	2.0	0.25	High Sensitivity to Potential Gain	2.00	TRUE	0
							Subtotal	**0**
							Total	**0**

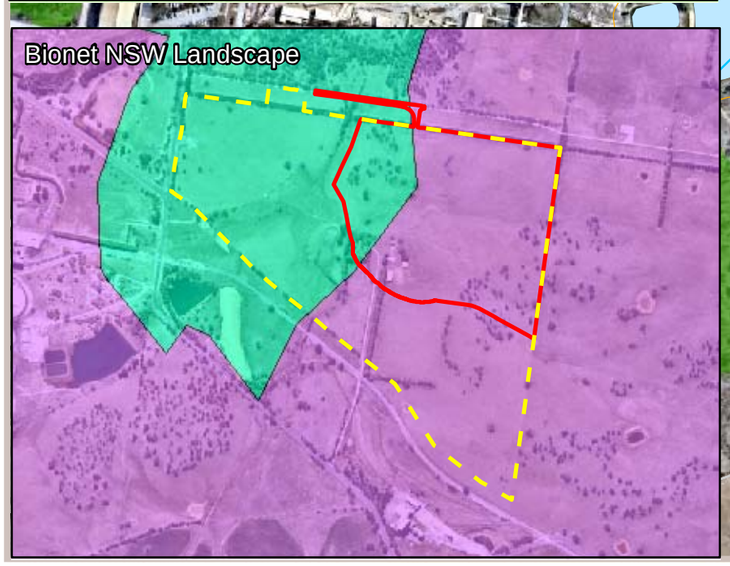
Species credits for threatened species

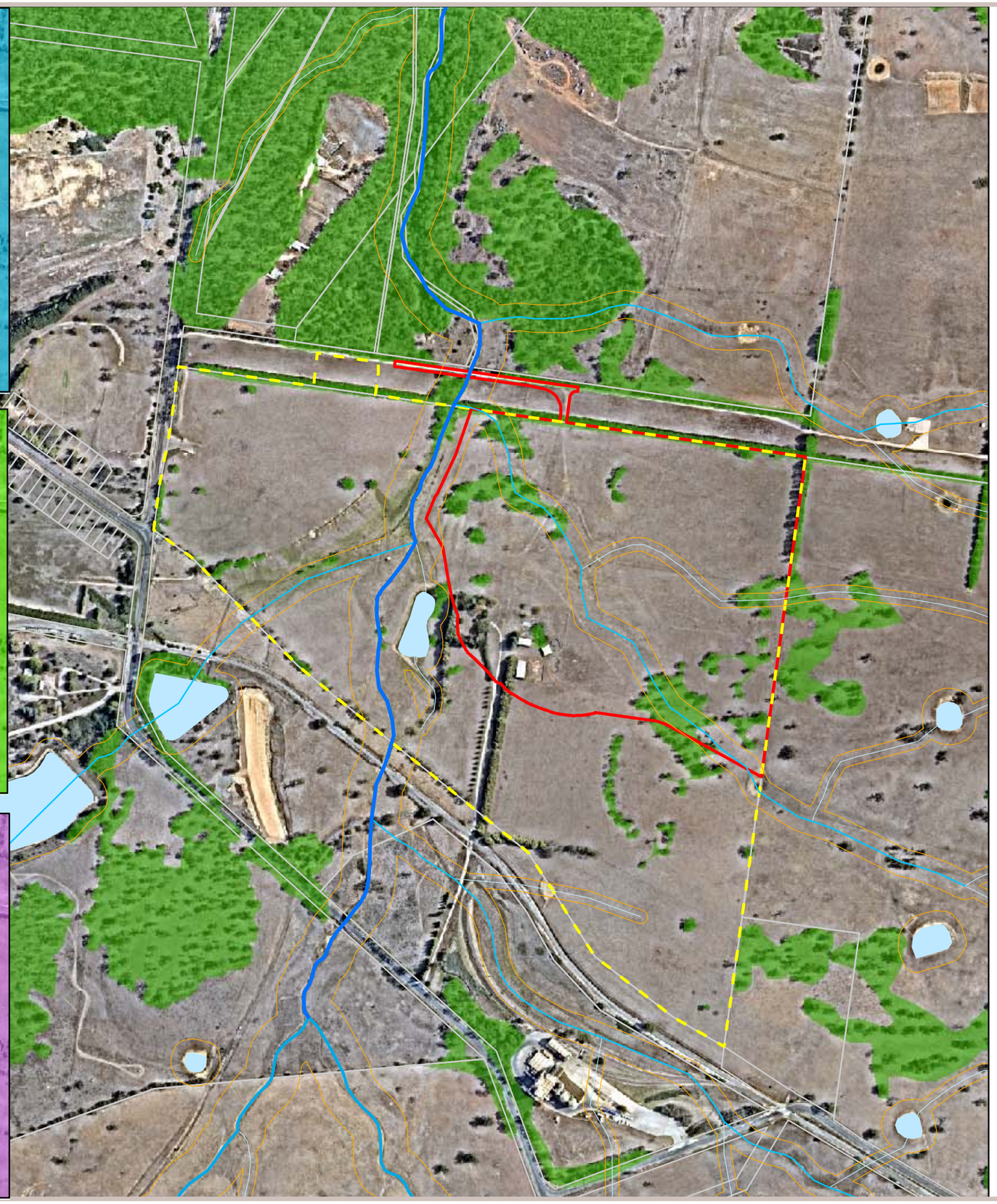
Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits
Callocephalon fimbriatum / Gang-gang Cockatoo (Fauna)						
944_Low	3.3	0.54	0.25	2	False	1
					Subtotal	**1**
Calyptorhynchus lathami / Glossy Black-Cockatoo (Fauna)						
944_Low	3.3	0.54	0.25	2	False	1
					Subtotal	**1**
Eucalyptus macarthurii / Paddys River Box, Camden Woollybutt (Flora)						
944_Low	N/A	16	0.25	2	False	32
					Subtotal	**32**
Myotis macropus / Southern Myotis (Fauna)						
944_Low	3.3	0.1	0.25	2	False	0
					Subtotal	**0**

