Fraser Earthmoving Construction Pty Ltd

ABN: 84 476 527 814

Part 8 Biodiversity Development Assessment Report

for the

Howlong Sand and Gravel Expansion Project

State Significant Development 17_8804

Prepared by

Advanced Environmental Systems Pty Ltd

March 2020

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HOWLONG SAND AND GRAVEL EXPANSION PROJECT

STATE SIGNIFICANT DEVELOPMENT

ENVIRONMENTAL IMPACT STUDY

BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT

2020

ADVANCED ENVIRONMENTAL SYSTEMS
CREATING A SUSTAINABLE FUTURE

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Client Details	
Project name	Howlong Sand and Gravel Expansion Project
Address of site	4343 Riverina Highway, Howlong NSW 2643
Business owner, contact number and email	Mr Greg Fraser 0427 337 376 gregfraser@fraserearthmoving.com
Business owner postal address and ABN	Fraser Earthmoving Construction Pty Ltd 574 Kiewa Street, Albury NSW 2640 ABN: 84 476 527 814
Site manager, contact number and email	Andrew McKimmie 0417 883 576 andrewmckimmie@fraserearthmoving.com
Lot numbers listed in Extractive Industry Licence and Planning and Environment Secretary's Requirements	173/DP753744, 174/DP753744, 174A/DP753744, 231/DP753744, 1/DP1039973, 1/DP798291, 3/DP113703 (Road Reserve within Lot 1 DP798291).
Quarry Site Land Titles	Lot 173 DP753744 Lot 1 DP1039973 Lot 174 DP753744 Lot 1 DP798291 Lot 174A DP753744 Lot 3 DP113703 Lot 231 DP753744 Lot 4 DP113703 Lot 1 DP741037

Assessor Details	
Name of investigating company	Advanced Environmental Systems Pty Ltd (AES)
Nominated individual/s	Mr Peter Clinnick (B. Ag. Sci. Hons. M. ASSSI.) Accredited BAM Assessor (BAAS 18107)
Date of assessment commencement	1-01-2018
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Authors' Expertise: Peter Clinnick has a Degree in Agricultural Science with Honours from La Trobe University. Peter is a NSW Biodiversity Assessment Method Accredited Assessor (BAAS 18107) and is a recognized ecologist/soil scientist and member of the Soil Science Society of Australia with over 30 years' experience in biodiversity, soils and geomorphology assessments. He has been engaged by CSIRO Forestry, industry, community groups and local government to work in extension, research and statutory planning throughout Australia. Peter is currently Managing Director of the regionally based environmental consulting company Advanced Environmental Systems Pty Ltd.

Disclaimer: This report has been prepared based on the information available to AES – Advanced Environmental Systems at the time and represents to the best of AES's knowledge and the client's intentions at the time of printing of the document. The assessment of potential issues and impacts and conclusions drawn reflect our best judgment, based on that information. Although all possible care is taken, AES – Advanced Environmental Systems Pty Ltd, together with its employees accepts no responsibility for any resultant errors contained herein and any damage or loss, howsoever caused, and suffered by any individual, company or corporation.

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Executive Summary

Fraser Earthmoving Construction Pty Ltd (the Applicant) is proposing a State Significant Development Application to the Department of Planning and Environment for an expansion to the existing sand and gravel quarry located at 4343 Riverina Highway, Howlong NSW, approximately 25 km west of Albury. The Secretary for the Department of Planning and Environment determines the detailed requirements for an Environmental Impact Statement and has indicated that a Biodiversity Development Assessment Report (BDAR) be prepared to meet the requirements of the Biodiversity Conservation Act (2016).

The Applicant intends to increase the volume of extracted material from 30,000 tonnes per annum (tpa) to 300,000 tpa. This increased activity will all be conducted within the footprint of the existing pits and an expanded area currently used to grow irrigated lucerne. The activity in the footprint area (extraction, processing and stockpiling areas) is not expected to generate significant negative biodiversity impacts. Proposed progressive rehabilitation and revegetation works, encompassing an area of approximately 40.8ha, in addition to final rehabilitation of the disturbance footprint, would generate significant positive biodiversity outcomes.

