

MENANGLE PARK - MASTER PLAN

Biodiversity Assessment

For:

Dahua Group Australia

November 2018

Final



**PO Box 2474
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Report No. 17072RP4

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 recommendations 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.

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Table of Contents

1 INTRODUCTION

1.1	Purpose	1.1
1.2	Project Context	1.2
1.2.1	Proposal Description	1.2
1.2.2	Previous Ecological Surveys	1.3
1.3	Background	1.4
1.3.1	Location of the Study Area	1.4
1.3.2	Landform, Geology and Soils	1.4
1.3.3	Vegetation	1.4
1.3.4	Hydrology	1.4
1.3.5	Land Uses	1.5
1.4	Relevant Strategic Planning Framework	1.5

2 METHODOLOGY

2.1	Desktop Assessment	2.1
2.1.1	Literature Review	2.1
2.1.2	Database Analysis	2.2
2.1.3	Vegetation Mapping and Spatial Data Review	2.2
2.2	Previous Field Surveys	2.2
2.3	Recent Field Surveys	2.5
2.3.1	Vegetation Mapping	2.5
2.3.2	Vegetation Sampling	2.5
2.3.3	Threatened Flora Searches	2.6
2.3.4	Vegetation Data Analysis	2.6
2.3.5	Fauna Habitat Assessment	2.7
2.3.6	Targeted Threatened Fauna Surveys	2.7
2.4	Limitations	2.9

3 RESULTS

3.1	Vegetation Communities	3.1
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Table of Contents *(Cont'd)*

3.1.1	Shale Plains Woodland	3.2
3.1.2	Shale Hills Woodland	3.3
3.1.3	Shale Hills Woodland Derived Native Grassland	3.5
3.1.4	Elderslie Banksia Scrub Forest	3.6
3.1.5	River-flat Eucalypt Forest	3.7
3.1.6	Swamp Oak Floodplain Forest	3.8
3.1.7	Freshwater Wetlands	3.10
3.1.8	River Oak Riparian Woodland	3.11
3.1.9	Acacia Regrowth	3.12
3.1.10	Exotic Vegetation and Cleared Land	3.13
3.2	Flora	3.15
3.2.1	General Species	3.15
3.2.2	Threatened Species	3.16
3.3	Fauna	3.16
3.3.1	Fauna Habitat	3.16
3.3.2	General Species	3.16
3.3.3	Threatened Species	3.17
4	CONSTRAINTS ANALYSIS	
4.1	Ecological Constraints	4.1
4.2	Potential Impacts of the Proposal	4.2
4.2.1	Overview	4.2
4.2.2	Vegetation Communities	4.2
4.2.3	Threatened Flora	4.5
4.2.4	Threatened Fauna	4.5
4.3	Future Ecological Assessments	4.5
4.3.1	Future Development Applications within the Study Area	4.5
4.3.2	Compensatory Measures	4.6

Table of Contents *(Cont'd)*

5 CONCLUSION

REFERENCES

List of Appendices

- A. FLORA SPECIES RECORDED BY CUMBERLAND ECOLOGY WITHIN THE STUDY AREA**
 - B. FAUNA SPECIES RECORDED BY CUMBERLAND ECOLOGY WITHIN THE STUDY AREA**
-

List of Tables

Table 3.1	Extent of vegetation communities within the study area	3.1
Table 3.2	State and regional priority weeds, weeds of regional concern and weeds of national significance	3.15
Table 4.1	Vegetation to be removed and retained within the study area under the proposal	4.3
Table 4.2	Vegetation to be removed and retained within the site under the proposal	4.4
Table A.1	Flora species recorded by Cumberland Ecology within the study area	A.1
Table B.1	Fauna species recorded by Cumberland Ecology within the study area	B.1

List of Figures

1.1	The site and study area	1.6
1.2	Land use plan of the proposal	1.7

List of Figures

2.1	Flora survey locations	2.10
2.2	Fauna survey locations	2.11
3.1	Vegetation communities within the study area	3.19
3.2	Threatened fauna recorded by Cumberland Ecology within the study area	3.20
4.1	Ecological constraints of the study area	4.8
4.2	Vegetation communities to be retained within the study area	4.9
4.3	Locations of proposed biodiversity stewardship sites	4.10

List of Photographs

3.1	Shale Plains Woodland within the study area	3.3
3.2	Shale Hills Woodland within the study area	3.5
3.3	Shale Hills Woodland derived native grassland within the study area	3.5
3.4	Elderslie Banksia Scrub Woodland within the study area	3.6
3.5	River-flat Eucalypt Forest within the study area	3.8
3.6	Swamp Oak Floodplain Forest within the study area	3.9
3.7	Freshwater Wetlands within the study area	3.10
3.8	River Oak Riparian Woodland within the study area	3.11
3.9	Acacia regrowth within the study area	3.12
3.10	Exotic Vegetation within the study area	3.13
3.11	Exotic Vegetation within the study area	3.14

Introduction

1.1 Purpose

Cumberland Ecology has been engaged by Dahua Group (Aust) Pty Ltd (Dahua) to prepare a biodiversity assessment of land located within the Menangle Park Urban Release Area (URA) that is subject to a proposed local environment plan (LEP) amendment and planning proposal (referred to collectively as the 'proposal') to be submitted to Campbelltown City Council (Council) in 2018.

The land to which the proposal relates includes all land owned or under the control of Dahua and six (6) additional properties to the east or north of Cummins Road owned or under the control of other landowners. This land is hereafter referred to collectively as the 'site' (see **Figure 1.1**). The Structure Plan, as proposed to be amended, continues to relate to all land within the Menangle Park URA. The proposed land use plan under the proposal is identified in **Figure 1.2**.

The purpose of this biodiversity assessment is to document the findings of the previous and recent ecological assessments to identify the potential ecological constraints within the site, and to identify the potential impacts of the proposal on the biodiversity values of the site. This biodiversity assessment also includes assessment of the proposal's impact on the broader area of the site as the potential impact of the proposal may extend beyond the boundaries of the site. For the purposes of this report the broader area is referred to as the 'study area' which constitutes the entire Menangle Park URA (see **Figure 1.1**).

Although the Structure Plan applies to the entire study area (i.e. Menangle Park URA), the amendments proposed within the proposal apply to the site only. As a result, the undertaking of detailed studies within areas outside of the proponent's land is not considered to be required for the purposes of this biodiversity assessment as these areas were assessed previously for the approved Structure Plan.

This biodiversity assessment also addresses comments received by Council on the preliminary planning proposal prepared by APP Corporation Pty Ltd and dated May 2018.

Ecological constraints of particular relevance include fauna habitat, and threatened species, populations and communities that are listed under the New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

It is noted that the NSW *Biodiversity Conservation Act 2016* (BC Act) has replaced the TSC Act as of 25 August 2017. However, for the purposes of this assessment, all reference is made to the TSC Act instead of the BC Act as the proposal applies to an 'interim designated area' under the NSW *Biodiversity Conservation (Savings and Transitional) Regulation 2017* which allows developments within the Campbelltown Local Government Area to be assessed under the TSC Act until 24 November 2018.

The specific objectives of this biodiversity assessment are to:

- Describe and map the vegetation communities within the study area;
- Identify the fauna habitats occurring within the study area;
- Identify any threatened species, populations and/ ecological communities (as listed under the TSC Act and/or EPBC Act) existing within the study area;
- Calculate the extent of vegetation removal and retention based on the proposal;
- Identify areas of low, moderate and high ecological constraints, including identification of areas where development may be increased as a result of the review of ecological constraints; and
- Discuss the requirement to undertake further ecological impact assessments for future development along with the future offsetting requirements/options.

As a precaution this assessment has assumed a 'worst case' scenario where all areas of the study area that are zoned for development under the proposal (i.e. not zoned as riparian or ecology) have been assumed to be entirely cleared. This is unlikely to be the case as areas of vegetation will likely be retained, especially in areas outside of the site that have been previously developed.

1.2 Project Context

1.2.1 Proposal Description

This biodiversity assessment has been prepared to support an amendment to *Campbelltown Local Environmental Plan 2015* (Campbelltown LEP 2015) in relation to 516 hectares (ha) of land within the Menangle Park URA, including 498 ha of land owned or under the control of Dahua and 18 ha owned or under the control of other landowners.

The URA was rezoned from rural land to urban purposes on 18 November 2017 to accommodate approximately 3,400 residential lots, a retail/commercial town centre, employment lands, and community and recreational facilities.

The proposed amendment builds upon the URA's previous rezoning and associated Structure Plan to create a new sustainable, healthy and high quality residential community comprising:

- 5,250 dwellings (an increase of 1,850 dwellings);

- A new major town centre comprising 30,000m² of retail / employment gross floor area;
- A new neighbourhood centre (approximately 3,500m² of employment floor space);
- A revised road and street network to provide better permeability throughout the site;
- Sporting fields and parks;
- Integrated passive recreation area within a riparian corridor network;
- Land for environmental conservation;
- Community facilities to support the proposed increase to the population; and
- A primary school.

1.2.2 Previous Ecological Surveys

The biodiversity values of the site are well known as the area has been extensively surveyed. Cumberland Ecology has undertaken a number of ecological surveys throughout the site from 2016-2018 to support development applications (DAs) previously submitted to Council. Ecological assessments undertaken within the site by Cumberland Ecology include the following: Ecological Constraints Assessment (Cumberland Ecology 2016), Menangle Park Stage 1 Flora and Fauna Assessment (Cumberland Ecology 2017), Stage 2A Flora and Fauna Assessment (Cumberland Ecology 2018c), Stage 2B Species Impact Statement (Cumberland Ecology 2018d), Cummins and Menangle Road Intersection Species Impact Statement (Cumberland Ecology 2018e) and a Land Clearing Species Impact Statement (Cumberland Ecology 2018b). The locations of the lands subject to these previous assessments are identified in **Figure 1.1**.

Previous ecological assessments undertaken by Cumberland Ecology were primarily limited to the site. In order to determine the ecological values of areas within the study area but outside of the site, this assessment relied on ecological assessments undertaken previously by other ecological consultancies which include the following:

- Ecological Assessment – Proposed Subdivision and Infrastructure Delivery – Precinct 200 and Adjacent Bulk Earthworks (Travers Bushfire & Ecology 2013);
- Report on Menangle Park Offsetting Strategy (GHD 2010);
- Menangle Park Flora, Fauna and Aquatic Assessments (Eco Logical Australia 2009); and
- Menangle Park Rezoning: *Pimelea spicata* Survey and Results (GHD 2009).

1.3 Background

1.3.1 Location of the Study Area

The study area is wholly located within the Campbelltown Local Government Area, adjacent to the M5/Hume Highway and approximately 65 km south-west of Sydney. It is bound by the Hume Highway to the east, Mount Annan Botanical Gardens to the north, the Nepean River to the west and south. The nearest town centre, Macarthur Square, is 6 km to the north-east.

1.3.2 Landform, Geology and Soils

The landform of the study area consists generally of gently undulating terrain with the flattest areas alongside the Nepean River and Howes Creek. Low lying areas of the study area contain riparian areas that remain inundated throughout the year. The geology of the study area is dominated by clay based soils originating from Wianamatta Shale. Areas of alluvial and sandy soils are also present. Alluvial soils are generally located within/nearby riparian areas while sandy soils are restricted to small pockets adjacent to riparian areas.

1.3.3 Vegetation

Vegetation within the study area includes intact and modified patches of native woodland and forest, as well as cleared land. The study area has a history of agricultural development, which resulted in the degradation and clearing of native vegetation across a high proportion of the study area. Intact and modified patches of native woodland and forest vegetation are typically associated with riparian areas. Nevertheless, some small to moderate sized patches of native woodland are also present outside of riparian areas. Woody vegetation on shale soils within riparian areas is dominated by *Eucalyptus amplifolia* (Cabbage Gum), *Casuarina glauca* (Swamp Oak) and/or *Eucalyptus elata* (River Peppermint). Woody vegetation on shale soils outside of riparian areas is dominated by *Eucalyptus tereticornis* (Forest Red Gum), with *Eucalyptus moluccana* (Grey Box) and *Eucalyptus crebra* (Narrow-leaved Ironbark) also occurring. In areas comprising sandy substrates, *Angophora subvelutina* (Broad-leaved Apple) generally dominates.

1.3.4 Hydrology

The study area occurs within the Hawkesbury/Nepean catchment. The Nepean River is the main surface drainage system associated with the study area, with several drainage lines, including Howes Creek, forming tributaries to this system. The Nepean River occurs along the southern and western boundary of the Menangle Park Urban Release Area. Howes Creek transects the north of the study area from east to west. Drainage lines within the study area generally flow in a westerly or southerly direction into the Nepean River.

Several agricultural dams are present within the study area, most of which comprise aquatic and semi-aquatic vegetation and are surrounded by cleared land.

1.3.5 Land Uses

A high proportion of the study area has and/or is being currently utilised for a number of rural or agricultural purposes, including horse and cattle grazing. The agricultural land has been extensively cleared of vegetation which has resulted in a significant loss of flora and fauna habitat. Exotic flora species have been introduced within these areas, which have also spread into remaining woodland and forest vegetation, particularly along drainage lines.

Additional land uses of the study area include a rail line, train station, horse racing course, Menangle Road, the Hume Highway and rural residential development within the Menangle Park Village. Similar to the agricultural lands, these areas have been extensively cleared and are primarily comprised of cleared lands with small patches of planted exotic/native vegetation.

1.4 Relevant Strategic Planning Framework

The following legislation is relevant to the proposal and has been considered within this assessment.

State Legislative Framework

- *Environmental Planning and Assessment Act 1979 and Environmental Planning and Assessment Regulation 2000*
- *Biodiversity Conservation Act 2016*
- *Threatened Species Conservation Act 1995*
- *Environment Protection and Biodiversity Conservation Act 1999*

State Environmental Planning Policies (SEPPs)

- *State Environmental Planning Policy (Sydney Region Growth Centres) 2006*

Local Environmental Plan (LEP)

- *Campbelltown Local Environmental Plan 2015*

Development Control Plan

- *Campbelltown Development Control Plan 2015: Part 8 Menangle Park*

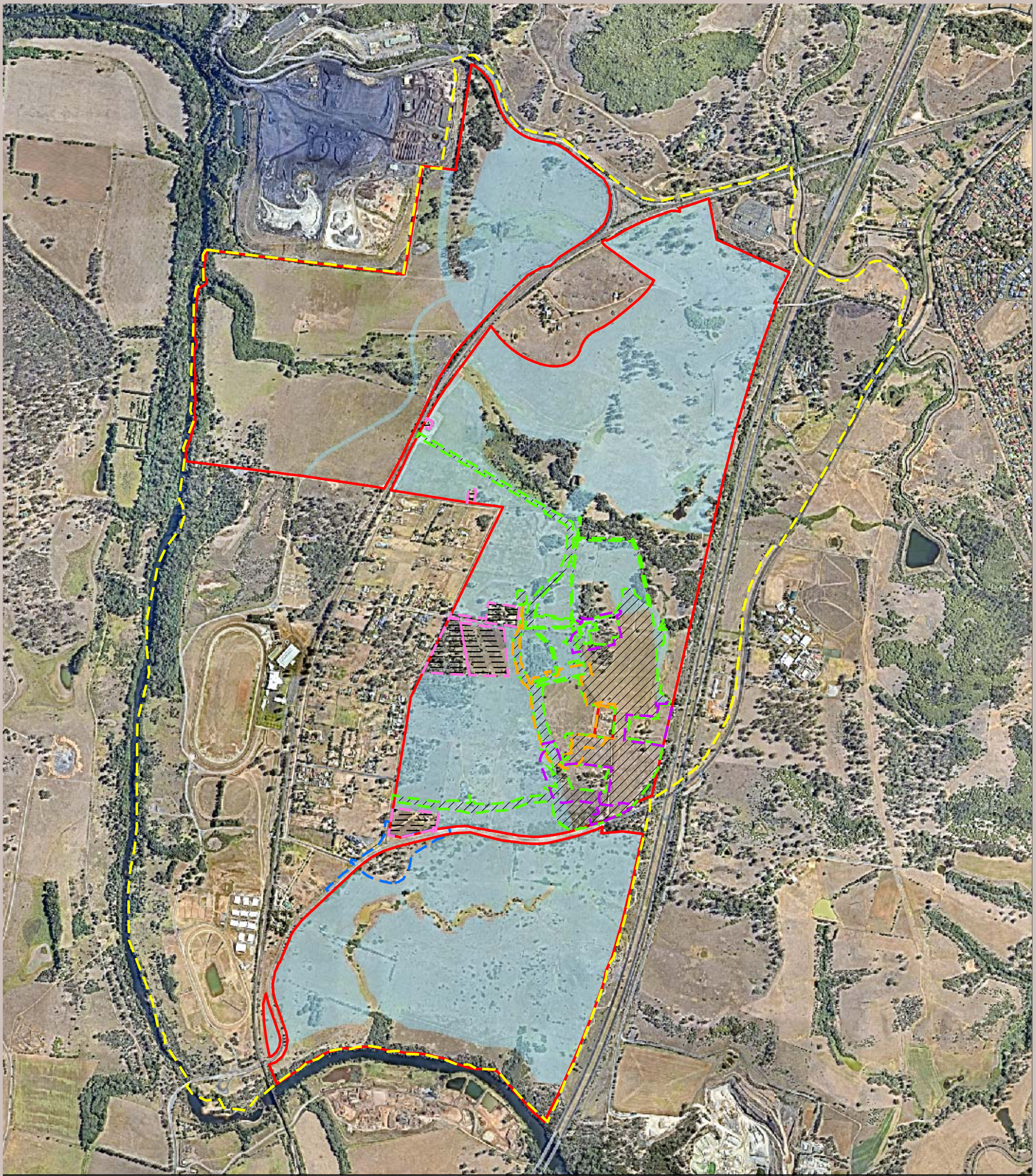


Figure 1.1. The site and study area

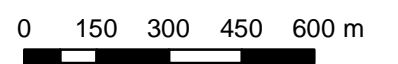




Image Source: Robert's Day 2018

Methodology

2.1 Desktop Assessment

2.1.1 Literature Review

A comprehensive review of previous ecological studies was undertaken to evaluate the ecological values associated with the study area. Key documents reviewed for this biodiversity assessment include:

- Menangle Park – The Dahua Group: Proposed Vegetation Clearing within the Menangle Park Urban Release Area – Species Impact Statement (Cumberland Ecology 2018b);
- Menangle Park – The Dahua Group: Proposed Intersection at Cummins Road and Menangle Road - Species Impact Statement (Cumberland Ecology 2018a);
- Menangle Park Stage 2B Species Impact Statement (Cumberland Ecology 2018d);
- Menangle Park Stage 2A Flora and Fauna Assessment (Cumberland Ecology 2018c);
- Menangle Park Stage 1 Flora and Fauna Assessment (Cumberland Ecology 2017);
- Menangle Park Ecological Constraints Assessment (Cumberland Ecology 2016);
- Travers Bushfire & Ecology (2013): Ecological Assessment – Proposed Subdivision and Infrastructure Delivery – Precinct 200 and Adjacent Bulk Earthworks;
- Report on Menangle Park Offsetting Strategy (GHD 2010);
- Menangle Park Flora, Fauna and Aquatic Assessments (Eco Logical Australia 2009); and
- Menangle Park Rezoning: *Pimelea spicata* Survey and Results (GHD 2009).