FIGURES









Legend

- Subject Land
- Study Area
- Cadastre
- Native Vegetation Cover
- Riparian Buffer
- Local Wetland

Stream Order

- 1st Order (10 m Buffer)
- 2nd Order (20 m Buffer)
- 3rd Order (30 m Buffer)
- 4th Order (40 m Buffer)
- 5th Order (40 m Buffer)
- 6th Order and Above (50 m Buffer)

IBRA Bioregion

- Sydney Basin

IBRA Subregion

- Moss Vale

Bionet NSW Landscape

- Moss Vale Highlands
- Nattai Plateau

Image Source:
Image © Nearmap (2019)
Dated: 29/09/2019

Data Source:
State Environmental Planning Policy (Coastal Management) 2018
© Department of Finances, Sercives and Innovation 2017
DECCW (2008). Landscapes (Mitchell) of NSW - Version 3.
DSEWPaC (2012). Interim Biogeographic Regionalisation for Australia (IBRA) - Version 7.
Naylor, SD, Chapman, GA, Atkinson, G, Murphy CL, Tulau MJ, Flewin TC, Milford HB, Morand DT, (1998), Guidleines for the Use of Acide Sulfate Soil Risk Maps, 2nd ed., Department of Land and Water Conservation, Sydney

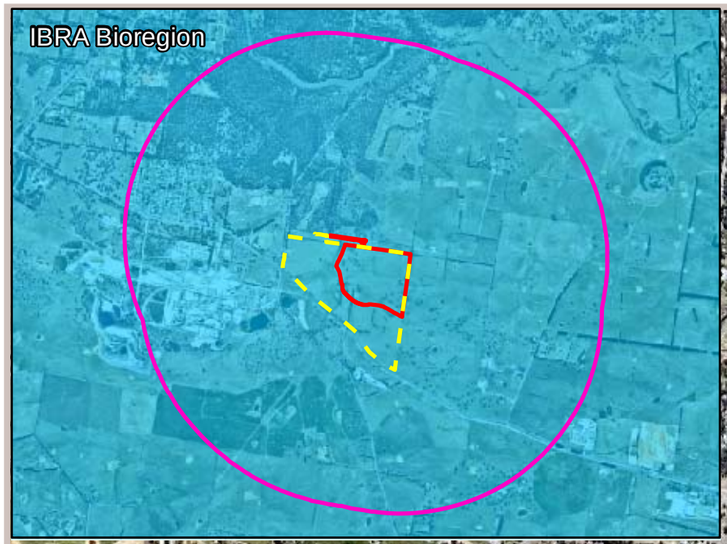
Coordinate System: MGA Zone 56 (GDA 94)