The reasons that there will be no significant negative biodiversity impacts are:

- The disturbance footprint area has been subject to sand and gravel extraction and intensive agricultural production for the past 60 years. Important patch and core habitat areas are excluded from the Quarry Site and remnant vegetation will be retained where practicable;
- The site would be surrounded by a 1:100 year flood levee that contains runoff. The levee would be constructed to an elevation of 142.7 m AHD;
- Machinery operates at very slow speed (<10 km/hr). Haul trucks for raw product are governed at 40 km/hr. Site conditions do not allow for any greater speed than 20 km/hr in the processing area. Road going haul trucks are regulated by speed limits to 40 km/hr on the access road into the site;
- Machinery noise is minimal with processing operations proposed for daylight period (no blasting will occur and use of a crusher will be limited to a maximum of four times per year);
- Dust is minimal, because the activity is a ‘wet’ operation, trucks are covered and access tracks are watered;
- A 100 m vegetated buffer to the Murray River will be established to ensure that the activity has sufficient separation from the river to reduce the potential risks of off-site impacts such as degradation of river water quality;
- Part of the south western section of the existing pit (Stage 1) will be backfilled to form part of the 100m Murray River vegetation buffer ;

- Proposed vegetation clearing would occur along the banks of the Stage 2 extraction area and involve only isolated trees, some of which have been planted. Existing young trees and older remnant trees within the ~100 m Murray River buffer will be retained and vegetation restoration will occur in areas of the riparian buffer previously used for grazing.
- Environmental standards and management are set to the highest possible level of best industry practice;
- Rehabilitation/revegetation will commence early in the life of the project and will be undertaken progressively.

NSW BioNet Atlas investigations indicate that within a 10 km radius of the activity site there are eight vulnerable fauna species and one flora species that is listed as endangered under the NSW Biodiversity Conservation Act 2016. The Biodiversity Assessment Model (BAM) calculator indicated that an additional six species are possible candidates and are listed as vulnerable, a further one is endangered and one critically endangered within a 10 km radius of the activity site.

The BioNet database indicated that there are four recorded species that come under the Commonwealth *Environment and Biodiversity Conservation (EPBC) Act 1999.* These are the Koala (Vulnerable), Sloane's Froglet (Endangered), Spotted Tailed Quoll (Endangered), the Superb Parrot (Vulnerable). In addition, the BAM database indicated that the Regent Honeyeater (Critically Endangered) and the Swift Parrot (Endangered) are listed as threatened species under the *EPBC Act*. Advice from the OEH indicated that the neither the Regent Honeyeater or the Swift Parrot has a presence in the area (within 10km) and the Quarry Site is not a Serious and Irreversible Impact Area. Based on the scope of works and existing land use together with consultation with the then Commonwealth Department of Environment and Energy, the proposed action is considered unlikely to result in significant impacts on matters of national environmental significance.

There are no threatened communities listed for the search area on the OEH database. However, the Murray River Aquatic Ecological Community is listed by the Department of Primary Industries. None of the species population (if they were present) would be threatened by the proposed extension of the quarry into irrigated agricultural land.

Targeted surveys were conducted principally to establish the presence of Sloane's Froglet *(Crinia Sloanei),* the Superb Parrot *(Polytelis swainsonii)* and Austral Pillwort (*Pilularia novae- hollandiae).*

Other threatened species considered in the survey included Swift Parrot *(Lathamus discolor);* Superb Parrot *(Polytelis swainsonii);* Regent honeyeater *(Anthochaera phrygia)* Square-tailed Kite *(Lophoictinia isura)* White-bellied Sea Eagle *(Haliaeetus leucogaster);* Powerful Owl *(Ninox strenua).* Bats included the Southern Myotis *(Myotis macrocarpus)* and Eastern Bentwing Bat *(Miniopterus orianae oceanensis).* Other fauna included Brush-tailed Phascogale *(Phascogale tapoatafa);* Squirrel Glider *(Petaurus norfolcensis);* Koala

(Phascolarctos cinereus); Spotted Tailed Quoll *(Dasyurus maculatus).* Flora included *Austral Pillwort (Pilularia novaehollandiae) and Small Scurf-pea (Cullen Parvum).*

The proposed development will provide an opportunity to extend buffer areas important to the Murray River ecology, implement environmental improvements with the restoration and improve management of wetlands, native grassland and Red Gum riparian habitat. Importantly it will enable plans to be developed to encourage threatened species (e.g. Sloane's Froglet and Austral Pillwort) occupation and or proliferation in relatively undisturbed areas nearby (i.e. wetlands).