2.1.2 Database Analysis

Database analysis was conducted for the locality using both the NSW Office of Environment and Heritage (OEH) BioNet Atlas (OEH 2018a) and the Commonwealth Department of the Environment and Energy Protected Matters Search Tool (DoEE 2018b). The locality is defined as the area within a 10 km radius of the centre of the study area. The BioNet Atlas search was used to generate records of threatened flora and fauna species listed under the TSC Act and/or EPBC Act within the locality. The Protected Matters Search Tool generated a list of Matters of National Environmental Significance listed under the EPBC Act potentially occurring within the locality. The lists generated from these databases were reviewed against available knowledge of the study area, in conjunction with the abundance, distribution and age of records, to ascertain the likelihood of occurrence of threatened species within the study area.

2.1.3 Vegetation Mapping and Spatial Data Review

Existing vegetation mapping was reviewed and ground-truthed during field surveys undertaken by Cumberland Ecology from 2016 to 2017. These maps include broad-scale mapping of the Cumberland Plain (OEH 2013), mapping provided within the Flora, Fauna and Aquatic Assessment prepared by Eco Logical Australia (2009), and within the Ecological Assessment prepared by Travers Bushfire & Ecology (2013).

Mapping from the Remnant Vegetation of the Western Cumberland Subregion mapping project (OEH 2013), was utilised for areas not subject to recent field surveys undertaken by Cumberland Ecology (see **Section 2.3**).

2.2 Previous Field Surveys

Several ecological surveys have been undertaken within the study area previously to support the original planning proposal and a number of DAs. Previous assessments of the study area along with a brief description of surveys undertaken are provided below.

i. Proposed Vegetation Clearing within the Menangle Park Urban Release Area: Species Impact Statement – Cumberland Ecology

This assessment was prepared in 2018 to support a 'Land Clearing' DA within areas of the Menangle Park URA owned by Dahua. The DA proposes to remove the following threatened ecological communities (TECs): Cumberland Plain Woodland, Elderslie Banksia Scrub Forest, Freshwater Wetlands, Swamp Oak Floodplain Forest and River-flat Eucalypt Forest. In order to compensate for the impacts on these TECs the DA proposes to conserve large areas of land to be managed as Biodiversity Stewardship Sites or under a Vegetation Management Plan, as well as the purchase and retirement of ecosystem credits. BioBanking calculations were undertaken to determine the offsetting liability of the DA with consideration of the proposed impacts and offsets.

No threatened flora species were recorded or were considered likely to occur. Several threatened fauna species were considered to be affected by the DA; however, it was

concluded that none of the species were likely to be significantly impacted as the habitat to be removed was unlikely to be important to the long-term survival of any of these species.

ii. Cummins and Menangle Road Intersection: Species Impact Statement – Cumberland Ecology

This assessment was prepared in 2018 for a proposed intersection DA at the corner of Cummins and Menangle Road. The assessment concluded that the proposed intersection would result in a significant impact on the TEC Cumberland Plain Woodland as the majority of the community's local occurrence would be removed. In order to offset impacts on Cumberland Plain Woodland, the DA proposes to purchase and retire an appropriate number and type of ecosystem credits that were identified by BBAM calculations undertaken.

No threatened flora species were recorded or were considered likely to occur. Several threatened fauna species were considered to be affected by the DA; however, it was concluded that none of the species were likely to be significantly impacted as the habitat to be removed was unlikely to be important to the long-term survival of any of these species.

iii. Stage 2B Species Impact Statement – Cumberland Ecology

This assessment was prepared in 2018 for a proposed residential development DA within the site. The DA proposed impacts on the TEC Cumberland Plain Woodland. In order to compensate for the proposed impacts on Cumberland Plain Woodland, the DA proposes the purchase and retirement of ecosystem credits.

No threatened flora species were recorded or were considered likely to occur. Several threatened fauna species were considered to be affected by the DA; however, it was concluded that none of the species were likely to be significantly impacted as the habitat to be removed was unlikely to be important to the long-term survival of any of these species.

iv. Stage 2A Flora and Fauna Assessment – Cumberland Ecology

This assessment was prepared in 2018 for a proposed residential development DA within the site. All vegetation to be impacted comprised of exotic dominated grassland, with no TECs present.

No threatened flora species were recorded or were considered likely to occur, and only highly marginal potential foraging habitat was present for fauna. No significant impact was considered likely to occur to any threatened entities as a result of the DA.

v. Stage 1 Flora and Fauna Assessment – Cumberland Ecology

This assessment was prepared in 2017 for a proposed residential development DA within the site. A very small area of the TEC Cumberland Plain Woodland is proposed to be removed.

No threatened flora species were recorded or were considered likely to occur, and only highly marginal potential foraging habitat was present for fauna. No significant impact was considered likely to occur to any threatened entities as a result of the DA.

vi. *Ecological Constraints Assessment – Cumberland Ecology*

In 2016, an Ecological Constraints Assessment was prepared for Dahua-owned areas of the site. Seven TECs were recorded in the area. No threatened flora species were recorded or were considered highly likely to occur, but habitat is present for threatened fauna.

Both the Biodiversity Certification Assessment Methodology and BioBanking Assessment Methodology (BBAM) were utilised to conduct a preliminary assessment of the quantum of impacts and the potential offset value of retained vegetation. The results of this assessment were utilised in the design of this proposal for the Menangle Park URA.

vii. *Ecological Assessment – Proposed Subdivision and Infrastructure Delivery – Precinct 200 and Adjacent Bulk Earthworks – Travers Bushfire and Ecology*

In 2013, an ecological assessment was undertaken by Travers Bushfire and Ecology within areas of the site located to the south of Howes Creek. The assessment included vegetation mapping and targeted threatened flora and fauna surveys. The assessment recorded the following TECs: Cumberland Plain Woodland, River-flat Eucalypt Forest and Elderslie Banksia Scrub Forest. The assessment also recorded the following six threatened fauna species within the study area: Greater Broad-nosed Bat (*Scoteanax rueppellii*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Southern Myotis (*Myotis macropus*), Varied Sittella (*Daphoenositta chrysoptera*) and Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*).

viii. *Report on Menangle Park Offsetting Strategy – GHD*

In 2010, GHD developed a vegetation 'Offset Strategy' for a proposed development within the study area. The study included vegetation mapping of the study area where the following TECs were recorded: Cumberland Plain Woodland and River-flat Eucalypt Forest. The Offset Strategy identified areas within the Howes Creek riparian corridor to be utilised as 'on-site' offsets as these areas contained the best condition vegetation that has connectivity to off-site habitat.

ix. *Flora, Fauna and Aquatic Assessments – Eco Logical Australia*

This report encompassed nearly the entire study area. Field surveys undertaken included vegetation mapping, and targeted threatened flora and fauna surveys. This report concluded that the following TECs were recorded within the study area: River-flat Eucalypt Forest, Cumberland Plain Woodland and Sydney Freshwater Wetlands. No threatened flora species were recorded within the study area and the Greater Broad-nosed Bat (*Scoteanax rueppellii*) was the only threatened fauna species recorded with the study area.

x. *Menangle Park Rezoning: Pimelea spicata Survey and Results – GHD*

Targeted surveys for the threatened plant *Pimelea spicata* were undertaken by GHD within four separate areas of the study area. Reference sites of known populations located outside of the study area were visited as part of the surveys; however, no individuals were recorded.

2.3 Recent Field Surveys

Field surveys were undertaken within the study area by Cumberland Ecology in 2016, 2017 and 2018. Surveys included vegetation mapping, targeted threatened flora searches and targeted threatened fauna surveys. Further details of each of the survey methods are provided below.

Previous surveys undertaken within the study area have been primarily limited to the site. The majority of areas of the study area located outside of the site were not surveyed by Cumberland Ecology due to access restrictions. In order to determine the ecological values of areas not surveyed by Cumberland Ecology, this biodiversity assessment relied on ecological assessments undertaken previously by other ecological consultancies (see **Section 2.2** as well as the other databases and mapping projects identified in **Section 2.1**).

2.3.1 Vegetation Mapping

Cumberland Ecology conducted vegetation surveys to revise and update the exiting vegetation maps as mentioned in **Section 2.1.3**. The vegetation within the site was ground-truthed to verify the mapping of the condition and extent of the different vegetation communities. Where vegetation community boundaries were found to differ from the previous mapping, records were made of proposed new boundaries using a hand-held Global Positioning System and/or mark-up of aerial photographs. The resultant information was synthesised using a Geographic Information System to create a spatial database that was used to interpret and interpolate the data to produce a vegetation map of the site.

Areas of the study area not surveyed utilised existing broad-scale mapping of the Cumberland Plain (OEH 2013) as this is the most recent broad-scale mapping available for the study area.

2.3.2 Vegetation Sampling

Vegetation sampling within the site was undertaken in accordance with the BioBanking Assessment Methodology (BBAM) (OEH 2014). A total of 37 BioBanking plots (30 plots in 2016 and seven in 2017) were surveyed within the site, the locations of which are shown in **Figure 2.1**.

Surveys included establishment of a 20 m x 50 m plot within which the following data was collected:

- Native species richness recorded within each stratum of a 20 m x 20 m plot;
- Native overstorey projected foliage cover recorded at 10 points along a 50 m transect;
- Native mid-storey projected foliage cover recorded at 10 points along a 50 m transect;
- Native groundcover projected foliage cover recorded at 10 points along a 50 m transect for three life forms (shrubs, grasses and other);

- Weed species projective foliage cover expressed as a percentage of overstorey, mid-storey and ground cover along a 50 m transect;
- Number of trees with hollows where entrance width is over 5 cm and hollow is at least 1 m above ground within the 20 m x 50 m plot;
- The percentage of regenerating canopy species within the vegetation zone; and
- The total length in metres of fallen logs over 10 cm in diameter within the 20 m x 50 m plot.

Additionally, full floristic data was collected within each 20 m x 20 m plot to enable classification of each vegetation zone to the best-fit Plant Community Type (PCT). All vascular plants recorded or collected were identified using keys and nomenclature provided in Harden (1990-1993). Where known, taxonomic and nomenclatural changes have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2018).

The surveys undertaken in 2016 were conducted within the site in order to identify areas of high biodiversity value that are an ecological constraint to future development. The surveys undertaken in 2017 were conducted to support DAs previously submitted to Council.

2.3.3 Threatened Flora Searches

Despite existing data from previous ecological studies within the study area, Cumberland Ecology undertook targeted threatened flora searches in 2016, 2017 and 2018. Surveys included random meanders through suitable habitat for threatened species that were previously assessed as potentially occurring within the study area. These targeted species include, but are not limited to: *Pimelea spicata* (Spiked Rice-flower), *Grevillia juniperina* subsp. *juniperina* (Juniper-leaved Grevillea), *Pomaderris brunnea* (Rufous Pomaderris) and *Persicaria elatior* (Tall Knotweed).

2.3.4 Vegetation Data Analysis

i. Plant Community Types

Identification of the vegetation communities, i.e. PCTs, occurring within the study area was guided by the results of the desktop assessment and field surveys. The data was analysed in conjunction with a review of the PCTs held within the BioNet Vegetation Classification (OEH 2018b). Consideration was given to the following:

- Occurrence within the Sydney Basin Interim Biogeographic Regionalisation for Australia subregion and Hawkesbury-Nepean management area;
- Vegetation formation;
- Alignment with Threatened Ecological Communities (TECs);
- Landscape position; and

- Upper, mid and ground strata species.

The selected PCTs were subsequently utilised within BioBanking credit calculations.

ii. *Threatened Ecological Communities*

Following review of potentially occurring TECs, the vegetation communities identified within the study area were examined against the listings of TECs under the TSC Act and EPBC Act. In order to identify communities listed under the TSC Act, the species found on Dahua-owned area of the site within each community were compared with the species list provided in the final determination of the TEC. Additional information such as location and biophysical aspects of each final determination were also taken into account in the assessment. For TECs listed under the EPBC Act, vegetation communities were examined against the DoEE Species Profile and Threats Database and any associated documentation, such as listing advice and policy statements.

2.3.5 Fauna Habitat Assessment

A general fauna habitat assessment was undertaken within Dahua-owned areas of the site during field surveys in 2016, 2017 and 2018. This assessment included consideration of important indicators of habitat conditions and complexity as well as the occurrence of micro-habitats such as tree hollows, fallen logs and riparian areas. An assessment of the structural complexity of the vegetation, the age structure of the forest and the nature and extent of human disturbance was also undertaken. Notes were taken on specific habitat features that may be utilised by threatened fauna species known to occur in the locality.

In addition to the general habitat assessment, fauna habitat data was also collected within the BioBanking plots, which included the number of trees with hollows, the total length of logs and composition of the ground stratum.

2.3.6 Targeted Threatened Fauna Surveys

In 2017 and 2018, targeted surveys for threatened species considered to have the potential to occur were undertaken within proponent-owned areas of the site (see **Figure 2.2**) to support previously submitted DAs. Fauna surveys were conducted, where appropriate, in accordance with the survey guidelines provided in the Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft) (DEC (NSW) 2004) and included the following surveys:

- Targeted searches for Cumberland Plain Land Snail;
- Diurnal bird census;
- Microchiropteran bat surveys;
- Spotlighting and call playback; and
- Incidental fauna observations.

A detailed description of the survey methodologies undertaken for each of the survey types performed within the study area is provided below.

i. Cumberland Plain Land Snail Searches

Targeted searches were undertaken throughout Dahua-owned areas of the site for the Cumberland Plain Land Snail (*Meridolum corneovirens*) which is listed as endangered under the TSC Act. Searches for the Cumberland Plain Land Snail were undertaken within all areas of the site considered to provide suitable habitat for the species (i.e. Cumberland Plain Woodland). Searches consisted of checking within 1 m of the base of suitable trees (e.g. *Eucalyptus tereticornis*, *Eucalyptus crebra*, *Eucalyptus moluccana*) that had a diameter at breast height greater than 10 cm and had leaf litter present at the base, as well as around logs, log piles and other areas of woody debris.

ii. Diurnal Bird Census

A total of twenty-one 20 minute area surveys were undertaken within Dahua owned areas site over a period of six days between December 2017 and March 2018. Surveys were undertaken by two ecologists during the morning. Bird species that were observed or heard calling were recorded.

iii. Microchiropteran Bat Surveys

An SM2 or Anabat Unit were deployed at nine separate locations within the site from December 2017 to March 2018. Units were deployed for a minimum of four nights for a period of 12 hours from 6:00pm to 6:00am. As microbats are generally most active between October and March, the survey was undertaken when the weather was warm during the optimum survey period, thereby increasing the likelihood of detecting microbats.

The identification of bat echolocation calls recorded during surveys was undertaken by Dr Anna McConville from Echo Ecology using AnalookW software (Echo Ecology, 2018). Full spectrum calls (.WAV files) were first converted to zero crossings using Kaleidoscope. The identification of calls was undertaken with reference to Pennay et al. (2004) and through the comparison of recorded reference calls from the Sydney Basin. Reference calls were obtained from the NSW database and from the personal collection of Dr McConville.

iv. Spotlighting and Call Playback

Eighteen 20 minute area surveys were undertaken within the site over six nights from December 2017 to March 2018. Surveys consisted of undertaking spotlighting/ call playback targeting nocturnal birds, as well as recording any incidental species.

Surveys consisted of two ecologists conducting a random meander through each survey point using a high powered hand-held torch to search for evidence of nocturnal birds (owls). Call playback for the Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*) and Masked Owl (*Tyto novaehollandiae*) was undertaken. Call playback included projecting recorded calls of each species over a hand held speaker for five minutes, then listening for five minutes, and repeating for at least 20 minutes at each survey location.

v. *Incidental Fauna Observations*

Any incidental vertebrate fauna species that were observed, heard calling, or otherwise detected on the basis of tracks or signs, were recorded.