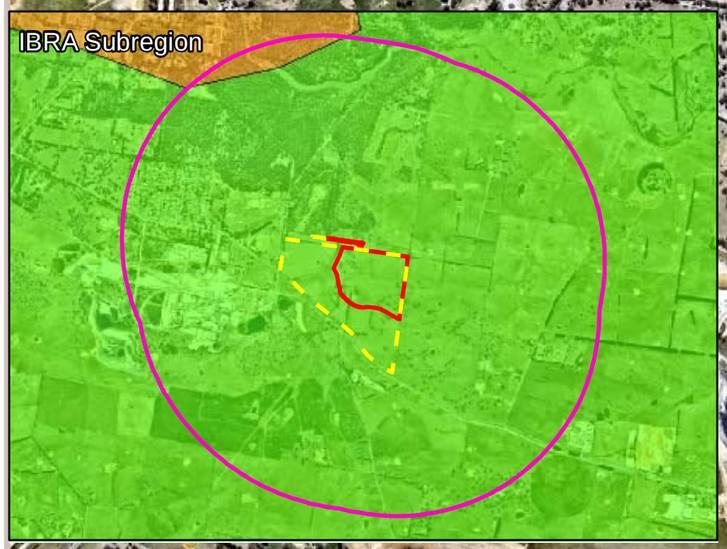
cumberland ecology

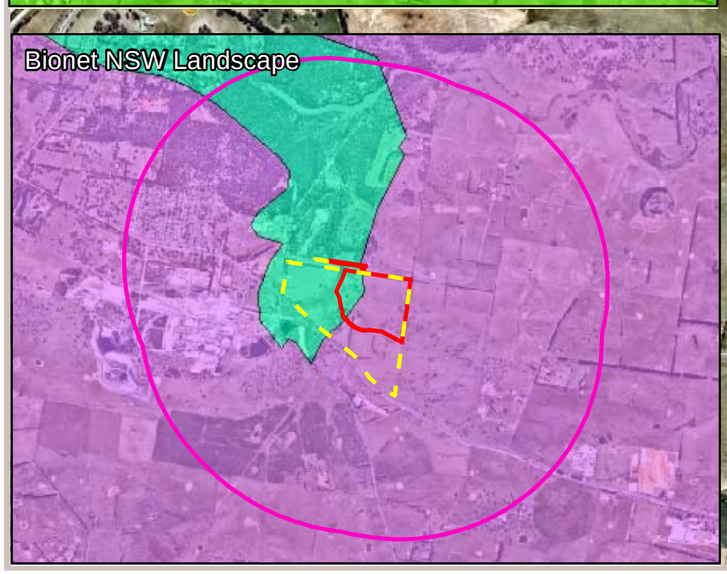
0 50 100 150 200 m

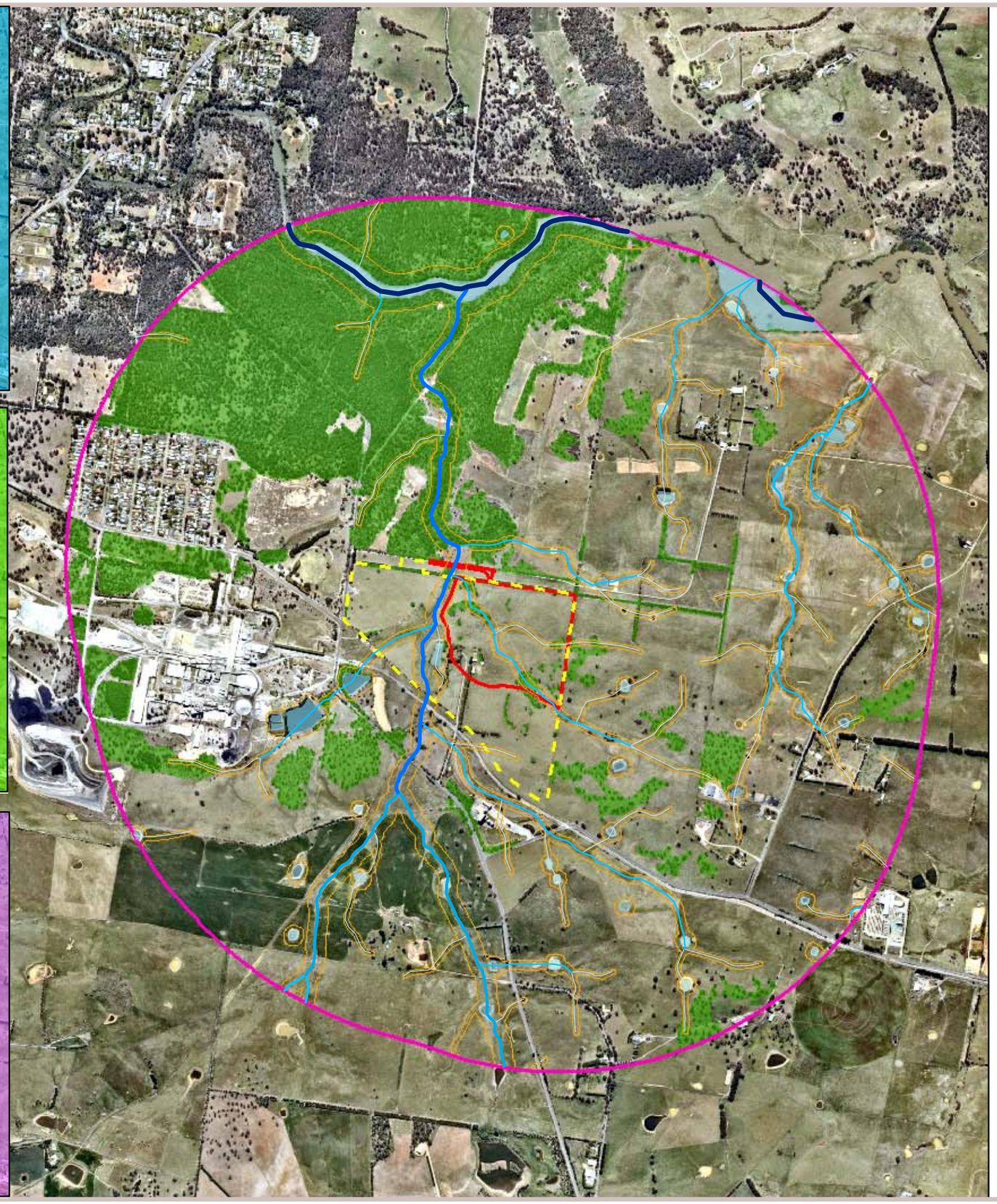
I:\...\19164\Figures\RP1\20200313\Figure 1. Site Map

Figure 1. Site Map









Legend

- Subject Land
- Study Area
- Assessment Area (1500 m)
- Native Vegetation Cover
- Riparian Buffer
- Local Wetland

Stream Order

- 1st Order (10 m Buffer)
- 2nd Order (20 m Buffer)
- 3rd Order (30 m Buffer)
- 4th Order (40 m Buffer)
- 5th Order (40 m Buffer)
- 6th Order and Above (50 m Buffer)

IBRA Bioregion

- Sydney Basin

IBRA Subregion

- Burragorang
- Moss Vale

Bionet NSW Landscape

- Moss Vale Highlands
- Nattai Plateau

Image Source:
Image © Nearmap (2019)
Dated: 29/09/2019

Data Source:
State Environmental Planning Policy (Coastal Management) 2018
© Department of Finances, Sercives and Innovation 2017
DECCW (2008). Landscapes (Mitchell) of NSW - Version 3.
DSEWPaC (2012). Interim Biogeographic Regionalisation for Australia (IBRA) - Version 7.
Naylor, SD, Chapman, GA, Atkinson, G, Murphy CL, Tulau MJ, Flewin TC, Milford HB, Morand DT, (1998), Guidleines for the Use of Acide Sulfate Soil Risk Maps, 2nd ed., Department of Land and Water Conservation, Sydney