1. Introduction

1.1 Project Background

Fraser Earthmoving Construction Pty Ltd (the Applicant) have made a State Significant Development Application to the Department of Planning, Industry and Environment for an expansion in the existing sand and gravel quarry located at 4343 Riverina Highway, Howlong, approximately 25 km west of Albury (**Figure 1**).

The Preliminary Environmental Assessment (PEA) was prepared on behalf of Fraser Earthmoving Construction by CAF Consulting (2017). The PEA describes the proposed development at the site in context to the relevant local, state and Commonwealth planning instruments and plans, with the aim of characterising the key aspects of the development and surrounding environment to enable Secretary's Environmental Assessment Requirements (SEARs) to be granted. The SEARs provide the basis upon which the Environmental Impact Statement (EIS) has been prepared. Advanced Environmental Systems has undertaken a biodiversity assessment and prepared this Biodiversity Development Assessment Report (BDAR) on behalf of Fraser Earthmoving Construction Pty Ltd. The proposed Project is a "State Significant Development" (SSD) as defined under the State Environmental Planning Policy (SEPP) (State and Regional Development) (SRD) 2011, and will require development consent under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The Biodiversity Conservation Act (2016) with transitional Regulations was enacted on the 25th of August 2017. In relation to applications for developments of State Significant Development or infrastructure Section 7.9 (2) states:

Any such application is to be accompanied by a biodiversity development assessment report unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values.

In order to satisfy the requirement of the Biodiversity Assessment Method (BAM) the assessment of Biodiversity values must be undertaken on the land proposed for development and/or clearing (the Quarry Site).

In order to determine whether the proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats and biodiversity values, an assessment of threatened species biodiversity values and ecological communities was conducted.

1.2 Supporting Documents and Resources

The following information is set out as indicated by the BAM in the form of a Biodiversity Development Assessment Report (BDAR) and has been prepared by Peter Clinnick (Accredited Assessor BAAS 18107). Key sources of information were:

- Australian bird distribution maps - Birds in Backyards 2018.
- Bionet Atlas of Wildlife (NSW Office of Environment and Heritage 2018);
- NSW Planning Portal (NSW Department of Planning and Environment 2018);
- BioNet Vegetation Classification (NSW Office of Environment and Heritage 2018);
- Office of Environment and Heritage Biodiversity Assessment Model (BAM) (2017).
- Office of Environment and Heritage NSW Guide to Surveying Threatened Plants (2016) and related “Field Survey Methods” guidance notes.
- Office of Environment and Heritage – Threatened Species Profile Database.
- Office of Environment and Heritage Vegetation information System (VIS) Mapping through the Spatial Information eXchange (SIX) Vegetation Map Viewer.
- Office of Environment and Heritage – Biobanking Credit Calculator.
- Office of Environment and Heritage - Biodiversity Assessment Method Calculator.
- Protected Matters Search Tool. Department of Environment and Energy (Department of Environment and Energy 2018)
- Knight, A. (2014) Sloane’s Froglet interim habitat guide and management recommendations. Office of Environment and Heritage, Sydney.

Several other references used to prepare the BDAR are listed in the Bibliography at the end of the BDAR Report.

1.3 Site Location and Identification

The Quarry Site (disturbance footprint) for this BDAR is approximately 53.5 ha in area and is located in the eastern Riverina approximately 3 km east of Howlong and 25 km west of Albury (**Figure 1**).