2.4 Limitations

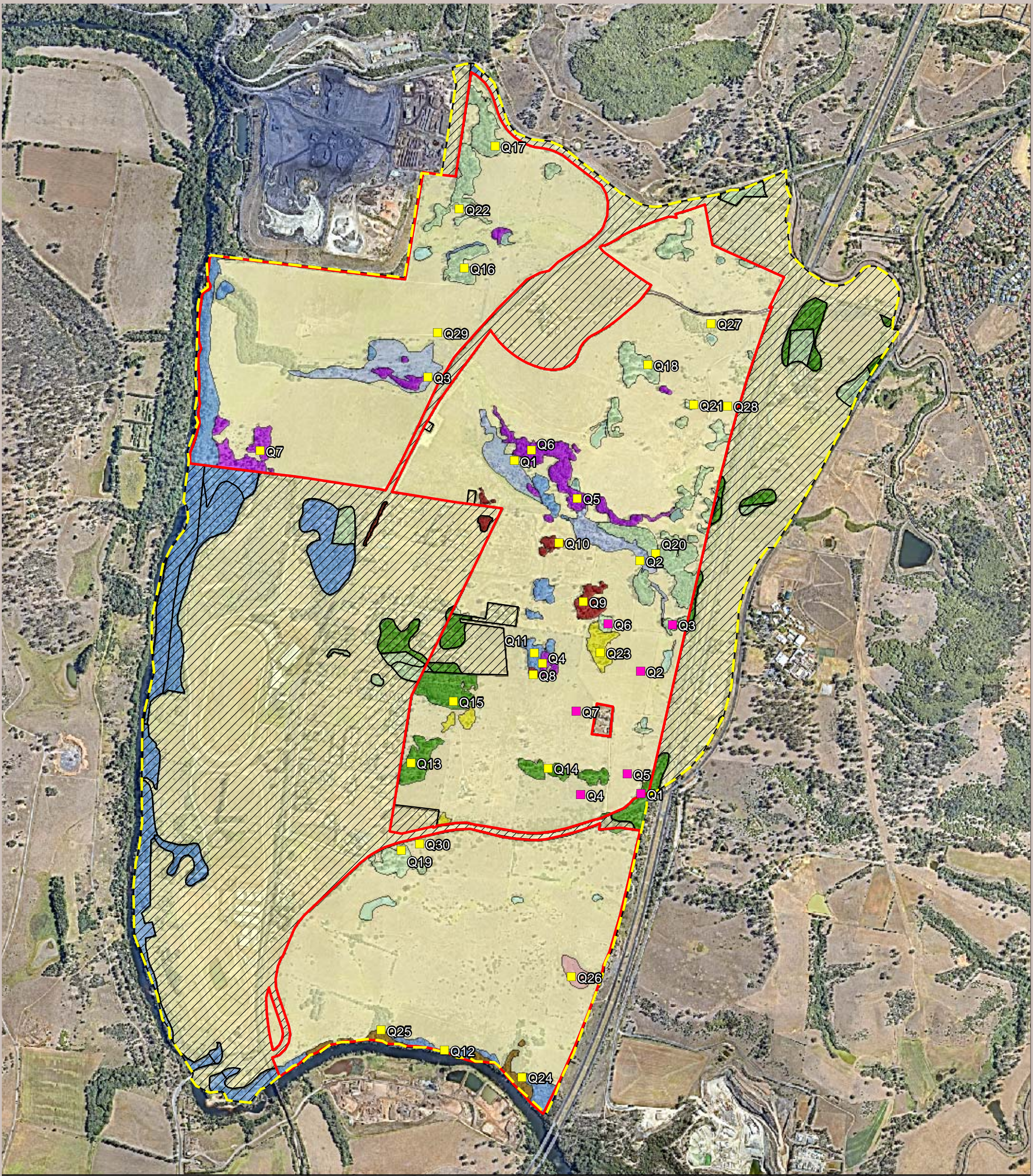
Surveys undertaken for this assessment were primarily limited to proponent owned areas of the site and generally did not include areas of the study area that are not owned by the proponent. Areas outside of Dahua-owned lands were accessed where possible to confirm broad scale mapping of the area. This was limited to public roads within the Menangle Park village.

As the zoning amendments proposed within the proposal apply primarily to the site that is largely comprised of Dahua-owned lands, the undertaking of detailed studies within areas outside of the site is not considered to be required for the purposes of this assessment. Areas of the study area not surveyed by Cumberland Ecology have been previously surveyed by other ecological consultancies. This assessment has utilised the findings of these previous surveys and therefore, the results presented within this assessment are considered to be appropriate to support the proposal.

Vertebrate fauna and vascular flora of the locality are well known based upon a sizeable database of past records and various published reports. The surveys by Cumberland Ecology added to the existing database and helped to provide a clear indication of the likelihood that various species occur, or are likely to occur within the study area. The data obtained from database assessment and surveys of the site provided an appropriate level of information to support this assessment.

The weather conditions at the time of the flora surveys were generally favourable for plant growth and production of features required for identification of most species. Shrubs, grasses, herbs and creepers were readily identifiable in most instances. It is expected that not all flora species present would have been recorded during surveys. Despite this, it is considered that sufficient information has been collected to assess issues including conservation significance of the flora, condition and viability of vegetation and likely impact on native vegetation. An assessment of the likelihood of occurrence of threatened flora species recorded within the locality of the study area in the database searches was undertaken to supplement the flora survey.

In general, fauna surveys provide a "snapshot" of some of the fauna present on site that were active during the time of the survey. The data produced by the survey is intended to be indicative of the types of species that could occur and not an absolute census of all vertebrate fauna species occurring within the study area. Therefore, not all fauna utilising the study area are likely to have been recorded during surveys. An assessment of the likelihood of occurrence of threatened and migratory fauna species listed for the locality in the database searches was undertaken to supplement the fauna surveys. The combination of these techniques is considered appropriate for assessing the habitat values of the study area for threatened fauna.



Coordinate System: MGA Zone 56 (GDA 94)



Image Source:
Image © NearMap
(05/02/2018)

Data Source:
OEH (2013). Remnant Vegetation
of the western Cumberland subregion,
2013 Update. Office of Environment
and Heritage, NSW

Legend



Site



Study area



OEH vegetation mapping (2013)

Flora survey locations



Flora plot (2016)



Flora plot (2017)

Vegetation Community



Shale Plains Woodland



Shale Hills Woodland



Shale Hills Woodland Derived Native
Grassland



Elderslie Banksia Scrub Forest



River Flat Eucalypt Forest



Swamp Oak Floodplain Forest



River Oak Riparian Woodland



Freshwater Wetlands



Acacia Regrowth



Exotic Vegetation and Cleared Land

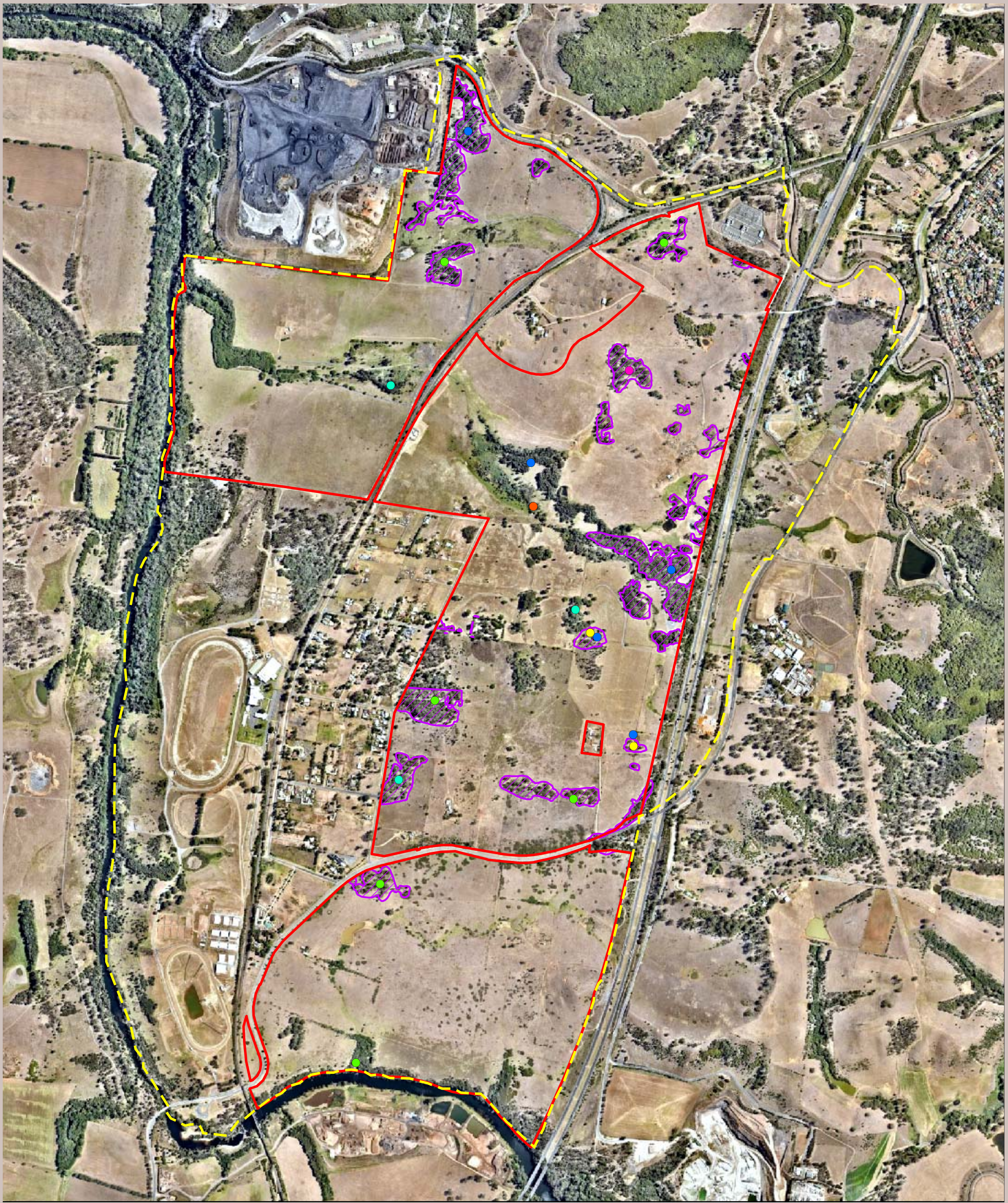


Dam

cumberland
ecology

Figure 2.1. Flora survey locations

0 150 300 450 600 m



Legend

Site

Study area

Fauna Survey Location

Cumberland Plain Land Snail

Microchiropteran bat survey

Microchiropteran bat survey, diurnal bird survey

Microchiropteran bat survey, diurnal bird survey, call playback and spotlighting

Diurnal bird survey

Diurnal bird survey, call playback and spotlighting

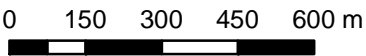
Call playback and spotlighting

Coordinate System: MGA Zone 56 (GDA 94)

Image Source:
Image © Nearmap
(05/02/2018)

cumberland
ecology

Figure 2.2. Fauna survey locations



Results

Recent surveys of the study area undertaken by Cumberland Ecology were primarily limited to Dahua-owned areas of the site. In order to determine the biodiversity values of the entire study area, previous studies of the study area were utilised to supplement the findings of the recently undertaken Cumberland Ecology surveys. The details of these results are provided within this chapter.

3.1 Vegetation Communities

The vegetation of the study area has been largely cleared as a result of historical agricultural practices. Fragmented areas of native vegetation are scattered throughout the study area, most of which has been substantially modified due to grazing and/or other agricultural land practises. Areas of native vegetation are primarily present within or adjacent to riparian corridors, as isolated patches of woodland or as grassland bounded by exotic dominated agricultural lands. Patches of scattered mature remnant eucalypt trees are also present throughout the study area, all of which have significantly modified understoreys.

Ten locally-defined vegetation communities have been identified within the study area as identified in **Table 3.1**. Descriptions of the communities are provided below and their distribution within the study area is shown in **Figure 3.1**. **Table 3.1** also includes unmapped areas that are comprised primarily of previously cleared areas based on recent aerial photography. The vegetation descriptions provided below are based only on areas of the communities that were surveyed.

Table 3.1 **Extent of vegetation communities within the study area**

Vegetation Community	TSC Act Status	EPBC Act Status	Area Mapped by CE (ha)	Area Mapped by OEH (ha)	Area within Study Area (ha)*
Shale Plains Woodland	CEEC	-	23.58	6.45	30.03
Shale Hills Woodland	CEEC	-	9.40	8.10	17.50
Shale Hills Woodland Derived Native Grassland	CEEC		1.02	0.00	1.02
Elderslie Banksia Scrub Forest	CEEC	-	2.70	0.00	2.70
River-flat Eucalypt Forest	EEC	-	11.81	32.62	44.43
Swamp Oak Floodplain Forest	EEC	-	10.05	0.00	10.05

Table 3.1 **Extent of vegetation communities within the study area**

Vegetation Community	TSC Act Status	EPBC Act Status	Area Mapped by CE (ha)	Area Mapped by OEH (ha)	Area within Study Area (ha)*
Freshwater Wetlands	EEC	-	11.13	0.00	11.13
River Oak Riparian Woodland	-	-	2.33	0.00	2.33
Acacia Regrowth	-	-	2.45	0.00	2.45
Exotic Vegetation and Cleared Land**	-	-	431.84	334.98	766.82
Dams	-	-	2.98	0.00	2.98
Total			509.28	382.16	891.43

*Areas include vegetation mapping provided by both Cumberland Ecology and OEH.

**All unmapped areas by OEH (2013) have been assumed to conform to Exotic Vegetation and Cleared Land.

TSC Act/EPBC Act Status: CEEC = Critically Endangered Ecological Community, EEC = Endangered Ecological Community.

3.1.1 Shale Plains Woodland

TSC Act Status: Cumberland Plains Woodland in the Sydney Basin Bioregion CEEC

EPBC Act Status: Does not meet listing criteria

Shale Plains Woodland within the study area is present as both small isolated patches of woodland surrounded by exotic vegetation and medium sized patches of woodland with limited connectivity to adjacent areas of native vegetation.

The canopy of the community is comprised of mature *Eucalyptus tereticornis* (Forest Red Gum) and/or *Eucalyptus moluccana* (Grey Box) trees. The community lacks a substantial shrub layer in most areas but does contain scattered regrowth *Eucalyptus tereticornis* (Forest Red Gum) and/or *Eucalyptus moluccana* (Grey Box) trees, *Acacia decurrens* (Black Wattle) and the exotic *Olea europaea* subsp. *cuspidata* (African Olive) and *Lycium ferocissimum* (African Boxthorn). The groundcover of the community is comprised primarily of exotic herbs and grasses with native species scattered throughout. The most prevalent native species present are *Microlaena stipoides* (Weeping Grass), *Oxalis perennans*, *Einadia trigonos* (Fishweed) and *Cotula australis* (Common Cotula). Exotic species include *Cyclospermum leptophyllum* (Slender Celery), *Facelis retusa* (Annual Trampweed), (Fireweed), *Bromus catharticus* (Prairie Grass) and *Ehrharta erecta* (Panic Veldtgrass). An example of this vegetation community is shown in **Photograph 3.1**.

Despite the degraded nature of the vegetation within this community, it is listed under the TSC Act as the CEEC Cumberland Plain Woodland in the Sydney Basin Bioregion. This is due to the alignment with locational and floristic descriptions contained within the Final Determination (NSW Scientific Committee 2009). The vegetation is not considered to form the EPBC Act listed Cumberland Plain Woodland CEEC following an assessment against

the 'Flowchart of key diagnostic features and condition thresholds to identify the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community' on Page 11, Chapter 3 of the EPBC Guidelines on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (DEWHA 2010). Although the native canopy foliage cover is at least 10% and the patch is greater than 5 ha, less than 30% of the perennial understorey foliage cover is comprised of native species. Therefore, due to the dominance of exotic species within the perennial vegetative cover, the Cumberland Plain Woodland within the study area is not recognised as a CEEC under the EPBC Act.



Photograph 3.1 Shale Plains Woodland within the study area

3.1.2 Shale Hills Woodland

TSC Act Status: Cumberland Plains Woodland in the Sydney Basin Bioregion CEEC

EPBC Act Status: Does not meet listing criteria

Shale Hills Woodland within the study area is present as small to medium sized isolated patches of woodland offering little connectivity to native vegetation off-site.

The canopy of this community consists of mature *Eucalyptus crebra* (Narrow-leaved Ironbark) with a mid-storey comprised of regrowth *Eucalyptus crebra* (Narrow-leaved Ironbark), *Eucalyptus tereticornis* (Forest Red Gum) and *Acacia decurrens* (Black Wattle). The shrub layer contains regrowth of the canopy and mid-storey, along with the native

Bursaria spinosa (Blackthorn) and exotic weeds *Olea europaea* subsp. *cuspidata* (African Olive) and *Lycium ferocissimum* (African Boxthorn). The groundcover of this community is dominated by exotic species with scattered natives present scattered throughout in small numbers. Native herbs and grasses present include *Cotula australis* (Common Cotula), *Euchiton sphaericus*, *Wahlenbergia gracilis* (Sprawling Bluebell), *Oxalis perennans*, *Eragrostis leptostachya* (Paddock Lovegrass) and *Microlaena stipoides* (Weeping Grass). Dominant exotic groundcovers include *Cerastium glomeratum* (Mouse-ear Chickweed), *Sida rhombifolia* (Paddy's Lucerne), *Ehrharta erecta* (Panic Veldtgrass) and *Lolium perenne* (Perennial Ryegrass). An example of this vegetation community is shown in **Photograph 3.2**.