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 150 300 450 600 m

I:\...\19164\Figures\RP1\20200313\Figure 2. Location Map

Figure 2. Location Map

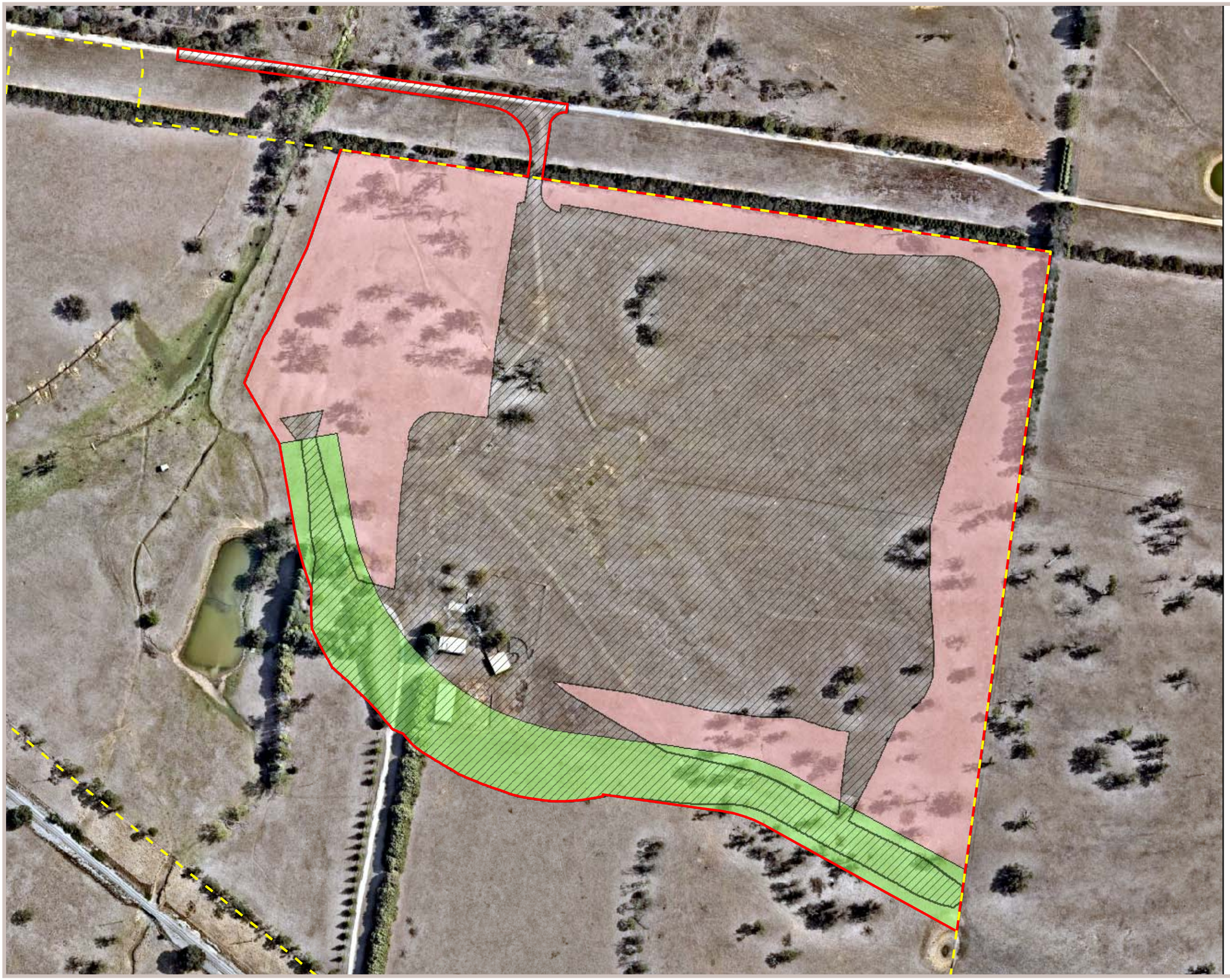


Figure 3. Layout of the Project



Legend

- BAM Plot
- Study Area
- Subject Land
- Survey Tracks

Plant Community Type

- 944 - Mountain Grey Gum - Narrow-leaved Peppermint grassy woodland on shales of the Southern Highlands, southern Sydney Basin Bioregion
- 731 - Broad-leaved Peppermint - Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion

Image Source:
Image © Nearmap (2020)
Dated: 30/01/2020

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 100 m

I:\...\19164\Figures\RP1\20200528\Figure 4. Field Survey

Figure 4. Field surveys within the subject land



Figure 5. Native vegetation extent within the subject land



Figure 6. Plant Community Types within the subject land

Legend

Subject Land

Study Area

Threatened Ecological Community

Southern Highlands Shale Woodlands in the Sydney Basin Bioregion

Image Source:
Image © Nearmap (2020)
Dated: 30/01/2020

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 100 m

I:\...\19164\Figures\RP1\20200313\Figure 7. TECs_Subject Land

Figure 7. Threatened Ecological Communities within the subject land

Legend

Subject Land

Study Area

Management Zone

APZ

Complete Clearance

Vegetation Zone

Zone 1 - 944 Low

Zone 2 - 731 Low

Image Source:
Image © Nearmap (2020)
Dated: 30/01/2020

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 50 100 m

I:\...\19164\Figures\RP1\20200528\Figure 8. Vegetation Zones_Subject Land

Figure 8. Vegetation zones within the subject land

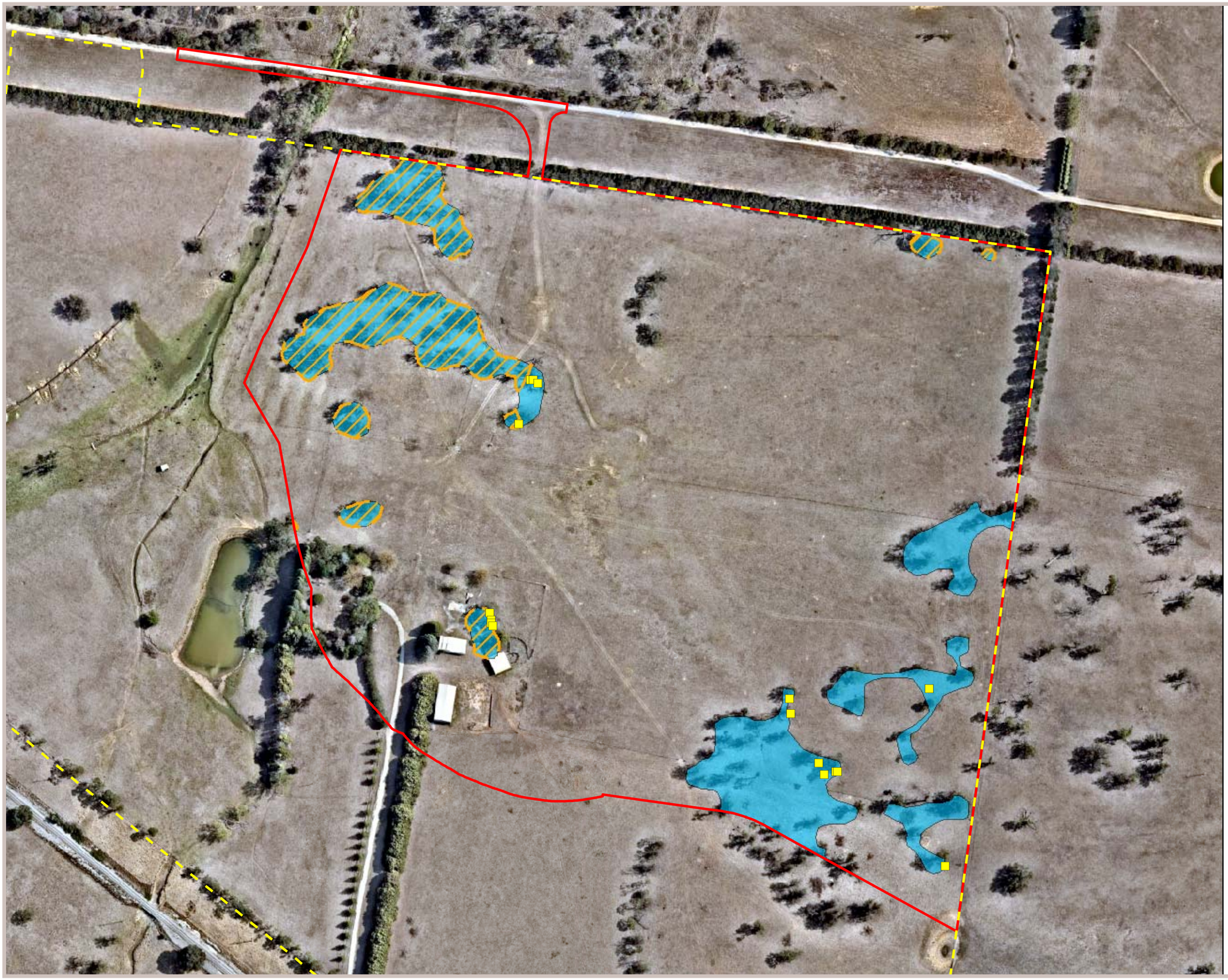


Figure 9. Species polygons and species credit species within the subject land

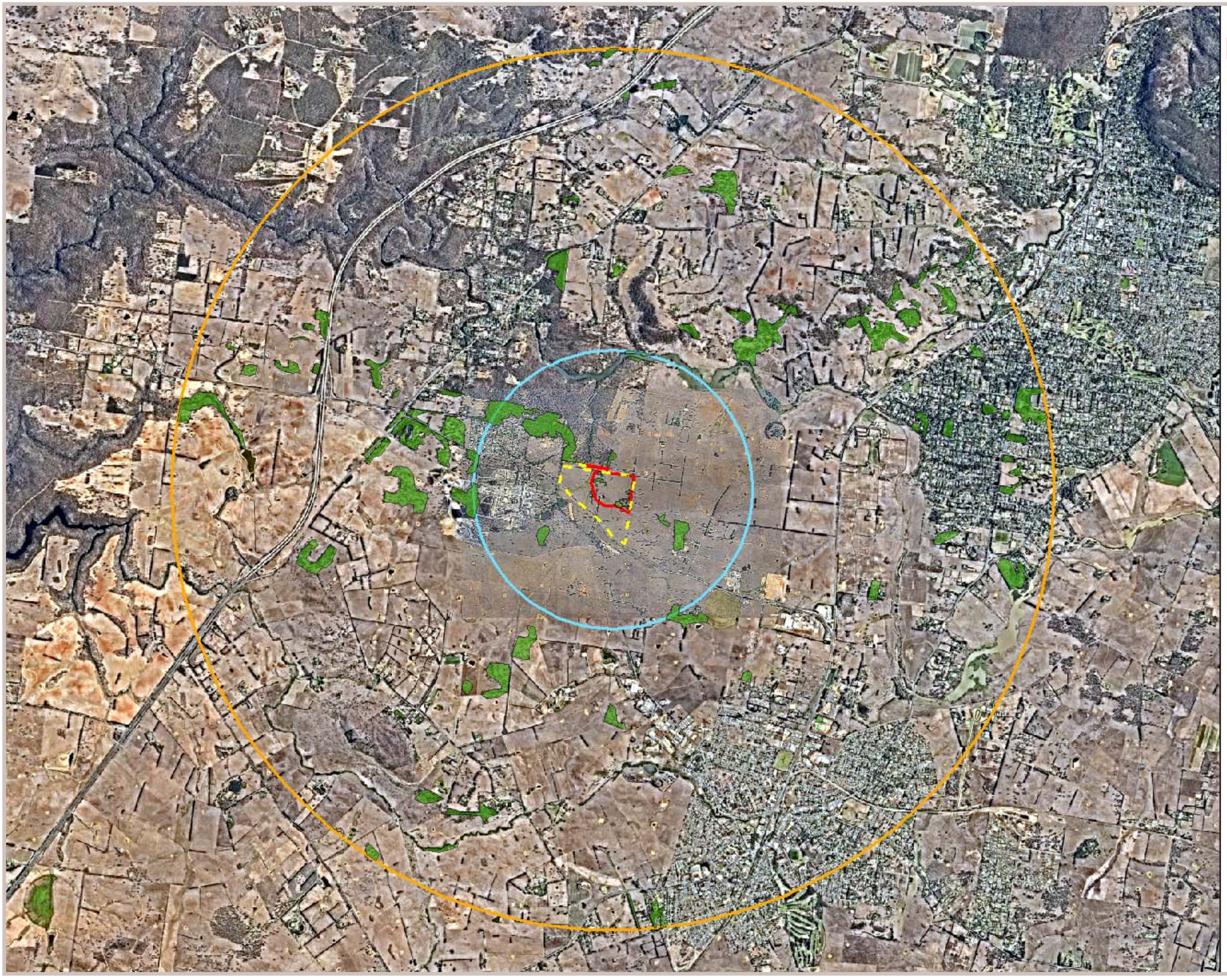


Figure 10. Extent of Southern Highlands Shale Woodland within a 10000 ha area surrounding the subject land