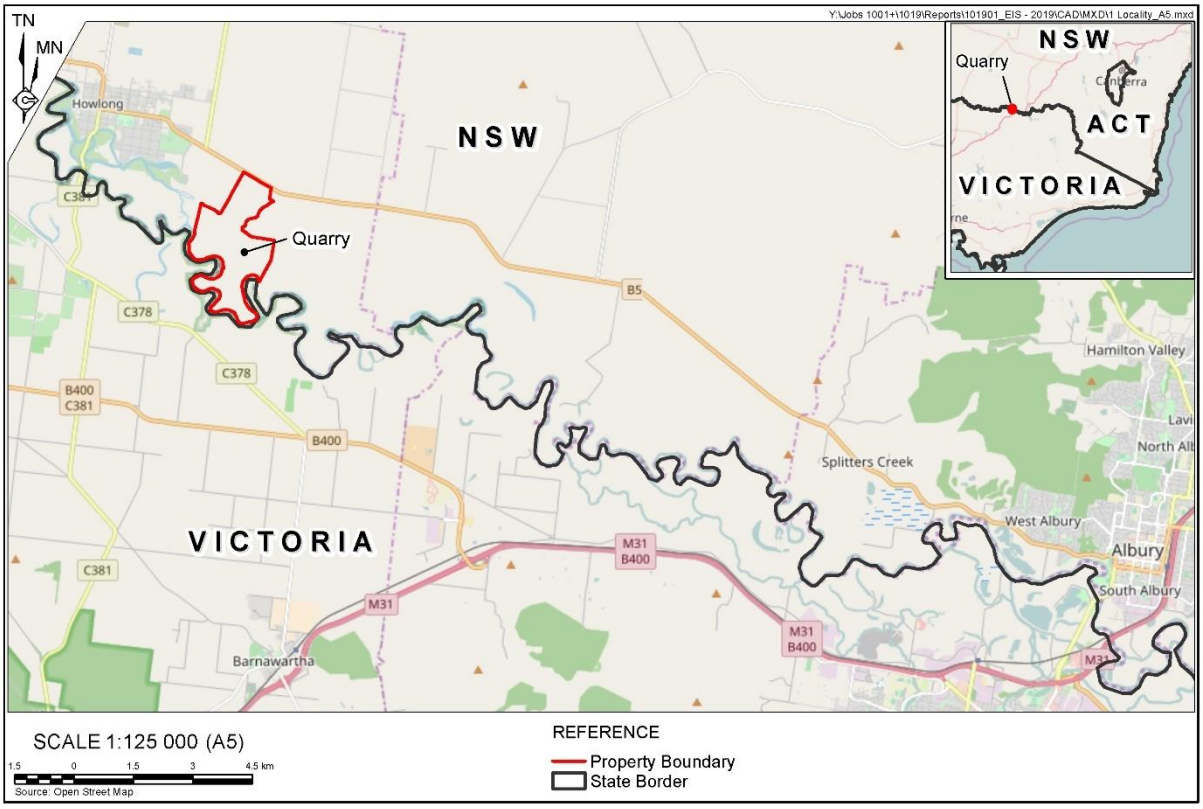


Figure 1 Regional Location

The Howlong Sand and Gravel extraction area (Quarry Site) is situated on an island located on the river floodplain between the Murray River to the south with the Black Swan Anabranch to the north. Access to the site is from the Riverina Highway and through agricultural land with access to the island across a concrete bridge

1.4 Development Proposal and Quarry Site Footprint

The proposed Quarry layout is displayed in **Figure 2**. **Figures 3**, **4**, **5** and **6** present the existing condition of the Quarry.

For the purpose of assessment, the Quarry Site is defined as the areas of disturbance for the extraction and processing activities. The Study Area refers to the broader area within the subject property that was surveyed by AES.

The Project would principally comprise an increase to the annual production rate to 300 000tpa and expansion into additional extraction areas as well as the ongoing processing, stockpiling and transportation at the increased production intensity. The following is a brief overview of the proposed Project.

- Ongoing extraction, processing, stockpiling and transportation activities at an increased rate of up to 300 000 tonnes per annum.
- Extraction of sand and gravel to a maximum elevation of 119 m AHD.