Despite the degraded nature of the vegetation within this community, it is listed under the TSC Act as the CEEC Cumberland Plain Woodland in the Sydney Basin Bioregion. This is due to the alignment with locational and floristic descriptions contained within the Final Determination (NSW Scientific Committee 2009). The vegetation is not considered to form the EPBC Act listed Cumberland Plain Woodland CEEC following an assessment against the 'Flowchart of key diagnostic features and condition thresholds to identify the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community' on Page 11, Chapter 3 of the EPBC Guidelines on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (DEWHA 2010). Although the native canopy foliage cover is at least 10% and the patch is greater than 5 ha, less than 30% of the perennial understorey foliage cover is comprised of native species. Due to the dominance of exotic species within the perennial vegetative cover, the Cumberland Plain Woodland within the study area is not recognised as a CEEC under the EPBC Act.



Photograph 3.2 Shale Hills Woodland within the study area

3.1.3 Shale Hills Woodland Derived Native Grassland

TSC Act Status: Cumberland Woodland CEEC

EPBC Act Status: Does not meet listing criteria

Shale Hills Woodland derived native grassland is present as an isolated patch surrounded by exotic grasslands. This community has a relatively high native species richness which includes native grasses such as *Microlaena stipoides* (Weeping Grass), *Aristida ramosa* (Purple Wiregrass), *Austrostipa scabra*, *Bothriochloa decipiens* (Red Grass) and *Sporobolus creber* (Western Rat-tail Grass). Exotic species present include *Briza subaristata*, *Verbena bonariensis* (Purpletop), *Plantago lanceolata* (Lamb's Tongue) and *Hypericum perforatum* (St. John's Wort). An example of this vegetation community is shown in **Photograph 3.3**.

Despite the degraded nature of the vegetation within this community, it is listed under the TSC Act as the CEEC Cumberland Plain Woodland. This is due to the alignment with locational and floristic descriptions contained within the Final Determination (NSW Scientific Committee 2009). The vegetation is not considered to form the EPBC Act listed Cumberland Plain Woodland CEEC as derived native grassland communities are not included.



Photograph 3.3 Shale Hills Woodland derived native grassland within the study area

3.1.4 Elderslie Banksia Scrub Forest

TSC Act Status: Elderslie Banksia Scrub Forest CEEC

EPBC Act Status: Not listed

Elderslie Banksia Scrub Forest is present as small isolated patches surrounded mostly by previously cleared lands. The canopy and mid-storey of this community are comprised of mature and regrowth *Angophora subvelutina* (Broad-leaved Apple) and *Banksia integrifolia* (Coast Banksia). The shrub layer is comprised of the native *Duboisia myoporoides* (Corkwood), regrowth *Angophora subvelutina* and *Kunzea ambigua* (Tick Bush). Dominant exotic shrubs include *Olea europaea* subsp. *cuspidata* (African Olive) and *Lycium ferocissimum* (African Boxthorn). The groundcover in areas is dominated by native species and in other areas is dominated by exotic species. Common native groundcover species include *Pteridium esculentum* (Common Bracken), *Hydrocotyle laxiflora* (Stinking Pennywort), *Einadia trigonos* (Fishweed) and *Microlaena stipoides* (Weeping Grass). Common exotic groundcovers include *Sida rhombifolia* (Paddy's Lucerne), *Ehrharta erecta* (Panic Veldtgrass), *Acetosella vulgaris* (Sorrel) and *Eragrostis curvula* (African Lovegrass). An example of this vegetation community is shown in **Photograph 3.4**.

This community within the study area is listed under the TSC Act as the CEEC Elderslie Banksia Scrub Forest. This is due to the alignment with locational and floristic descriptions contained within the Final Determination (NSW Scientific Committee 2015). This community is not listed under the EPBC Act.



Photograph 3.4 Elderslie Banksia Scrub Woodland within the study area

3.1.5 River-flat Eucalypt Forest

TSC Act Status: River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC

EPBC Act Status: Not listed

River-flat Eucalypt Forest is present primarily along or nearby riparian areas of the study area. The canopy of this community is comprised of mature *Eucalyptus amplifolia* (Cabbage Gum) and *Eucalyptus botryoides* (Bangalay) trees. The mid-storey contains mature *Casuarina glauca* (Swamp Oak) and regrowth *Eucalyptus amplifolia* (Cabbage Gum) and *Eucalyptus elata* (River Peppermint). Native shrub species present include regrowth *Casuarina glauca* (Swamp Oak) and *Eucalyptus amplifolia* (Cabbage Gum), and *Backhousia myrtifolia* (Grey Myrtle), *Melicytus dentatus* (Tree Violet) and *Callistemon salignus* (Willow Bottlebrush). Exotic shrubs include *Ligustrum lucidum* (Large-leaved Privet), *Olea europaea* subsp. *cuspidata* (African Olive) and *Ligustrum sinense* (Small-leaved Privet). Common native groundcover species include *Microlaena stipoides* (Weeping Grass), *Austrostipa verticillata* (Slender Bamboo Grass) and *Persicaria decipiens* (Slender Knotweed). Common exotic groundcover species includes *Cynodon dactylon* (Couch) and *Ehrharta erecta* (Panic Veldtgrass). An example of this vegetation community is shown in **Photograph 3.5**.

This community within the study area is listed under the TSC Act as the EEC River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This is due to the alignment with locational and floristic descriptions contained within the Final Determination (NSW Scientific Committee 2011b). This community is not listed under the EPBC Act.



Photograph 3.5 River-flat Eucalypt Forest within the study area

3.1.6 Swamp Oak Floodplain Forest

TSC Act Status: Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC

EPBC Act Status: Does not meet listing criteria

Swamp Oak Floodplain Forest is present in areas adjacent to riparian corridors within the study area. The canopy of this community is comprised entirely of mature *Casuarina glauca* (She Oak). The mid-storey and shrub layer are primarily comprised of the native *Casuarina glauca* (She Oak), *Kunzea ambigua* (Tickbush) and *Leptospermum polygalifolium* (Tantoon). Exotic shrubs are present in areas and consist of dense patches of *Olea europaea* subsp. *cuspidata* (African Olive), *Ligustrum sinense* (Small-leaved Privet) and *Lycium ferocissimum* (African Boxthorn). Common native groundcover species include *Microlaena stipoides* (Weeping Grass), *Cyperus gracilis* (Slender Flat-sedge) and *Juncus usitatus*. Common exotic groundcovers include *Asparagus asparagoides* (Bridal Creeper), *Ehrharta erecta* (Panic Veldtgrass), *Plantago lanceolata* (Lamb's Tongue) and *Cirsium vulgare* (Spear Thistle). An example of this vegetation community is shown in **Photograph 3.6**.

This community within the study area is listed under the TSC Act as the EEC Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This is due to the alignment with locational and floristic descriptions contained within the Final Determination (NSW Scientific Committee 2011).

The vegetation is not considered to form the EPBC Act listed Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland EEC following an assessment against the key diagnostics section of the approved conservation advice (DOEE 2018a) for the community. Page 12 of the approved conservation advice includes a key diagnostic characteristic that the community occurs at elevations up to 50 m above sea level (ASL). The vegetation within the study area occurs at a minimum of 77 m ASL. As identified in the approved conservation advice, a community must meet all key diagnostic characteristics to be listed under the EPBC Act. As the community within the study area does not meet this key diagnostic characteristic, it is therefore not considered to meet the listing criteria under the EPBC Act.



Photograph 3.6 Swamp Oak Floodplain Forest within the study area

3.1.7 Freshwater Wetlands

TSC Act Status: Freshwater Wetlands of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions EEC.

EPBC Act Status: Not listed

Freshwater Wetlands are present within the low lying riparian corridors of the study area. The canopy layer of this community is mostly absent, with the exception of a few regrowth native *Casuarina glauca* (Swamp Oak), and the exotic *Ligustrum lucidum* (Large-leaved Privet), *Olea europaea* subsp. *cuspidata* (African Olive) and *Ligustrum sinense* (Small-leaved Privet) in places. The majority of the groundcover is comprised of native species

including *Isolepis prolifer*, *Juncus usitatus*, *Phragmites australis* (Common Reed) and *Carex appressa* (Tall Sedge). Common exotics within the ground stratum include *Cyperus eragrostis* (Umbrella Sedge), *Paspalum dilatatum* (Paspalum), *Cynodon dactylon* (Couch) and *Rubus fruticosus* (Blackberry). An example of this vegetation community is shown in **Photograph 3.7**.

This community within the study area is listed under the TSC Act as the EEC Freshwater Wetlands of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This is due to the alignment with locational and floristic descriptions contained within the Final Determination (NSW Scientific Committee 2011a). This community is not listed under the EPBC Act.



Photograph 3.7 Freshwater Wetlands within the study area

3.1.8 River Oak Riparian Woodland

TSC Act Status: Not listed

EPBC Act Status: Not listed

River Oak Riparian Woodland is present along the southern boundary of the study area in areas adjacent to the Nepean River. This community has a canopy layer comprised entirely of *Casuarina cunninghamiana* (River Oak) and a mid-storey containing regrowth *Casuarina cunninghamiana* (River Oak) and the exotic species *Ligustrum lucidum* (Large-leaved Privet) and *Ligustrum sinense* (Small-leaved Privet). The shrub layer is dominated by the exotics *Ligustrum lucidum* (Large-leaved Privet) and *Ligustrum sinense* (Small-leaved Privet), but

also contains scattered native shrubs consisting of *Kunzea ambigua* (Tick Bush), *Casuarina cunninghamiana* (River Oak) and *Melicytus dentatus* (Tree Violet). The majority of the groundcover is comprised of exotic herbs and grasses including *Eragrostis curvula* (African Lovegrass), *Ehrharta erecta* (Panic Veldtgrass), *Plantago lanceolata* (Lamb's Tongue), *Senecio madagascariensis* (Fireweed) and *Cyclospermum leptophyllum* (Slender Celery). The most common native groundcover species include *Dichondra repens* (Kidney Weed), *Oxalis perennans*, *Microlaena stipoides* (Weeping Grass) and *Austrostipa verticillata* (Slender Bamboo Grass).

This community is not listed under the TSC Act or EPBC Act. An example of this vegetation community is shown in **Photograph 3.8**.



Photograph 3.8 River Oak Riparian Woodland within the study area

3.1.9 Acacia Regrowth

TSC Act Status: Not listed

EPBC Act Status: Not listed

Patches of Acacia Regrowth are present within the study area and are comprised of a mid-storey dominated by *Acacia decurrens* (Black Wattle). Shrub species present include the native *Duboisia myoporoides* (Corkwood) and regrowth *Acacia decurrens* (Black Wattle). The groundcover is dominated by exotic herbs and grasses including *Eragrostis curvula*

(African Lovegrass), *Cynodon dactylon* (Couch) and *Senecio madagascariensis* (Fireweed). The most dominant native groundcover within this community is *Microlaena stipoides* (Weeping Grass).

Due to the degraded nature of the vegetation within this community, it is not listed under the TSC Act or EPBC Act. For the purposes of BBAM, all native vegetation communities need to be assigned to a PCT. Acacia Regrowth has been assigned to the PCT Shale Plains Woodland as this is mostly likely what the community originally was based on the canopy species in adjoining areas.

An example of this vegetation community is shown in **Photograph 3.9**.



Photograph 3.9 Acacia regrowth within the study area

3.1.10 Exotic Vegetation and Cleared Land

TSC Act Status: Not listed

EPBC Act Status: Not listed

Exotic Vegetation and Cleared Land is present throughout the study area. This community is dominated by either exotic pasture grasses, dense patches of *Olea europaea* subsp. *cuspidata* (African Olive) or scattered isolated canopy trees with an exotic dominated understorey. Common exotic grasses occurring throughout this community include *Bromus*

molliformis (Soft Broome), *Briza subaristata* and *Poa annua* (Winter Grass). Native grasses are present but comprise less than 25% the native groundcover in all areas. Native grasses present include *Microlaena stipoides* (Weeping Grass) and *Paspalum distichum* (Water Couch).

Areas containing dense patches of *Olea europaea* subsp. *cuspidata* (African Olive) do have native groundcovers present, albeit in small numbers. Native species include *Dichondra repens* (Kidney Weed) and *Crassula sieberiana* (Australian Stonecrop). Exotic species comprise most of the groundcover in such areas and include *Anagallis arvensis* (Scarlet Pimpernel) and *Senecio madagascariensis* (Fireweed) along with regrowth *Olea europaea* subsp. *cuspidata* (African Olive).

Scattered canopy trees are present in small numbers and have no connectivity to nearby areas of woodland. Species include *Eucalyptus crebra* (Narrow-leaved Ironbark), *Eucalyptus eugenioides* (Thin-leaved Stringybark) and *Eucalyptus tereticornis* (Forest Red Gum). The understorey of such canopy trees is dominated by exotic shrubs such as *Olea europaea* subsp. *cuspidata* (African Olive) and contain a heavily degraded ground stratum due to previous land uses.

This community within the study area is not listed under the TSC Act or EPBC Act.

Examples of this vegetation community are shown in **Photographs 3.10** and **3.11**.



Photograph 3.10 **Exotic Vegetation within the study area**



Photograph 3.11 **Exotic Vegetation within the study area**

3.2 **Flora**

3.2.1 ***General Species***

Over 300 flora species have been recorded within the study area during recent field surveys by Cumberland Ecology. The dominant plant families encountered during recent surveys have consistently been represented by the Proteaceae, Poaceae, Myrtaceae, Fabaceae (Faboideae) and Fabaceae (Mimosoideae) families. Approximately 40% of the flora species recorded are exotic species. A list of flora species recorded from Dahua-owned areas of the study area during recent field surveys is provided in **Appendix A**.

A total of 15 exotic weeds recorded within the study area during recent field surveys by Cumberland Ecology are listed as priority weeds or weeds of concern under the *Biosecurity Act 2015* (see **Table 3.2**). This includes six state priority weeds, one regional priority weed and eight weeds of regional concern. All six state priority weeds are also Weeds of National Significance (WONS) (Department of the Environment 2014).

Table 3.2 State and regional priority weeds, weeds of regional concern and weeds of national significance

Species	Common Name	Status	Recorded within the subject site
<i>Asparagus asparagoides</i>	Bridal Creeper	SP, WONS	Yes
<i>Chloris gayana</i>	Rhodes Grass	OWRC	No
<i>Echium plantagineum</i>	Paterson's Curse	OWRC	No
<i>Eragrostis curvula</i>	African Lovegrass	OWRC	Yes
<i>Heliotropium amplexicaule</i>	Blue Heliotrope	OWRC	No
<i>Hypericum perforatum</i>	St. John's Wort	OWRC	No
<i>Lantana camara</i>	Lantana	SP, WONS	No
<i>Ligustrum lucidum</i>	Large-leaved Privet	OWRC	No
<i>Lycium ferocissimum</i>	African Boxthorn	SP, WONS	Yes
<i>Ochna serrulata</i>	Mickey Mouse Plant	OWRC	No
<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	RP	Yes
<i>Opuntia stricta</i>	Common Prickly Pear	SP, WONS	Yes
<i>Romulea rosea</i>	Onion Grass	OWRC	Yes
<i>Rubus fruticosus</i>	Blackberry	SP, WONS	Yes
<i>Senecio madagascariensis</i>	Fireweed	SP, WONS	Yes

SP=State Priority Weed, Regional Priority Weed, OWRC= Other Weed of Regional Concern, WONS=Weed of National Significance

3.2.2 Threatened Species

A number of threatened flora species have been recorded from the locality; however, no threatened flora species were detected during recent or previous surveys of the study area. Based on the results of previous studies, field surveys and assessment of the condition of potential habitat, none are considered as highly likely to occur within areas of the study area surveyed due to degradation of the land as a result of previous land practices. Areas of suitable habitat for threatened flora species may be present within unsurveyed areas located alongside the Nepean River in the west of the study area.

3.3 Fauna

3.3.1 Fauna Habitat

The fauna habitats within the study area predominantly occur within the woodland and forest vegetation and to a lesser extent within previously cleared areas comprised of exotic vegetation. Woodland and forest vegetation within the study area generally occurs as isolated patches surrounded by exotic grassland, or as linear patches adjacent to riparian corridors. To a large degree, the majority of the habitat within the study area is highly degraded due to previous clearing and land uses.

Despite the reduced extent of habitat, the study area does provide some habitat features that provide potential foraging, shelter and breeding opportunities for fauna. Key habitat features recorded within the study area include:

- Riparian environments and farm dams – suitable for fauna species dependent on these habitats such as wetland birds, amphibians and reptiles;
- Fallen logs, debris and leaf litter – shelter habitat for amphibians, reptiles and terrestrial mammals;
- Hollow-bearing trees and stags – providing shelter and breeding habitat for a range of reptiles, birds, arboreal mammals and Microchiropteran bats (microbats); and
- Nectar-producing trees and shrubs – foraging habitat for insects, blossom-dependant birds, arboreal mammals and megachiropteran bats (Flying-foxes).

These habitat features provide habitat for a range of fauna, including some species that are listed as threatened under the TSC Act and or EPBC Act.

3.3.2 General Species

A number of fauna species have been recorded from the study area during surveys. The majority of the species recorded are common to the area and primarily consisted of avian fauna. The disturbed nature of the study area is likely to have an impact on the species richness and abundance of fauna species. A full list of fauna species recorded within the study area by Cumberland Ecology to date is provided in **Appendix B**.

3.3.3 Threatened Species

Recent and previous surveys of the study area detected the presence of the threatened fauna species provided below. **Figure 3.2** identifies the locations of threatened fauna species recorded by Cumberland Ecology during recent surveys.