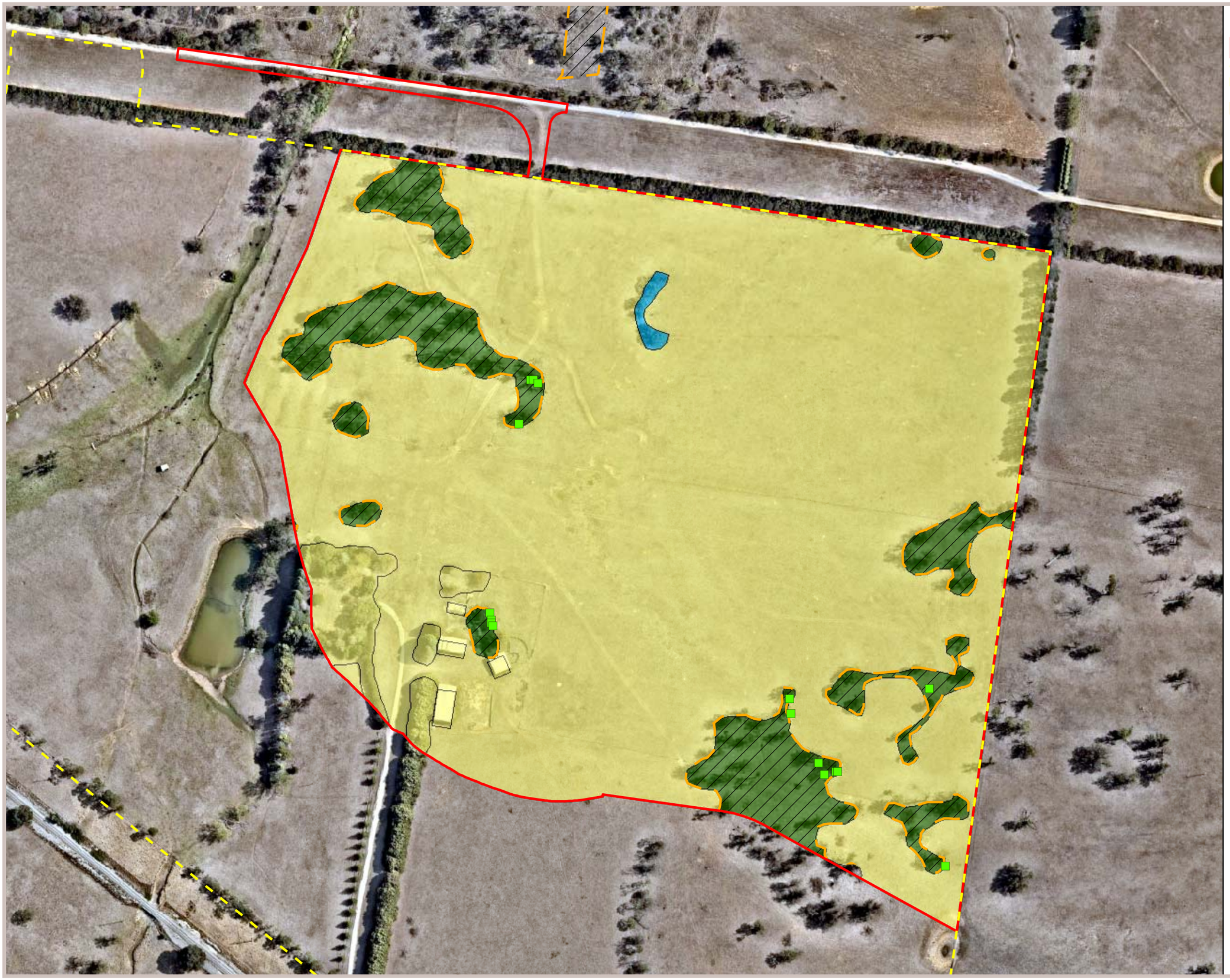


Figure 11. Thresholds for Assessment