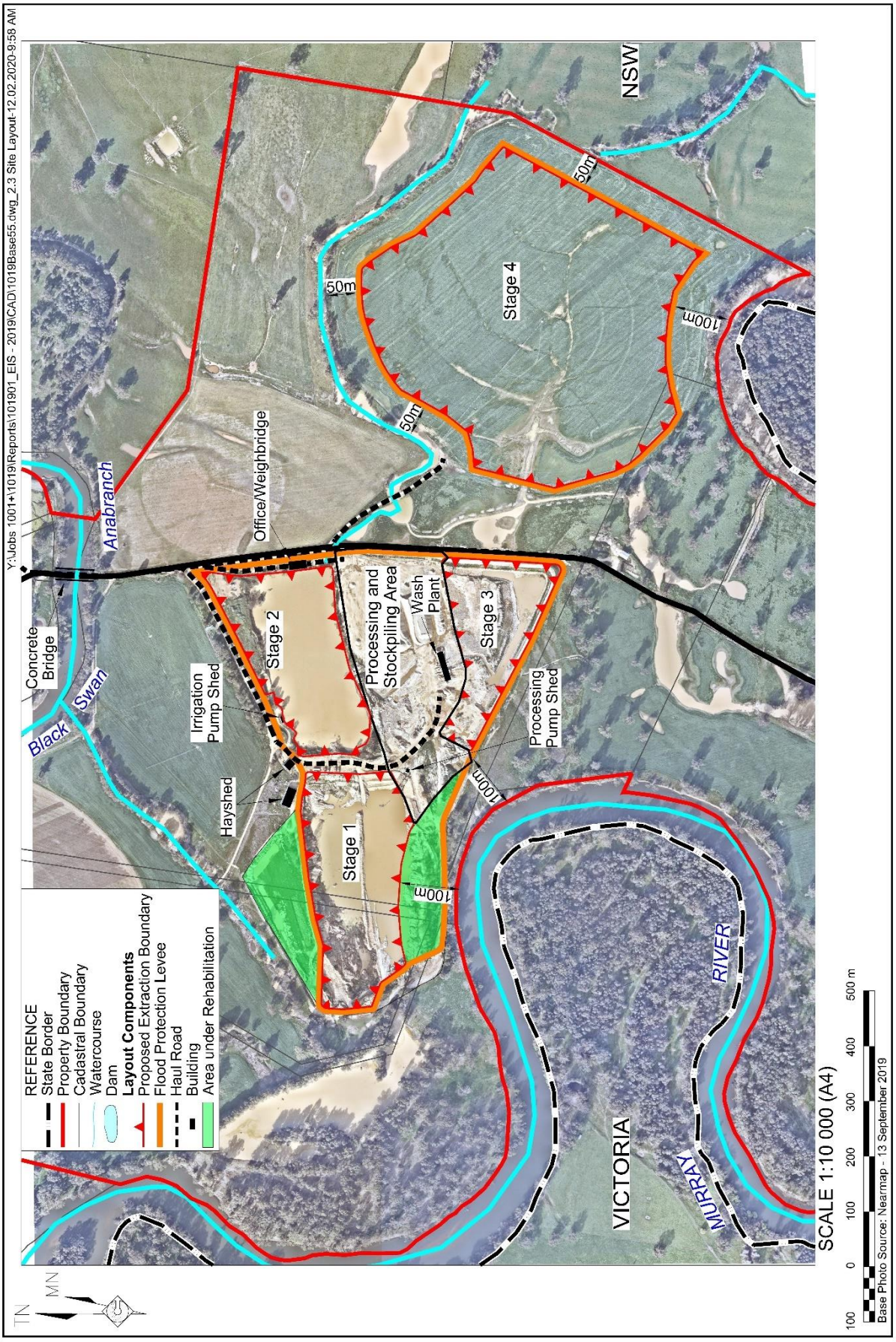


Figure 2 Proposed Quarry Layout

Figure 3 Quarry Site Stage 1 – View west

Figure 4 Quarry Site Stage 2 – View east

Figure 5 Quarry Site Stage 3 - View south

Figure 6 Quarry Site Stage 4 – View east

- Remediation of an existing private concrete bridge over the Black Swan Anabranch.
- Construction of levee banks and repairs and maintenance to previous water discharge points (eroded drainage lines).
- Revegetation and maintenance of riparian areas adjacent to the disturbance footprint within the Murray River buffer area.
- Backfilling and rehabilitation of a section (approximately 2.3 ha) of the existing Stage 1 extraction area to form part of a 100 m buffer to the Murray River.
- Rehabilitation of disturbed areas following the cessation of extractive activities to a final landform which supports native vegetation and wetlands.