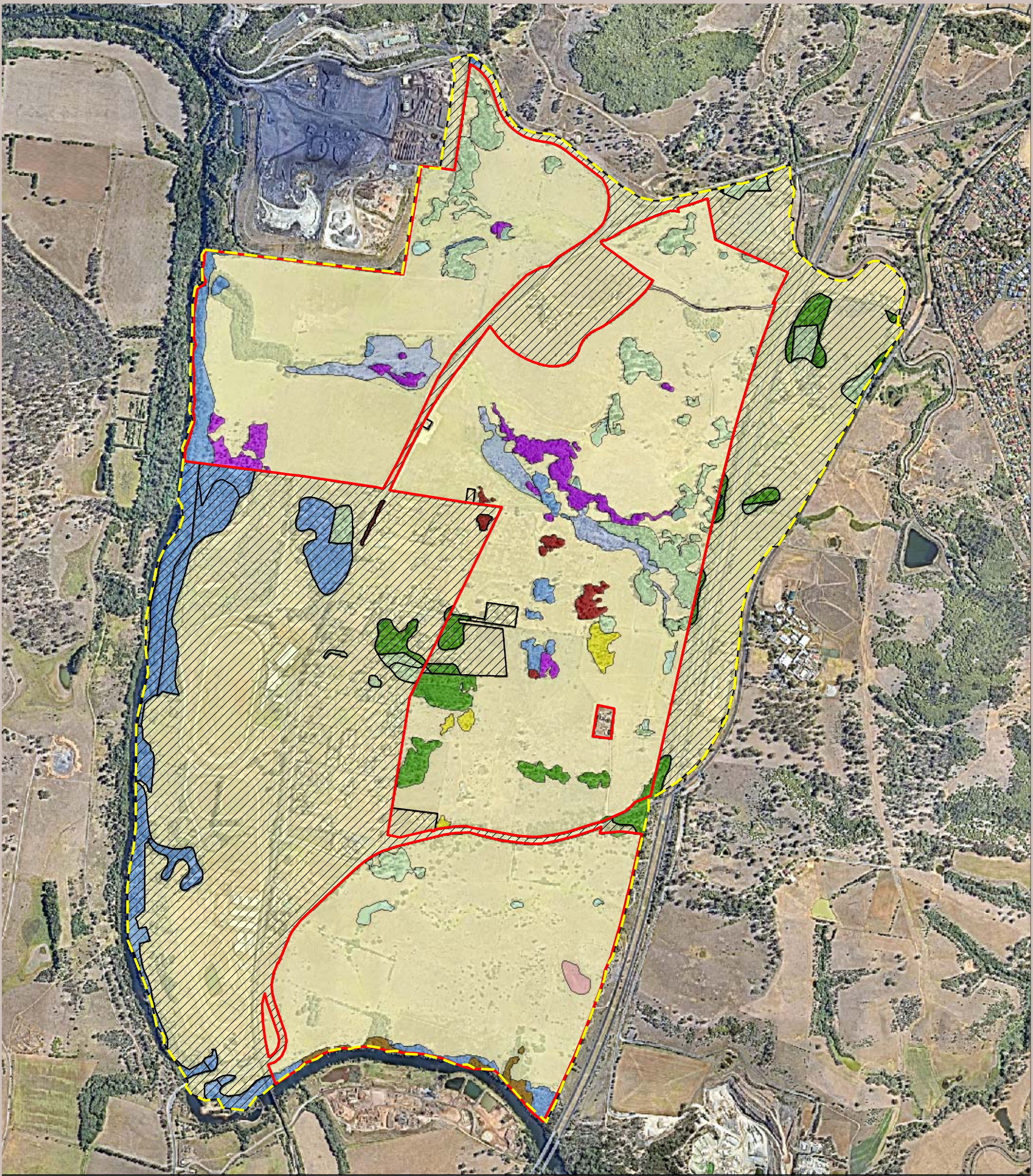
- Black-necked Stork (*Ephippiorhynchus asiaticus*) (TSC Act: Endangered; EPBC Act: not listed);
- Varied Sittella (*Daphoenositta chrysoptera*) (TSC Act: Vulnerable; EPBC Act: not listed);

- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) (TSC Act: Vulnerable; EPBC Act: not listed);
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) (TSC Act: Vulnerable; EPBC Act: not listed);
- Little Eagle (*Hieraaetus morphnoides*) (TSC Act: Vulnerable; EPBC Act: not listed);
- Rufous Fantail (*Rhipidura rufifrons*) (TSC Act: not listed; EPBC Act: Migratory)
- Powerful Owl (*Ninox strenua*) (TSC Act: Vulnerable; EPBC Act: not listed);
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*) (TSC Act: Vulnerable; EPBC Act: Marine);
- Grey-headed Flying-fox (*Pteropus poliocephalus*) (TSC Act: Vulnerable; EPBC Act: Vulnerable);
- Eastern Cave Bat (*Vespadelus troughtoni*) (TSC Act: Vulnerable; EPBC Act: not listed);
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (TSC Act: Vulnerable; EPBC Act: not listed);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) (TSC Act: Vulnerable; EPBC Act: not listed);
- Eastern Freetail-bat (*Mormopterus norfolkensis*) (TSC Act: Vulnerable; EPBC Act: not listed);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) (TSC Act: Vulnerable; EPBC Act: not listed);
- Little Bentwing-Bat (*Miniopterus australis*) (TSC Act: Vulnerable; EPBC Act: not listed); and
- Southern Myotis (*Myotis macropus*) (TSC Act: Vulnerable; EPBC Act: not listed).

Based on database searches, several additional threatened fauna species have been recorded in the locality. The following threatened fauna species have been assessed as having the potential to occur within the study area:

- Diamond Firetail (*Stagonopleura guttata*) (TSC Act: Vulnerable; EPBC Act: not listed);
- Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*) (TSC Act: Vulnerable; EPBC Act: not listed);

- Large-eared Pied Bat (*Chalinolobus dwyeri*) (TSC Act: Vulnerable; EPBC Act: Vulnerable); and
- Cumberland Plain Land Snail (*Meridolum carneovirens*) (TSC Act: Endangered; EPBC Act: not listed).



Legend

Site

Study area

OEH vegetation mapping (2013)

Vegetation Community

Shale Plains Woodland

Shale Hills Woodland

Shale Hills Woodland Derived Native Grassland

Elderslie Banksia Scrub Forest

River Flat Eucalypt Forest

Swamp Oak Floodplain Forest

River Oak Riparian Woodland

Freshwater Wetlands

Acacia Regrowth

Exotic Vegetation and Cleared Land

Dam

Coordinate System: MGA Zone 56 (GDA 94)

Image Source:
Image © NearMap
(05/02/2018)

Data Source:
OEH (2013). Remnant Vegetation
of the western Cumberland subregion,
2013 Update. Office of Environment
and Heritage, NSW

Figure 3.1. Vegetation communities within the study area

I:\...17072\Figures\RP4\20181106\Figure 3.1. Vegetation communities_study area

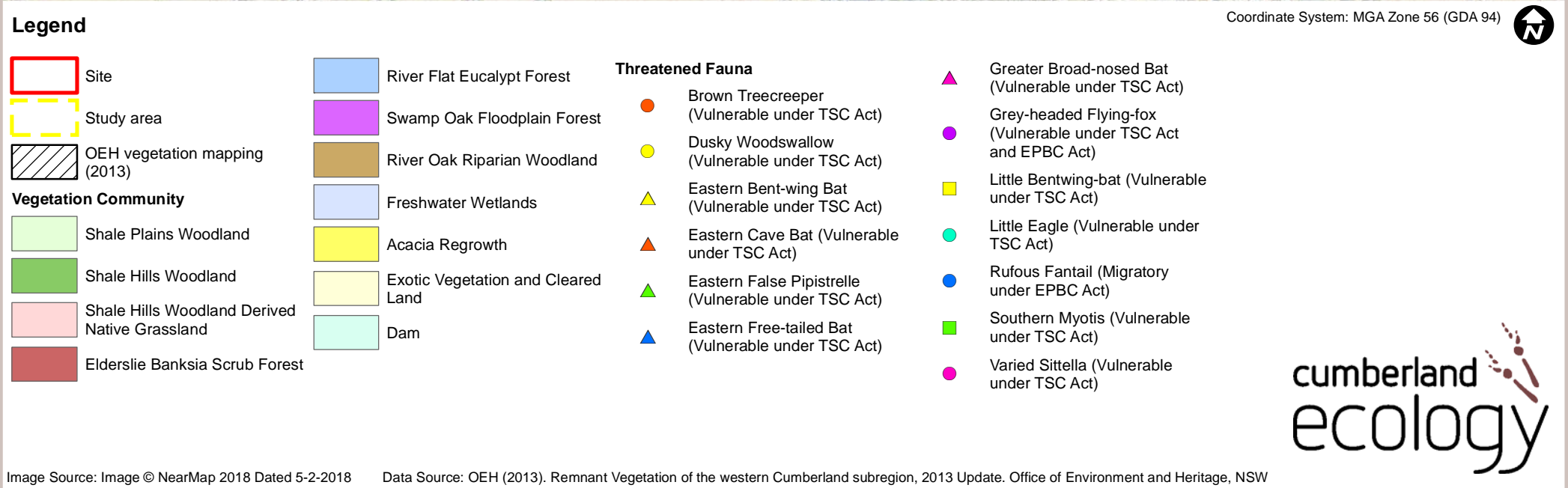
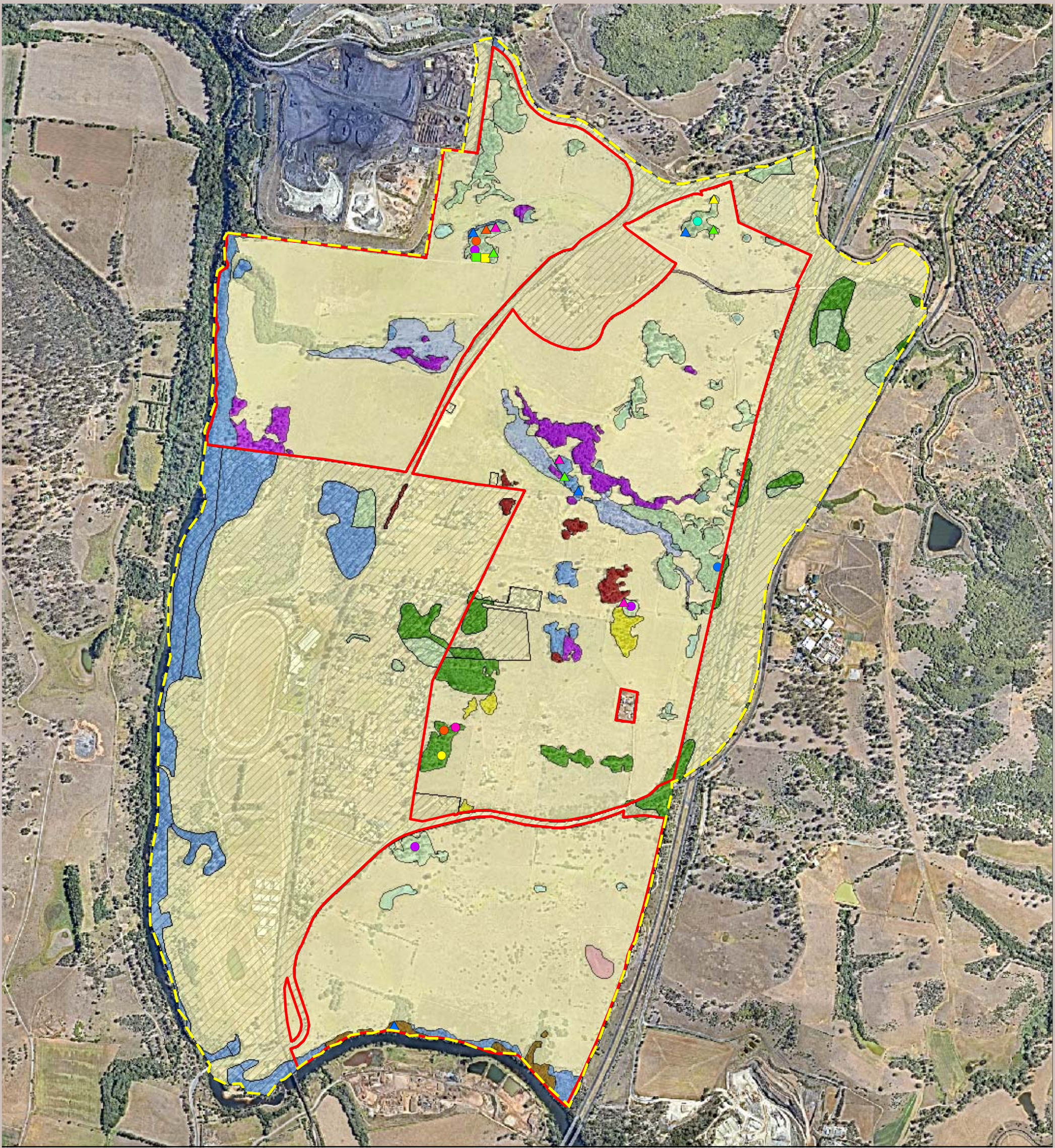


Figure 3.2. Threatened fauna recorded by Cumberland Ecology within the study area

0 150 300 450 600 m

Constraints Analysis

4.1 Ecological Constraints

This assessment includes descriptions of various biodiversity values of the study area, such as threatened species, populations and communities listed under the TSC Act and/or EPBC Act, and the presence of valuable habitat resources for threatened species. Based on this assessment, a number of ecological constraints have been identified within the study area. Key ecological constraints identified include:

- Presence of TECs, including Cumberland Plain Woodland, Elderslie Banksia Scrub Forest, River-flat Eucalypt Forest, Swamp Oak Floodplain Forest and Freshwater Wetlands;
- Presence of known habitat for 16 threatened fauna species;
- Presence of potential habitat for four threatened fauna species; and
- Presence of fauna habitat features, such as hollow-bearing trees and farm dams suitable for use by threatened fauna species.

The TEC vegetation and habitat identified within the study area appear to have been modified as a result of previous land clearing and management practices. As a consequence, the conservation value of some of these areas has been reduced. Nevertheless, there is still a requirement to consider the impacts to these biodiversity values.

Four general categories of ecological constraints have been identified within the study area: High, Moderate, Low and None, which are shown in **Figure 4.1**.

Areas of high constraint contain CEEC listed under the TSC Act that do not have ecosystem credits available on the open market and/or are within major riparian corridors. As such, these areas will likely be the most expensive and difficult to offset.

Areas of moderate constraint contain CEEC and/or EEC listed under the TSC Act that have a patch size greater than 0.5 ha, or are part of a vegetation/habitat corridor. The removal of such areas is typically less expensive to offset when compared to areas of high constraint; however offsetting is still required.

Areas of low constraint contain CEEC and/or EEC listed under the TSC Act that have a patch size of less than 0.5 ha, and are isolated from nearby areas of native vegetation. Additional areas of low constraint include native vegetation communities not listed under the

TSC Act or EPBC Act, farm dams and scattered trees that may provide suitable habitat for threatened fauna known to occur in the locality. Development in such areas still requires offsetting; however impacts are unlikely to have a significant impact on the biodiversity values of the study area.

Areas of no constraint comprise cleared land or areas dominated by exotic vegetation. Impacts to such areas do not need to be offset. Therefore, development in such areas can be maximised with little impact to the biodiversity values of the study area.

4.2 Potential Impacts of the Proposal

4.2.1 Overview

Any future development of the study area as a result of the proposal will require some land clearance that has the potential to directly and indirectly impact biodiversity values within the study area. Potential impacts of development associated with the proposal include:

- Removal of native vegetation;
- Removal of fauna habitat features such as hollow-bearing trees, coarse woody debris, and blossom-producing trees and shrubs;
- Removal of potential habitat for threatened flora and fauna species;
- Modification of microhabitats through edge effects;
- Modification of habitat connectivity;
- Runoff, sedimentation and erosion;
- Weed invasion; and
- Injury or mortality to fauna species.

It is important to note that the amendments proposed to the existing Structure Plan within the proposal only apply to the site as the zoning of areas outside of the site will remain unchanged. Nevertheless, the following section discusses potential impacts of the proposal on the study area (including areas that will not have zoning changed) and site (areas that will have zoning changed).

4.2.2 Vegetation Communities

Table 4.1 and **Table 4.2** provide a summary of the areas of each vegetation community to be removed and retained under the proposal, along with the total percentage of each community to be removed for the study area and site, respectively. **Figure 4.2** identifies the areas of each vegetation community to be retained under the proposal. For the purposes of this assessment we have assumed a 'worst case' scenario where all vegetation not identified as 'retained' or 'riparian' within **Figure 4.2** is assumed to be removed by future development.

As a result, it is likely that the total removed areas and percentages provided in **Table 4.1** and **Table 4.2** are overestimations of actual vegetation that will be cleared by future development as it is expected that some areas of vegetation will be retained.

i. The study area

The proposal will facilitate the removal of up to 57.25 ha of native vegetation within the study area assuming that all areas with potential for development are entirely cleared. Approximately 64.39 ha of native vegetation will be retained. An additional 688.02 ha of Exotic Vegetation and Cleared Land will be removed; however, these areas offer minimal ecological value and are unlikely to require offsetting.

The native vegetation communities to be most impacted within the study area under the proposal are Shale Hills Woodland, Shale Hills Woodland Derived Native Grassland and Acacia Regrowth as the entire occurrence of these communities within the study area will be removed. All other native vegetation communities will have at least 47% of their total occurrence within study area retained.

Table 4.1 Vegetation to be removed and retained within the study area under the proposal

Vegetation Community	TSC Act Status	EPBC Act Status	Total Area (ha)	Area Removed (ha)*	Area Retained (ha)	% Removed within the Study Area
Native Vegetation						
Shale Plains Woodland	CEEC	-	30.03	15.88	14.15	53%
Shale Hills Woodland	CEEC	-	17.50	17.50	0.00	100%
Shale Hills Woodland Derived Native Grassland	CEEC	-	1.02	1.02	0.00	100%
Elderslie Banksia Scrub Forest	CEEC	-	2.70	1.41	1.29	52%
River Flat Eucalypt Forest	EEC	-	44.43	14.25	30.18	32%
Swamp Oak Floodplain Forest	EEC	-	10.05	4.15	5.89	41%
Freshwater Wetlands	EEC	-	11.13	0.53	10.60	5%
River Oak Riparian Woodland	-	-	2.33	0.05	2.28	2%
Acacia Regrowth	-	-	2.45	2.45	0.00	100%
Other Vegetation						
Dam	-	-	2.98	1.11	1.88	37%
Exotic Vegetation and Cleared Land	-	-	766.82	688.02	78.80	90%
Total			891.43	746.37	145.06	84%

Note: Areas provided are for the study area and have been rounded to the nearest hundredth. All areas include a combination of Cumberland Ecology and OEH (2013) mapping.

All removed areas assume that all areas not proposed to be retained or are within riparian areas will have all vegetation cleared. This is likely an overestimation of clearing works that will occur under the proposal.

ii. The site

The proposal will facilitate the removal of up to 29.32 ha of native vegetation within the site assuming that all areas with potential for development are entirely cleared. Approximately 43.96 ha of native vegetation will be retained. An additional 374.48 ha of Exotic Vegetation and Cleared Land will be removed; however, these areas offer minimal ecological value and are unlikely to require offsetting.

The native vegetation communities within the site to be most impacted under the proposal are Shale Hills Woodland, Shale Hills Woodland Derived Native Grassland and Acacia Regrowth as the entire occurrence of these communities within the site will be removed. All other native vegetation communities will have at least 59% of their total occurrence within study area retained.

Table 4.2 Vegetation to be removed and retained within the site under the proposal

Vegetation Community	TSC Act Status	EPBC Act Status	Total Area (ha)	Area Removed (ha)*	Area Retained (ha)	% Removed within the Site
Native Vegetation						
Shale Plains Woodland	CEEC	-	23.29	9.14	14.15	39%
Shale Hills Woodland	CEEC	-	9.18	9.18	0.00	100%
Shale Hills Woodland Derived Native Grassland	CEEC	-	1.02	1.02	0.00	100%
Elderslie Banksia Scrub Forest	CEEC	-	2.16	0.87	1.29	40%
River Flat Eucalypt Forest	EEC	-	11.67	1.92	9.75	17%
Swamp Oak Floodplain Forest	EEC	-	10.05	4.15	5.89	41%
Freshwater Wetlands	EEC	-	11.13	0.53	10.60	5%
River Oak Riparian Woodland	-	-	2.33	0.05	2.28	2%
Acacia Regrowth	-	-	2.45	2.45	0.00	100%
Other Vegetation						
Dam	-	-	2.98	1.11	1.88	37%
Exotic Vegetation and Cleared Land	-	-	439.93	374.48	65.45	85%
Total			516.19	404.91	111.28	78%

Note: Areas provided are for the site and have been rounded to the nearest hundredth. All areas include a combination of Cumberland Ecology and OEH (2013) mapping.

All removed areas assume that all areas not proposed to be retained or are within riparian areas will have all vegetation cleared. This is likely an overestimation of clearing works that will occur under the proposal.

4.2.3 Threatened Flora

No threatened flora species were detected during recent or previous surveys of the study area and none are considered as highly likely to occur within areas of the study area that are zoned for future development. Therefore, future development within the study area under the proposal is unlikely to have a significant impact on any threatened flora species. Furthermore, the majority of vegetation that may provide suitable habitat for threatened flora is within riparian areas, most of which will be retained under the proposal.

4.2.4 Threatened Fauna

Twenty (20) threatened species listed under the TSC Act and/or the EPBC Act have either been recorded within the study area or are considered to have the potential to occur. The majority of the threatened fauna either recorded or considered to have the potential to occur are highly mobile and are likely utilising the scattered habitat present as part of a broader range. Although threatened species have been recorded in areas susceptible to clearing in the future under the proposal, the most suitable habitat for all of these species is considered to be within the largest patches of woodland contained within the riparian areas of the study area. As the majority of these areas will be retained under the proposal, future development is unlikely to have a significant impact on any of the threatened species known to occur or that are considered to have the potential to occur within the study area.

4.3 Future Ecological Assessments

4.3.1 Future Development Applications within the Study Area

Any future development within the study area will require assessment under either the former planning provisions (i.e. TSC Act) or BC Act depending on the timing of the DA submission. Any DA submitted prior to 24 November 2018 may be assessed under the former planning provisions, while all DAs submitted after 24 November 2018 will require assessment under the BC Act.

The proponent has previously lodged several DAs within the site that will be assessed under the TSC Act. All previously submitted DAs have included a number of compensatory measures to offset residual impacts of future development. Compensatory measures proposed as part of the previously lodged DAs are described in **Section 4.3.2** below. These measures could also be utilised for any future DAs submitted prior to 24 November 2018. It is expected that any previously submitted or future DAs lodged prior to 24 November 2018 that have significant impacts on TECs may require concurrent approval from OEH.

DAs submitted after 24 November 2018 will require offsetting to be undertaken in accordance with the BC Act, should the Biodiversity Offsets Scheme be triggered.

4.3.2 Compensatory Measures

A number of compensatory measures have been proposed to offset the residual impacts of DAs previously lodged by Dahua within the study area. The current strategy for compensatory measures proposed for Dahua-owned areas of the site include:

- Establishment of Biodiversity Stewardship Sites (BSS) managed under a Biodiversity Stewardship Agreement (BSA) under the BC Act;
- Purchase and retirement of ecosystem credits; and
- Revegetation/rehabilitation works.

Each of these measures is detailed further below.

Should any shortfalls of compensatory measures be identified during the DA process, consultation will be undertaken with Campbelltown Council and/or OEH to determine appropriate alternative compensatory measures. This may include varying the like-for-like rules to secure credits or monetary contributions into the NSW Biodiversity Conservation Trust.

i. Establishment of Biodiversity Stewardship Sites

In order to offset impacts to native vegetation, BSSs will be established within areas of retained vegetation within the site. BSSs are conservation areas established under the NSW BC Act. It is expected that all proposed BSSs will be created as per the requirements of the BC Act.

Such sites will result in the generation of ecosystem credits that can then be retired. BSSs will be contained within the riparian areas within the centre and northwest corner of the Menangle Park URA as identified in **Figure 4.3**. Such areas of retained habitat include some of the largest and best condition vegetation, which also provides connectivity to offsite habitat.

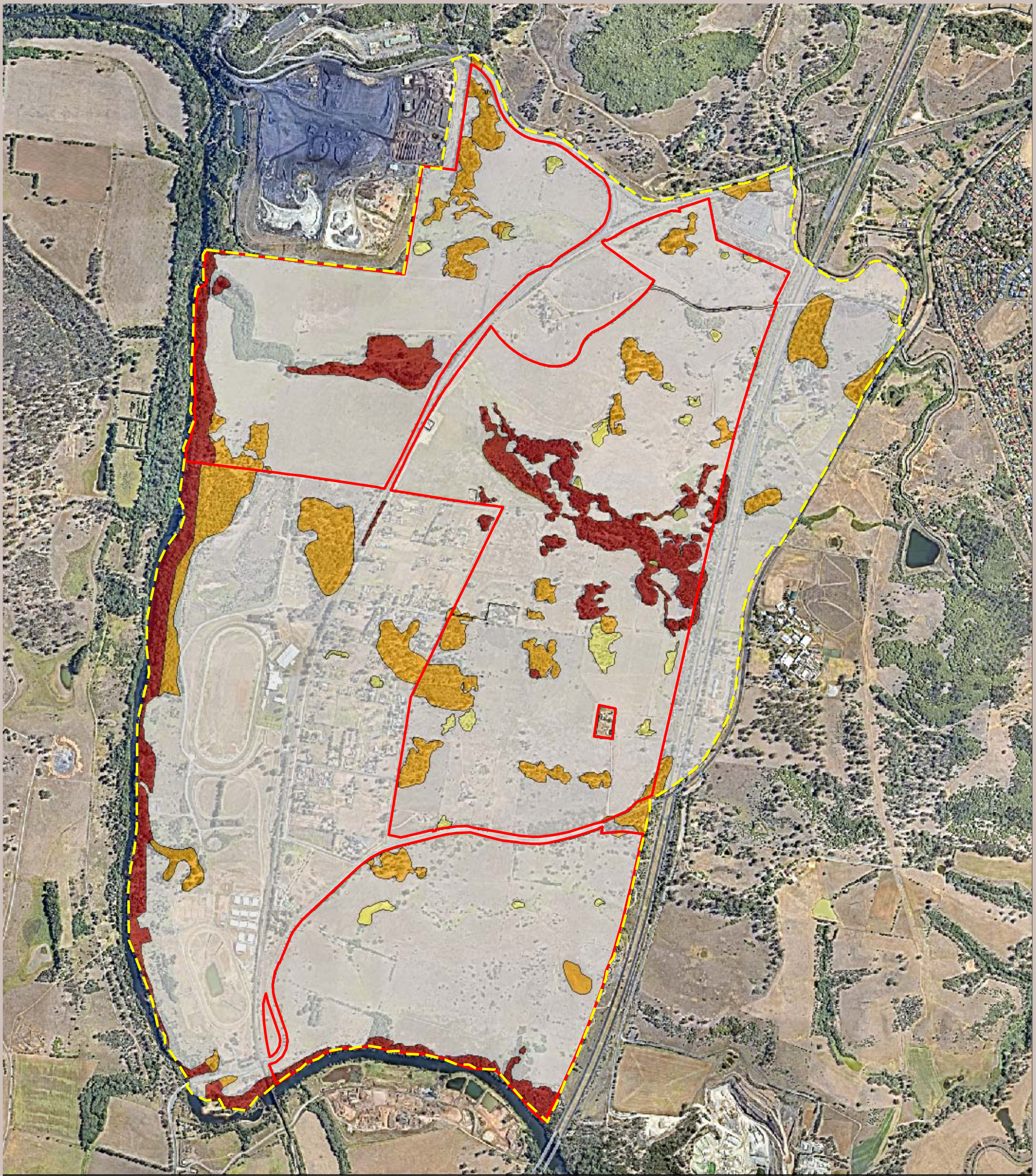
Ownership of the BSSs may be either the developer or Campbelltown Council. Ownership will be determined at the DA stage and will require negotiations with Campbelltown Council in order to determine if they will consider taking on ownership of the BSS and its associated BSA.

ii. Purchase and Retirement of Biodiversity Credits

In 2018, a BioBanking Assessment was undertaken by Cumberland Ecology (2018b) to support a DA for the majority of Dahua-owned land within the site. The purpose of the BioBanking Assessment was to determine the credit liability of the DA with consideration of the proposed impacts and offset areas. The BioBanking identified shortfalls of credits for Shale Hills Woodland and Elderslie Banksia Scrub Forest. The proponent has currently signed a contract for the purchase of all required Shale Hills Woodland credits as identified in the BioBanking Assessment. No credits for Elderslie Banksia Scrub Forest are currently available on the credit market.

iii. Revegetation/Rehabilitation Works

In addition to the compensatory measures provided above, vegetation communities to be impacted within the study area that do not currently have credits available (e.g. Elderslie Banksia Scrub Forest) on the credit market may be offset through revegetation/rehabilitation works within retained areas of the study area. Revegetation/rehabilitation works are proposed to be undertaken for the largest patch of Elderslie Banksia Scrub present within the site (see **Figure 4.3**) which will result in no net-loss of the community within the site as 2.16 ha the community will be revegetated. The details of the revegetation/rehabilitation works are detailed in Land Clearing DA (Ref. 17072RP5) submitted to Council. This option of revegetation/rehabilitation to offset impacts on native vegetation is only available to DAs that are assessed under the TSC Act and will require approval from Council. The specific details of any such works will need to be included in the ecological assessment for DAs within the study area.



Legend

Site

Study area

Ecological Constraint

High

Moderate


Low

None

Coordinate System: MGA Zone 56 (GDA 94)

Image Source:
Image © NearMap
(05/02/2018)

Data Source:
OEH (2013). Remnant Vegetation
of the western Cumberland subregion,
2013 Update. Office of Environment
and Heritage, NSW



0 150 300 450 600 m




Figure 4.1. Ecological constraints within the study area

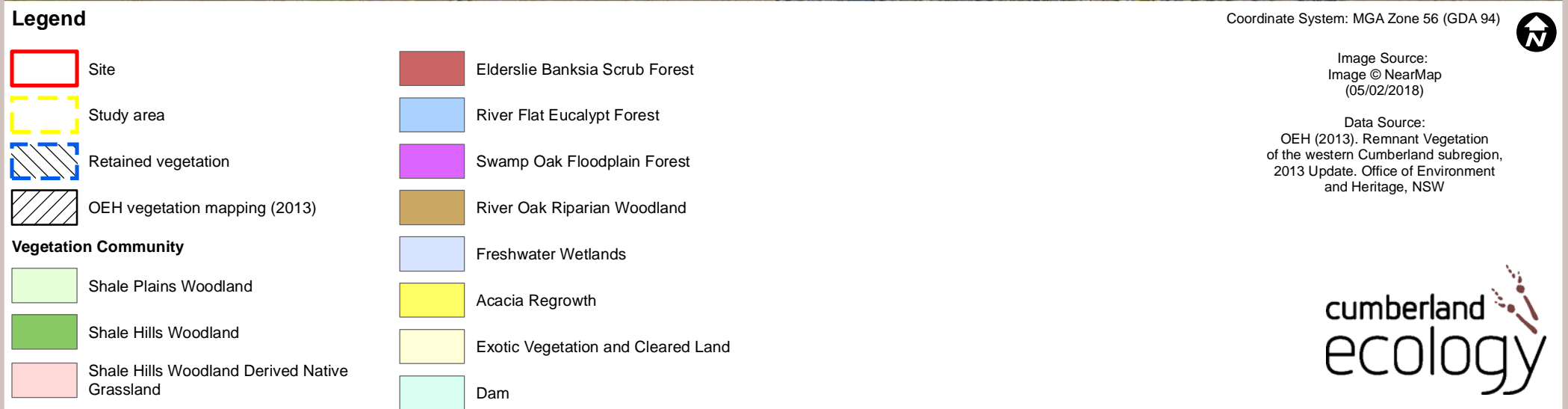
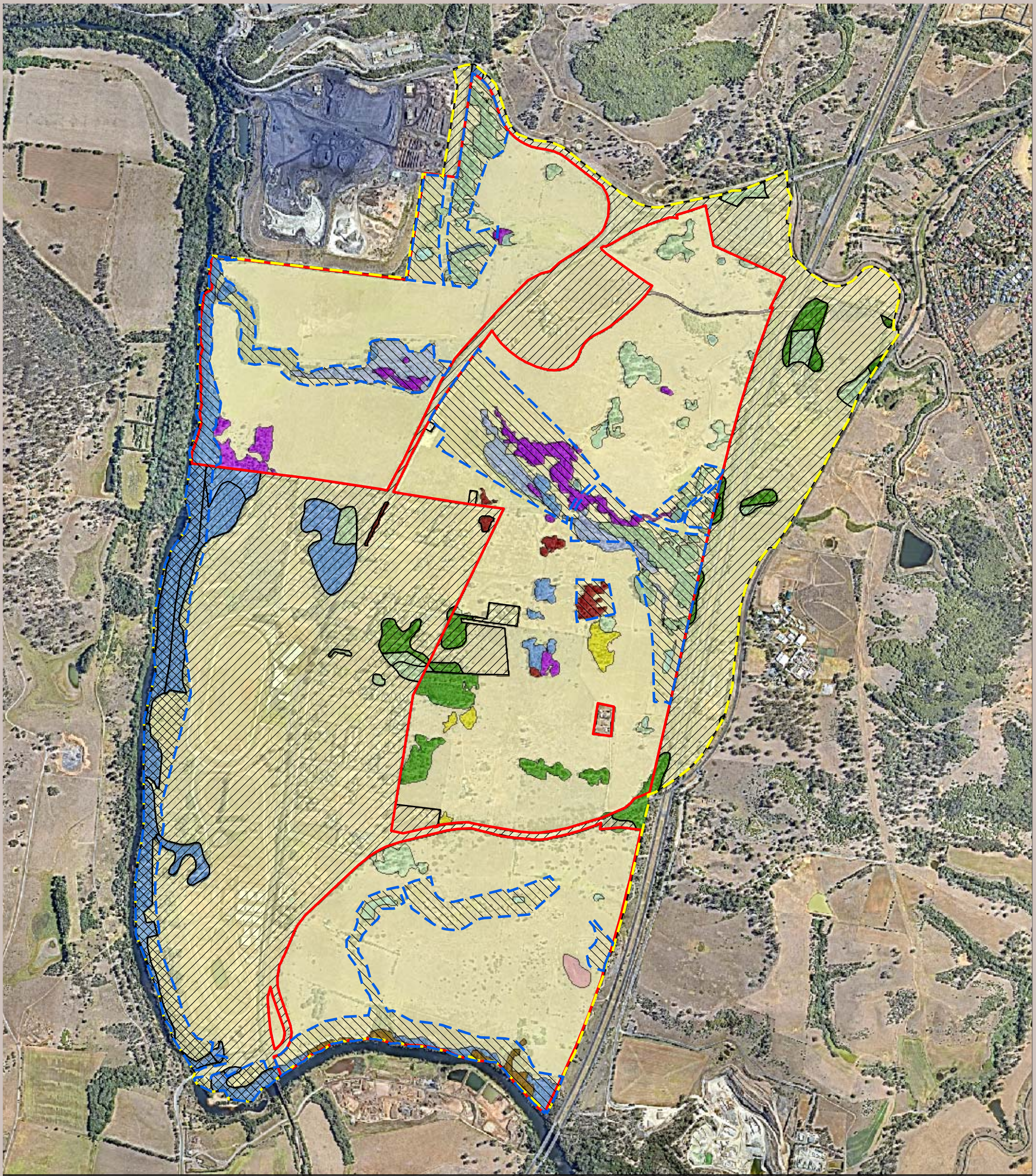