Staging and Site Rehabilitation

The proposed development is to be undertaken progressively in four stages, with the continuation of extractive operations in the extraction Stage 1 and Stage 2 areas initially. Stage 3 would involve the commencement of extractive operations in the Stage 3 extraction area that has already been disturbed under existing operations but not yet extracted. Stage 4 would involve the commencement of extractive operations in the proposed Stage 4 extraction area that is currently used by the landowner for irrigated lucerne production.

The staging of extractive operations in this manner would facilitate the progressive rehabilitation of the disturbance footprint, minimising exposed areas at any one time and allowing environmental mitigation measures to be implemented to manage impacts. An indicative final landform is presented in **Figure 7**.

In addition to final rehabilitation the Applicant has proposed to progressively revegetate wetland and riparian areas outside the Quarry disturbance areas. The areas outside of the site disturbance that would be revegetated are also presented on **Figure 7**.

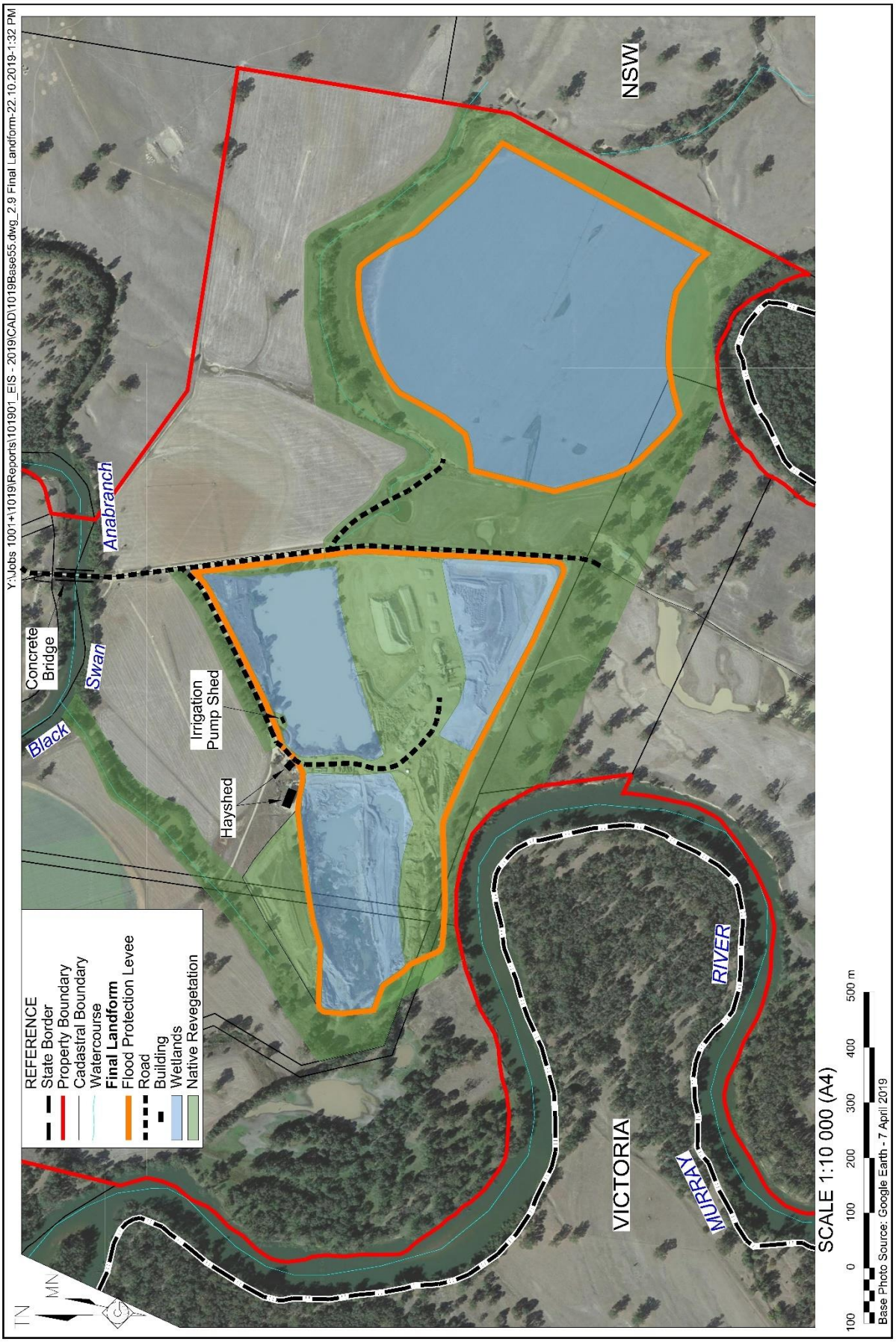


Figure 7 Indicative Final Landform

The total proposed disturbance footprint for the development, incorporating the Stage 1 to 4 extraction areas and the processing and stockpiling area, represents an area of approximately 53.5 ha. Rehabilitation and revegetation activities surrounding the disturbance area cover an additional area of approximately 40.80ha.

Figure 8 presents the extent of vegetation clearing for each identified vegetation community type.

The activity in the Quarry Site (pits, work areas and haul road and off-site) are not expected to generate any significant negative biodiversity impacts and would result in funding for implementing rehabilitation and revegetation works with substantial environmental benefits.

The reasons are:

- The disturbance footprint area has been subject to sand and gravel extraction and intensive agricultural production for the past 60 years. Important patch and core habitat areas are excluded from the Quarry Site and remnant vegetation will be retained where practicable;
- The site would be surrounded by a 1:100 year flood levee that contains runoff. The levee would be constructed to an elevation of 142.2 m AHD;
- Machinery operates at very slow speed (<10 km/hr). Haul trucks for raw product are governed at 40 km/hr. Site conditions do not allow for any greater speed than 20 km/hr in the processing area. Road going haul trucks are regulated by speed limits to 40 km/hr on the access road into the site;
- Machinery noise is minimal with processing operations proposed for daylight period (no blasting will occur and use of a crusher will be limited to a maximum of four times per year);
- Dust is minimal, because the activity is a ‘wet’ operation, trucks are covered and access tracks are watered;
- A 100 m vegetated buffer to the Murray River will be established to ensure that the activity has sufficient separation from the river to reduce the potential risks of off-site impacts such as degradation of river water quality;
- Part of the south western section of the existing pit (Stage 1) will be backfilled to form part of the 100m Murray River vegetation buffer ;
- Proposed vegetation clearing would occur along the banks of the Stage 2 extraction area and involve only isolated trees, some of which have been planted. Existing young trees and older remnant trees within the ~100 m Murray River buffer will be retained and vegetation restoration will occur in areas of the riparian buffer previously used for grazing.
- Environmental standards and management are set to the highest possible level of best industry practice;
- Rehabilitation/revegetation will commence early in the life of the project and will be undertaken progressively.