Figure 4.2. Vegetation communities to be retained within the study area

0 150 300 450 600 m

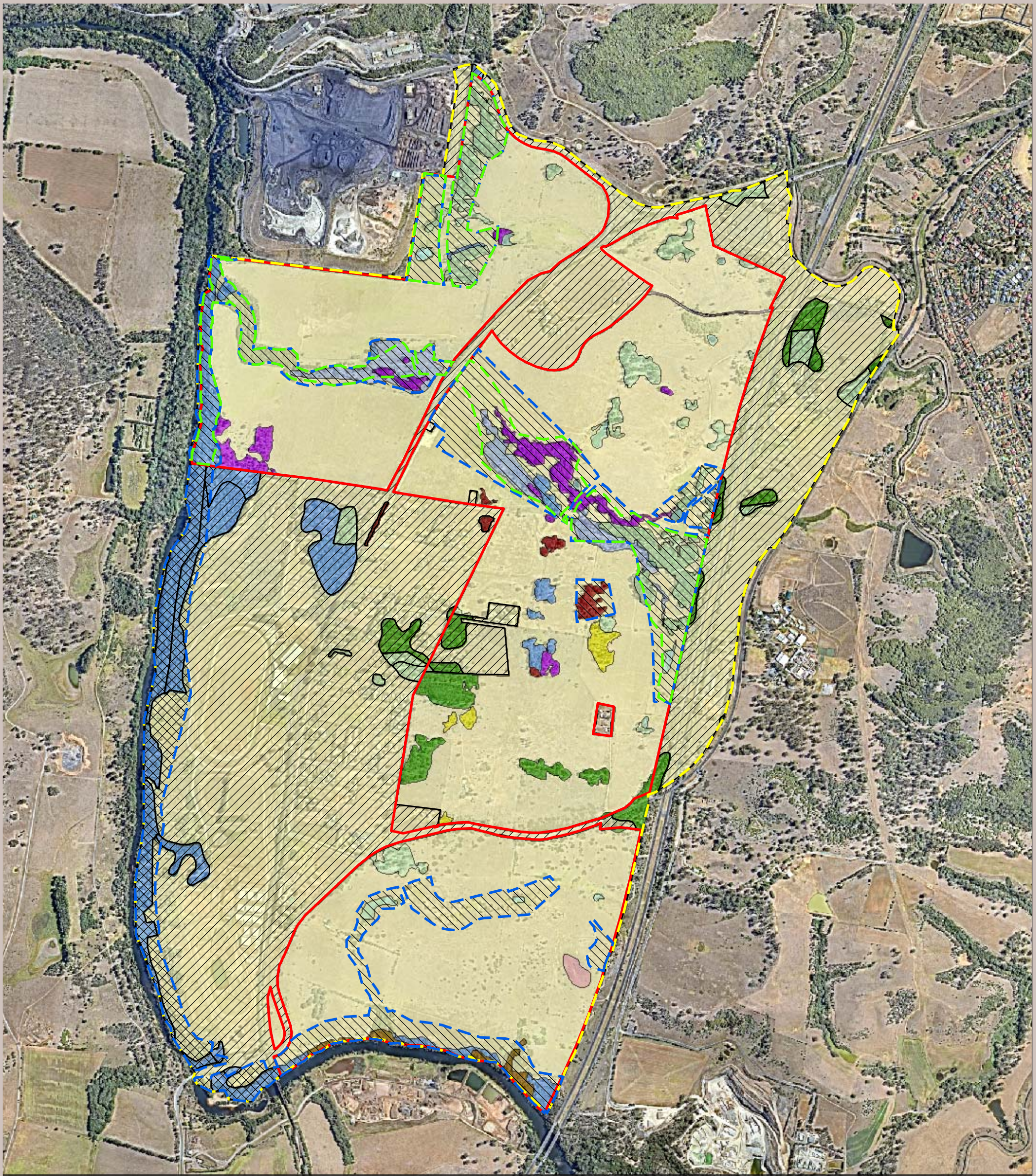


Figure 4.3. Locations of proposed biodiversity stewardship sites

0 150 300 450 600 m

Conclusion

The proposal will facilitate the removal of up to approximately 57.25 ha of native vegetation from the study area. This includes the clearing of the following seven TECs listed under the TSC Act: Shale Plains Woodland (15.88 ha), Shale Hills Woodland (17.50 ha), Shale Hills Woodland (derived native grassland) (1.02 ha), Elderslie Banksia Scrub Forest (1.41 ha), River-flat Eucalypt Forest (14.25 ha), Swamp Oak Floodplain Forest (4.15 ha) and Freshwater Wetlands (0.53 ha).

The proposal will facilitate the removal of up to approximately 29.32 ha of native vegetation from the site. This includes the clearing of the following seven TECs listed under the TSC Act: Shale Plains Woodland (9.14 ha), Shale Hills Woodland (9.18 ha), Shale Hills Woodland (derived native grassland) (1.02 ha), Elderslie Banksia Scrub Forest (0.87 ha), River-flat Eucalypt Forest (1.92 ha), Swamp Oak Floodplain Forest (4.15 ha) and Freshwater Wetlands (0.53 ha).

Although the proposal will result in impacts on TECs listed above, such areas are primarily comprised of small isolated patches that are exposed to a high degree of edge effects and are degraded. Nevertheless, it is expected that impacts to TECs will require compensation/offsetting measures. Such measures may include the establishment of BSSs, the purchase and retirement of ecosystem credits, payment into the Biodiversity Conservation Trust and/or revegetation/rehabilitation works (only applicable to DAs being assessed under the TSC Act).

Approximately 64.39 ha of native vegetation will be retained within the study area. This includes the following TECs: Shale Plains Woodland (14.15 ha), Elderslie Banksia Scrub Forest (1.29 ha), River-flat Eucalypt Forest (30.18 ha), Swamp Oak Floodplain Forest (5.89 ha) and Freshwater Wetlands (10.60 ha).

Approximately 43.96 ha of native vegetation will be retained within the site. This includes the following TECs: Shale Plains Woodland (14.15 ha), Elderslie Banksia Scrub Forest (1.29 ha), River-flat Eucalypt Forest (9.75 ha), Swamp Oak Floodplain Forest (5.89 ha) and Freshwater Wetlands (10.60 ha).

Areas of native vegetation to be retained are primarily within riparian areas that consist of the largest patches of native vegetation within the study area and site. These areas are typically in better condition than areas to be removed and also provide connectivity to other areas of habitat. Additionally, the largest patch of Elderslie Banksia Scrub Forest within the study area will be retained, along with areas immediately adjacent to this patch that are proposed to be managed and regenerated to adequately offset impacts to smaller patches of the community proposed to be removed.

In addition to the native vegetation to be removed/retained, large areas of Exotic Vegetation and Cleared Land (most of which has been previously cleared) and artificial dams will be removed. The removal of such areas are unlikely to have a significant impact on the biodiversity values of the study area or greater locality as they are unlikely to offer important habitat for any threatened species considered to occur in the locality.

The proposal will remove suitable habitat for threatened species previously recorded within the study area or that are considered to have the potential to occur within the study area; however, the habitat to be removed primarily consists of small isolated patches that are exposed to a high degree of edge effects. The most suitable habitat for threatened species within the study area is considered to be within the larger tracts of vegetation contained within the riparian areas that are to be largely retained under the proposal. As such, future development within the study area under the proposal is considered unlikely to have a significant impact on any threatened species predicted to occur with the study area based on the survey and database data collected to date.

With consideration of the above, it is expected that potential impacts to the biodiversity values of the study area as a result of future development under the proposal can be adequately offset for through the implementation of appropriate compensation measures as required under either the TSC Act or BC Act.

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Appendix A

Flora Species Recorded by Cumberland
Ecology within the Study Area

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
1 - Trees	Casuarinaceae		<i>Casuarina glauca</i>	Swamp Oak
1 - Trees	Myrtaceae		<i>Eucalyptus eugenoides</i>	Thin-leaved Stringybark
1 - Trees	Myrtaceae		<i>Eucalyptus moluccana</i>	Grey Box
1 - Trees	Myrtaceae		<i>Eucalyptus tereticornis</i>	Forest Red Gum
1 - Trees	Myrtaceae		<i>Angophora subvelutina</i>	Broad-leaved Apple
1 - Trees	Myrtaceae		<i>Eucalyptus amplifolia</i>	Cabbage Gum
1 - Trees	Myrtaceae		<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
1 - Trees	Proteaceae		<i>Banksia integrifolia</i>	Coast Banksia
2 - Small Trees	Casuarinaceae		<i>Casuarina glauca</i>	Swamp Oak
2 - Small Trees	Fabaceae (Mimosoideae)		<i>Acacia decurrens</i>	Black Wattle
2 - Small Trees	Myrtaceae		<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
2 - Small Trees	Myrtaceae		<i>Eucalyptus eugenoides</i>	Thin-leaved Stringybark
2 - Small Trees	Myrtaceae		<i>Eucalyptus moluccana</i>	Grey Box
2 - Small Trees	Myrtaceae		<i>Eucalyptus tereticornis</i>	Forest Red Gum
2 - Small Trees	Myrtaceae		<i>Angophora costata</i>	Smooth-barked Apple
2 - Small Trees	Myrtaceae		<i>Angophora subvelutina</i>	Broad-leaved Apple
2 - Small Trees	Myrtaceae		<i>Eucalyptus amplifolia</i>	Cabbage Gum
2 - Small Trees	Oleaceae	*	<i>Ligustrum lucidum</i>	Large-leaved Privet
2 - Small Trees	Oleaceae	*	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive
2 - Small Trees	Proteaceae		<i>Banksia integrifolia</i>	Coast Banksia
3 - Shrubs	Apocynaceae	*	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
3 - Shrubs	Cactaceae	*	<i>Opuntia stricta</i>	Common Prickly Pear
3 - Shrubs	Cactaceae	*	<i>Echinopsis pachanoi</i>	San Pedro Cactus
3 - Shrubs	Casuarinaceae		<i>Casuarina glauca</i>	Swamp Oak
3 - Shrubs	Dilleniaceae		<i>Hibbertia diffusa</i>	Wedge Guinea Flower
3 - Shrubs	Fabaceae (Mimosoideae)		<i>Acacia implexa</i>	Hickory Wattle
3 - Shrubs	Fabaceae (Mimosoideae)		<i>Acacia decurrens</i>	Black Wattle
3 - Shrubs	Myrtaceae	**	<i>Corymbia citriodora</i>	Lemon-scented Gum
3 - Shrubs	Myrtaceae		<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
3 - Shrubs	Myrtaceae		<i>Eucalyptus tereticornis</i>	Forest Red Gum
3 - Shrubs	Myrtaceae		<i>Bursaria spinosa</i>	Blackthorn
3 - Shrubs	Myrtaceae		<i>Angophora subvelutina</i>	Broad-leaved Apple
3 - Shrubs	Myrtaceae		<i>Eucalyptus amplifolia</i>	Cabbage Gum
3 - Shrubs	Myrtaceae		<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark
3 - Shrubs	Myrtaceae		<i>Eucalyptus tereticornis</i>	Forest Red Gum
3 - Shrubs	Myrtaceae		<i>Kunzea ambigua</i>	Tick Bush
3 - Shrubs	Myrtaceae		<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark
3 - Shrubs	Ochnaceae	*	<i>Ochna serrulata</i>	Mickey Mouse Plant
3 - Shrubs	Oleaceae	*	<i>Ligustrum lucidum</i>	Large-leaved Privet
3 - Shrubs	Oleaceae	*	<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive
3 - Shrubs	Pittosporaceae		<i>Bursaria spinosa</i>	Blackthorn
3 - Shrubs	Polygalaceae	*	<i>Polygala virgata</i>	

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
3 - Shrubs	Proteaceae		<i>Banksia integrifolia</i>	Coast Banksia
3 - Shrubs	Solanaceae	*	<i>Lycium ferocissimum</i>	African Boxthorn
3 - Shrubs	Solanaceae		<i>Duboisia myoporoides</i>	Corkwood
3 - Shrubs	Solanaceae	*	<i>Lycium ferocissimum</i>	African Boxthorn
3 - Shrubs	Verbenaceae	*	<i>Lantana camara</i>	Lantana
4 - Ferns and Allies	Dennstaedtiaceae		<i>Hypolepis muelleri</i>	Harsh Ground Fern
4 - Ferns and Allies	Dennstaedtiaceae		<i>Pteridium esculentum</i>	Common Bracken
4 - Ferns and Allies	Pteridaceae		<i>Cheilanthes sieberi</i>	
5 - Herbs (Dicots)	Acanthaceae		<i>Brunoniella australis</i>	Blue Trumpet
5 - Herbs (Dicots)	Apiaceae		<i>Centella asiatica</i>	Indian Pennywort
5 - Herbs (Dicots)	Apiaceae	*	<i>Cyclospermum leptophyllum</i>	Slender Celery
5 - Herbs (Dicots)	Apiaceae		<i>Hydrocotyle laxiflora</i>	Stinking Pennywort
5 - Herbs (Dicots)	Araceae		<i>Landoltia punctata</i>	
5 - Herbs (Dicots)	Asteraceae	*	<i>Carthamus lanatus</i>	Saffron Thistle
5 - Herbs (Dicots)	Asteraceae	*	<i>Cirsium vulgare</i>	Spear Thistle
5 - Herbs (Dicots)	Asteraceae	*	<i>Conyza sumatrensis</i>	Tall Fleabane
5 - Herbs (Dicots)	Asteraceae	*	<i>Facelis retusa</i>	Annual Trampweed
5 - Herbs (Dicots)	Asteraceae	*	<i>Gamochaeta americana</i>	Cudweed
5 - Herbs (Dicots)	Asteraceae	*	<i>Gamochaeta pensylvanica</i>	Cudweed
5 - Herbs (Dicots)	Asteraceae	*	<i>Gamochaeta purpurea</i>	Purple Cudweed
5 - Herbs (Dicots)	Asteraceae	*	<i>Hypochaeris microcephala</i>	White Flatweed

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
5 - Herbs (Dicots)	Asteraceae	*	<i>Hypochaeris radicata</i>	Catsear
5 - Herbs (Dicots)	Asteraceae	*	<i>Senecio madagascariensis</i>	Fireweed
5 - Herbs (Dicots)	Asteraceae	*	<i>Soliva sessilis</i>	Jo-jo, Bindyi,
5 - Herbs (Dicots)	Asteraceae	*	<i>Arctotheca calendula</i>	Capeweed
5 - Herbs (Dicots)	Asteraceae		<i>Calotis lappulacea</i>	Yellow Burr-Daisy
5 - Herbs (Dicots)	Asteraceae		<i>Cotula australis</i>	Common Cotula
5 - Herbs (Dicots)	Asteraceae	*	<i>Cotula coronopifolia</i>	Waterbuttons
5 - Herbs (Dicots)	Asteraceae		<i>Euchiton sphaericus</i>	
5 - Herbs (Dicots)	Asteraceae	*	<i>Lactuca saligna</i>	Willow-leaved Lettuce
5 - Herbs (Dicots)	Asteraceae		<i>Lagenophora stipitata</i>	Blue Bottle-daisy
5 - Herbs (Dicots)	Asteraceae		<i>Sigesbeckia orientalis</i>	
5 - Herbs (Dicots)	Asteraceae	*	<i>Sonchus asper</i>	Prickly Sowthistle
5 - Herbs (Dicots)	Asteraceae	*	<i>Sonchus oleraceus</i>	Common Sowthistle
5 - Herbs (Dicots)	Asteraceae	*	<i>Taraxacum officinale</i>	Dandelion
5 - Herbs (Dicots)	Boraginaceae	*	<i>Echium plantagineum</i>	Paterson's Curse
5 - Herbs (Dicots)	Boraginaceae	*	<i>Heliotropium amplexicaule</i>	Blue Heliotrope
5 - Herbs (Dicots)	Brassicaceae	*	<i>Capsella bursa-pastoris</i>	Shepherd's Purse
5 - Herbs (Dicots)	Callitrichaceae	*	<i>Callitriche stagnalis</i>	Common Starwort
5 - Herbs (Dicots)	Campanulaceae		<i>Wahlenbergia gracilis</i>	Sprawling Bluebell
5 - Herbs (Dicots)	Caryophyllaceae	*	<i>Cerastium glomeratum</i>	Mouse-ear Chickweed
5 - Herbs (Dicots)	Caryophyllaceae	*	<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
5 - Herbs (Dicots)	Caryophyllaceae	*	<i>Petrorhagia dubia</i>	
5 - Herbs (Dicots)	Caryophyllaceae	*	<i>Polycarpon tetraphyllum</i>	Four-leaved Allseed
5 - Herbs (Dicots)	Caryophyllaceae	*	<i>Silene gallica</i>	French Catchfly
5 - Herbs (Dicots)	Caryophyllaceae	*	<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort
5 - Herbs (Dicots)	Caryophyllaceae	*	<i>Arenaria serpyllifolia</i>	Thyme-leaved Sandwort
5 - Herbs (Dicots)	Caryophyllaceae	*	<i>Stellaria media</i>	Common Chickweed
5 - Herbs (Dicots)	Chenopodiaceae		<i>Einadia hastata</i>	Berry Saltbush
5 - Herbs (Dicots)	Chenopodiaceae		<i>Einadia trigonos</i>	Fishweed
5 - Herbs (Dicots)	Chenopodiaceae		<i>Einadia nutans</i>	Climbing Saltbush
5 - Herbs (Dicots)	Chenopodiaceae		<i>Einadia nutans</i> subsp. <i>nutans</i>	Climbing Saltbush
5 - Herbs (Dicots)	Chenopodiaceae		<i>Einadia nutans</i> subsp. <i>linifolia</i>	
5 - Herbs (Dicots)	Convolvulaceae		<i>Dichondra repens</i>	Kidney Weed
5 - Herbs (Dicots)	Crassulaceae		<i>Crassula sieberiana</i>	Australian Stonecrop
5 - Herbs (Dicots)	Fabaceae (Faboideae)	*	<i>Lotus uliginosus</i>	Birds-foot Trefoil
5 - Herbs (Dicots)	Fabaceae (Faboideae)	*	<i>Medicago polymorpha</i>	Burr Medic
5 - Herbs (Dicots)	Fabaceae (Faboideae)	*	<i>Trifolium arvense</i>	Haresfoot Clover
5 - Herbs (Dicots)	Gentianaceae	*	<i>Centaurium tenuiflorum</i>	
5 - Herbs (Dicots)	Geraniaceae		<i>Geranium solanderi</i>	Native Geranium
5 - Herbs (Dicots)	Haloragaceae		<i>Myriophyllum variifolium</i>	
5 - Herbs (Dicots)	Hypericaceae		<i>Hypericum gramineum</i>	Small St. John's Wort
5 - Herbs (Dicots)	Hypericaceae	*	<i>Hypericum perforatum</i>	St. John's Wort

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
5 - Herbs (Dicots)	Lamiaceae	*	<i>Stachys arvensis</i>	Stagger Weed
5 - Herbs (Dicots)	Linaceae	*	<i>Linum trigynum</i>	French Flax
5 - Herbs (Dicots)	Linaceae		<i>Linum marginale</i>	Native Flax
5 - Herbs (Dicots)	Malvaceae	*	<i>Sida rhombifolia</i>	Paddy's Lucerne
5 - Herbs (Dicots)	Malvaceae		<i>Sida corrugata</i>	Corrugated Sida
5 - Herbs (Dicots)	Malvaceae	*	<i>Modiola caroliniana</i>	Red-flowered Mallow
5 - Herbs (Dicots)	Onagraceae	*	<i>Oenothera sp.</i>	
5 - Herbs (Dicots)	Oxalidaceae		<i>Oxalis perennans</i>	
5 - Herbs (Dicots)	Phyllanthaceae		<i>Phyllanthus virgatus</i>	
5 - Herbs (Dicots)	Phyllanthaceae		<i>Poranthera microphylla</i>	
5 - Herbs (Dicots)	Phytolaccaceae	*	<i>Phytolacca octandra</i>	Inkweed
5 - Herbs (Dicots)	Plantaginaceae	*	<i>Plantago lanceolata</i>	Lamb's Tongue
5 - Herbs (Dicots)	Plantaginaceae	*	<i>Plantago myosuroides</i>	
5 - Herbs (Dicots)	Plantaginaceae	*	<i>Veronica arvensis</i>	Wall Speedwell
5 - Herbs (Dicots)	Plantaginaceae		<i>Veronica plebeia</i>	Trailing Speedwell
5 - Herbs (Dicots)	Polygonaceae	*	<i>Acetosella vulgaris</i>	Sorrel
5 - Herbs (Dicots)	Polygonaceae		<i>Persicaria decipiens</i>	Slender Knotweed
5 - Herbs (Dicots)	Polygonaceae	*	<i>Rumex crispus</i>	Curled Dock
5 - Herbs (Dicots)	Polygonaceae		<i>Rumex brownii</i>	Swamp Dock
5 - Herbs (Dicots)	Primulaceae	*	<i>Lysimachia arvensis</i>	Scarlet Pimpernel
5 - Herbs (Dicots)	Ranunculaceae		<i>Ranunculus inundatus</i>	River Buttercup

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
5 - Herbs (Dicots)	Rubiaceae		<i>Asperula conferta</i>	Common Woodruff
5 - Herbs (Dicots)	Rubiaceae	*	<i>Richardia stellaris</i>	
5 - Herbs (Dicots)	Rubiaceae	*	<i>Sherardia arvensis</i>	Field Madder
5 - Herbs (Dicots)	Rubiaceae		<i>Asperula sp.</i>	
5 - Herbs (Dicots)	Rubiaceae	*	<i>Galium aparine</i>	Goosegrass
5 - Herbs (Dicots)	Scrophulariaceae	*	<i>Verbascum virgatum</i>	Twiggy Mullein
5 - Herbs (Dicots)	Solanaceae	*	<i>Solanum nigrum</i>	Black-berry Nightshade
5 - Herbs (Dicots)	Solanaceae		<i>Solanum prinophyllum</i>	Forest Nightshade
5 - Herbs (Dicots)	Verbenaceae	*	<i>Verbena bonariensis</i>	Purpletop
5 - Herbs (Dicots)	Verbenaceae	*	<i>Verbena rigida</i>	Veined Verbena
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Aristida ramosa</i>	Purple Wiregrass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Axonopus fissifolius</i>	Narrow-leafed Carpet Grass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Bothriochloa decipiens</i>	Red Grass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Bothriochloa macra</i>	Red Grass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Briza subaristata</i>	
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Briza minor</i>	Shivery Grass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Bromus catharticus</i>	Prairie Grass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Bromus hordeaceus</i>	Soft Brome
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Bromus molliformis</i>	Soft Brome
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Capillipedium spicigerum</i>	Scented-top Grass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Cenchrus clandestinus</i>	Kikuyu Grass

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Chloris gayana</i>	Rhodes Grass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Chloris ventricosa</i>	Plump Windmill Grass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Cynodon dactylon</i>	Couch
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Dichanthium sericeum</i>	Queensland Bluegrass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Dichelachne micrantha</i>	Shorthair Plumegrass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Ehrharta erecta</i>	Panic Veldtgrass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Entolasia marginata</i>	Bordered Panic
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Eragrostis brownii</i>	Brown's Lovegrass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Eragrostis curvula</i>	African Lovegrass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Eragrostis leptostachya</i>	Paddock Lovegrass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Imperata cylindrica</i>	Blady Grass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Lolium perenne</i>	Perennial Ryegrass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Microlaena stipoides</i>	Weeping Grass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Oplismenus aemulus</i>	Australian Basket Grass
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Panicum effusum</i>	Hairy Panic
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Paspalidium distans</i>	
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Paspalum dilatatum</i>	Paspalum
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Paspalum distichum</i>	Water Couch
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Rytidosperma racemosum</i>	
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Setaria parviflora</i>	
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Sporobolus creber</i>	Western Rat-tail Grass

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
6 - Herbs (Monocots - Grasses)	Poaceae		<i>Themeda triandra</i>	Kangaroo Grass
6 - Herbs (Monocots - Grasses)	Poaceae	*	<i>Vulpia bromoides</i>	Squirrel Tail Fescue
7 - Herbs (Monocots - Other)	Alismataceae		<i>Alisma plantago-aquatica</i>	Water Plantain
7 - Herbs (Monocots - Other)	Anthericaceae		<i>Arthropodium milleflorum</i>	Pale Vanilla-lily
7 - Herbs (Monocots - Other)	Anthericaceae		<i>Caesia parviflora</i>	Pale Grass-Lilly
7 - Herbs (Monocots - Other)	Cyperaceae		<i>Carex inversa</i>	Knob Sedge
7 - Herbs (Monocots - Other)	Cyperaceae		<i>Cyperus gracilis</i>	Slender Flat-sedge
7 - Herbs (Monocots - Other)	Cyperaceae		<i>Carex appressa</i>	Tall Sedge
7 - Herbs (Monocots - Other)	Cyperaceae	*	<i>Cyperus eragrostis</i>	Umbrella Sedge
7 - Herbs (Monocots - Other)	Cyperaceae		<i>Cyperus exaltatus</i>	
7 - Herbs (Monocots - Other)	Cyperaceae		<i>Cyperus imbecillis</i>	
7 - Herbs (Monocots - Other)	Cyperaceae	*	<i>Cyperus rotundus</i>	Nutgrass
7 - Herbs (Monocots - Other)	Cyperaceae		<i>Fimbristylis dichotoma</i>	Common Fringe-sedge
7 - Herbs (Monocots - Other)	Cyperaceae		<i>Isolepis inundata</i>	
7 - Herbs (Monocots - Other)	Cyperaceae	*	<i>Isolepis prolifer</i>	
7 - Herbs (Monocots - Other)	Iridaceae	*	<i>Romulea rosea</i>	Onion Grass
7 - Herbs (Monocots - Other)	Juncaceae		<i>Juncus homalocaulis</i>	
7 - Herbs (Monocots - Other)	Juncaceae		<i>Juncus usitatus</i>	
7 - Herbs (Monocots - Other)	Juncaceae		<i>Juncus planifolius</i>	
7 - Herbs (Monocots - Other)	Juncaceae		<i>Juncus vaginatus</i>	
7 - Herbs (Monocots - Other)	Lomandraceae		<i>Lomandra filiformis</i> subsp. <i>filiformis</i>	

Table A.1 Flora species recorded by Cumberland Ecology within the study area

Form	Family	Exotic*	Scientific Name	Common Name
8 - Herbs (Vines and Climbers)	Asparagaceae	*	<i>Asparagus asparagoides</i>	Bridal Creeper
8 - Herbs (Vines and Climbers)	Apocynaceae	*	<i>Araujia sericifera</i>	Moth Vine
8 - Herbs (Vines and Climbers)	Convolvulaceae		<i>Convolvulus erubescens</i>	Blushing Bindweed
8 - Herbs (Vines and Climbers)	Fabaceae (Faboideae)		<i>Desmodium varians</i>	Slender Tick-trefoil
8 - Herbs (Vines and Climbers)	Fabaceae (Faboideae)		<i>Glycine microphylla</i>	Small-leaf glycine
8 - Herbs (Vines and Climbers)	Fabaceae (Faboideae)		<i>Glycine tabacina</i>	
8 - Herbs (Vines and Climbers)	Rosaceae	*	<i>Rubus fruticosus</i> species aggregate	Blackberry
8 - Herbs (Vines and Climbers)	Passifloraceae		<i>Passiflora herbertiana</i>	Native Passionfruit

* = exotic, ** = native but non-endemic

Appendix B

**Fauna Species Recorded by Cumberland
Ecology within the Study Area**

Table B.1 Fauna species recorded by Cumberland Ecology within the study area

Family	Common Name	Scientific Name	Introduced *	TSC Act Status	EPBC Act Status	Methodology
Amphibia						
Hylidae	Eastern Dwarf Tree Frog	<i>Litoria fallax</i>		-	-	Incidental observation
Myobatrachidae	Striped Marsh Frog	<i>Limnodynastes peronii</i>		-	-	Incidental observation
Aves						
Acanthizidae	Yellow Thornbill	<i>Acanthiza nana</i>		-	-	Diurnal bird survey
Accipitridae	Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>		-	-	Diurnal bird survey
Accipitridae	Little Eagle	<i>Hieraaetus morphnoides</i>		V		Diurnal bird survey
Anatidae	Australian Wood Duck	<i>Chenonetta jubata</i>		-	-	Diurnal bird survey
Ardeidae	Cattle Egret	<i>Ardea ibis</i>		-	Mar.	Incidental observation
Ardeidae	White-necked Heron	<i>Ardea pacifica</i>		-	-	Incidental observation
Artamidae	Australian Magpie	<i>Cracticus tibicen</i>		-	-	Diurnal bird survey, Incidental observation
Artamidae	Dusky Woodswallow	<i>Artamus cyanopterus</i>		V	-	Diurnal bird survey
Artamidae	Grey Butcherbird	<i>Cracticus torquatus</i>		-	-	Diurnal bird survey
Cacatuidae	Galah	<i>Eolophus roseicapillus</i>		-	-	Diurnal bird survey
Cacatuidae	Little Corella	<i>Cacatua sanguinea</i>		-	-	Diurnal bird survey, Incidental observation
Cacatuidae	Sulphur-Crested Cockatoo	<i>Cacatua galerita</i>		-	-	Diurnal bird survey, Incidental observation
Campephagidae	Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>		-	-	Diurnal bird survey
Climacteridae	Brown Treecreeper (eastern subspecies)	<i>Climacteris picumnus</i>		V		Diurnal bird survey

Table B.1 Fauna species recorded by Cumberland Ecology within the study area

Family	Common Name	Scientific Name	Introduced *	TSC Act Status	EPBC Act Status	Methodology
Columbidae	Crested Pigeon	<i>Ocyphaps lophotes</i>		-	-	Diurnal bird survey, Incidental observation
Corvidae	Australian Raven	<i>Corvus coronoides</i>		-	-	Diurnal bird survey
Estrildidae	Double-Barred Finch	<i>Stizoptera bichenovii</i>		-	-	Incidental observation
Estrildidae	Red-browed Finch	<i>Neochmia temporalis</i>		-	-	Diurnal bird survey
Maluridae	Superb Fairy-wren	<i>Malurus cyaneus</i>		-	-	Diurnal bird survey
Monarchidae	Magpie-lark	<i>Grallina cyanoleuca</i>		-	-	Diurnal bird survey, Incidental observation
Meliphagidae	Lewin's Honeyeater	<i>Meliphaga lewinii</i>		-	-	Diurnal bird survey
Meliphagidae	Little Wattlebird	<i>Anthochaera chrysoptera</i>		-	-	Diurnal bird survey
Meliphagidae	White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>		-	-	Diurnal bird survey
Meliphagidae	Bell Miner	<i>Manorina melanophrys</i>		-	-	Diurnal bird survey, Incidental observation
Meliphagidae	Noisy Miner	<i>Manorina melanocephala</i>		-	-	Diurnal bird survey, Incidental observation
Meliphagidae	Red Wattlebird	<i>Anthochaera carunculata</i>		-	-	Incidental observation
Motacillidae	Australasian Pipit	<i>Anthus novaeseelandiae</i>		-	-	Incidental observation
Oriolidae	Olive-backed Oriole	<i>Oriolus sagittatus</i>		-	-	Diurnal bird survey
Pachycephalidae	Rufous Whistler	<i>Pachycephala rufiventris</i>		-	-	Diurnal bird survey
Psittacidae	Eastern Rosella	<i>Platycercus eximius</i>		-	-	Diurnal bird survey, Incidental observation
Psittacidae	Australian King Parrot	<i>Alisterus scapularis</i>		-	-	Diurnal bird survey
Psittacidae	Rainbow Lorikeet	<i>Trichoglossus haematodus</i>		-	-	Diurnal bird survey, Incidental observation
Psittacidae	Red-rumped Parrot	<i>Psephotus haematonotus</i>		-	-	Diurnal bird survey

Table B.1 Fauna species recorded by Cumberland Ecology within the study area

Family	Common Name	Scientific Name	Introduced *	TSC Act Status	EPBC Act Status	Methodology
Pycnonotidae	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	*	-	-	Diurnal bird survey
Rallidae	Purple Swampphen	<i>Porphyrio porphyrio</i>		-	-	Diurnal bird survey, Incidental observation
Rhipiduridae	Grey Fantail	<i>Rhipidura albiscapa</i>		-	-	Diurnal bird survey, Incidental observation
Rhipiduridae	Willie Wagtail	<i>Rhipidura leucophrys</i>		-	-	Diurnal bird survey, Incidental observation
Sturnidae	Common Myna	<i>Acridotheres tristis</i>	*	-	-	Diurnal bird survey, Incidental observation
Sturnidae	Common Starling	<i>Sturnus vulgaris</i>	*	-	-	Diurnal bird survey
Timaliidae	Silvereye	<i>Zosterops lateralis</i>		-	-	Diurnal bird survey
Turdidae	Common Blackbird	<i>Turdus merula</i>	*	-	-	Incidental observation
Mammalia						
Miniopteridae	Little Bentwing-Bat	<i>Miniopterus australis</i>		V	-	Bat detector
Molossidae	White-Striped Freetail-Bat	<i>Austronomus australis</i>		-	-	Bat detector
Molossidae	Ride's Free-tailed Bat	<i>Mormopterus ridei</i>		-	-	Bat detector
Molossidae	Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>		V	-	Bat detector
Pteropodidae	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>		V	V	Spotlighting incidental
Vespertilionidae	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		-	-	Bat detector
Vespertilionidae	Chocolate Wattled Bat	<i>Chalinolobus morio</i>		-	-	Bat detector
Vespertilionidae	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>		V	-	Bat detector
Vespertilionidae	Little Forest Bat	<i>Vespadelus vulturnus</i>		-	-	Bat detector
Vespertilionidae	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>		V	-	Bat detector

Table B.1 Fauna species recorded by Cumberland Ecology within the study area

Family	Common Name	Scientific Name	Introduced *	TSC Act Status	EPBC Act Status	Methodology
Vespertilionidae	Southern Myotis	<i>Myotis macropus</i>		V	-	Bat detector
Vespertilionidae	Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>		-	-	Bat detector
Vespertilionidae	Gould's Long-eared Bat	<i>Nyctophilus gouldi</i>		-	-	Bat detector
Vespertilionidae	Eastern Broad-nosed Bat	<i>Scotorepens orion</i>		-	-	Bat detector
Reptilia						
Elapidae	Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>				Incidental

Key: V=vulnerable, Mig.= migratory, Mar. = marine