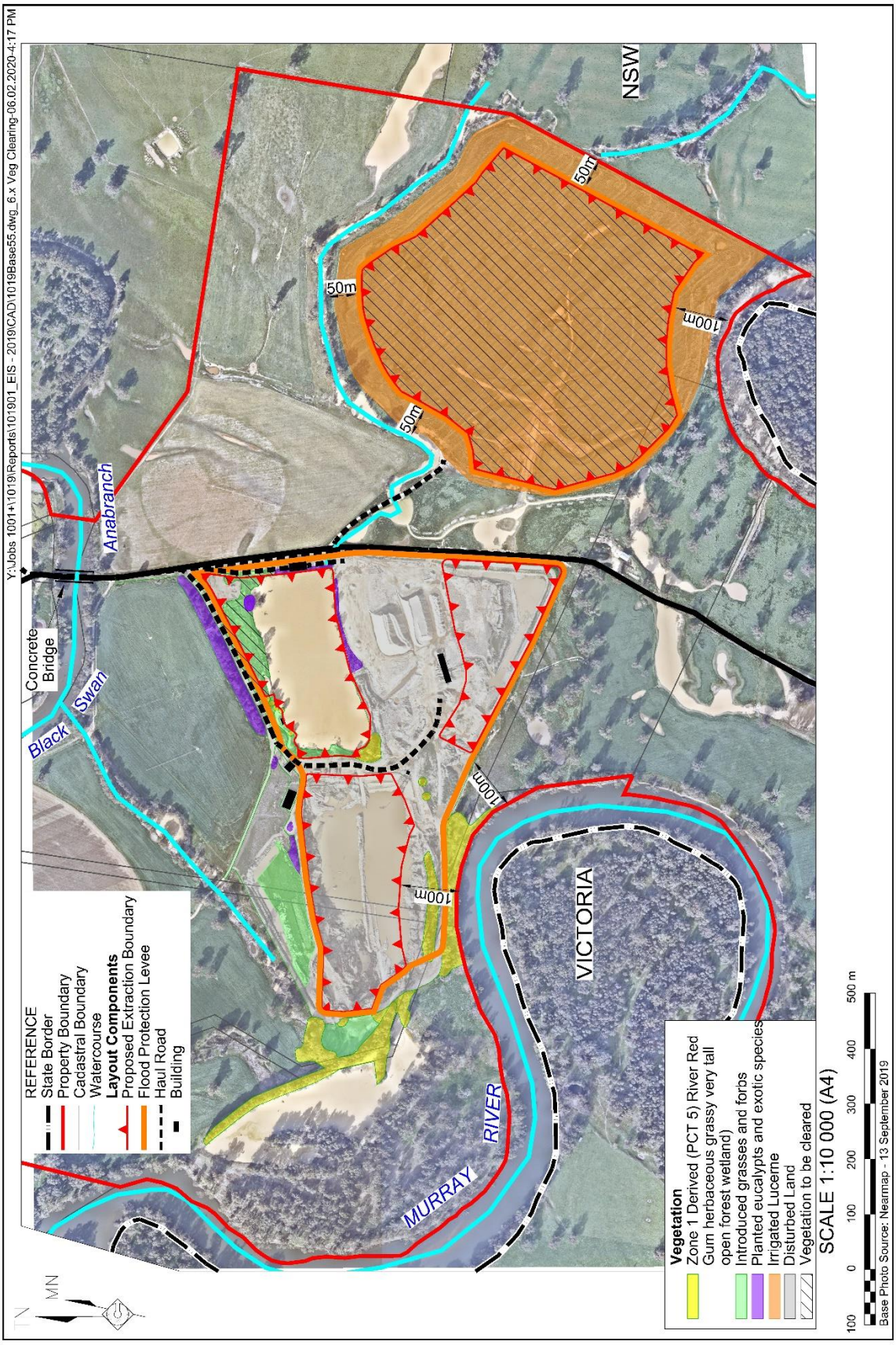


Figure 8 Proposed Vegetation Clearing

1.5 Ownership

The Quarry is situated on land owned by Nangunia Pastoral Pty Ltd. Extraction of sand and gravel material from the Quarry both currently and into the future will be undertaken by Fraser Earthmoving Construction under lease agreement with Nangunia Pastoral Pty Ltd. There are no known lease restrictions that will prevent quarry operations in the future.

The Quarry Site, including the access road, comprises all land the subject of the application for development consent. **Table 1** presents the land titles within the Quarry Site.

Table 1 Quarry Site Land Titles

Lot	Deposited Plan	Lot	Deposited Plan
173	753744	1	1039973
174	753744	1	798291
174A	753744	3	113703
231	753744	4	113703
1	741037		

1.6 Land Use Zoning

The property and Quarry Site are zoned Environmental management (E3) and Primary Production (RU1) under the Federation Council's Planning Scheme.

The site is located within the recently formed Federation Council Local Government Area (LGA) (an amalgamation of Corowa and Urana Shire councils). **Table 2** lists the land parcels associated with the development, and land zoning in accordance with the Corowa Local Environmental Plan (LEP), currently adopted by Federation Council. **Figure 8** shows of the land parcels associated with the development, and land zoning in accordance with the Corowa Local Environmental Plan (LEP), currently adopted by Federation Council.

Table 2 Land Parcels, area and land zoning

Land Parcel	Parcel Size (ha)	Zone	
Lot 173 DP753744	99.52	E3 – Environmental Management	
Lot 174 DP753744	125.63	E3 – Environmental Management	
Lot 174A DP753744	17.57	E3 – Environmental Management	
Lot 231 DP753744	69,43	E3 – Environmental Management	
Lot 1 DP1039973	0.03	E3 – Environmental Management	
Lot 1 DP741037	45.50	E3 – Environmental Management	RU1 – Primary production
Lot 1 DP798291	57.68	E3 – Environmental Management	RU1 – Primary production
Lot 3 DP113703	0.99	E3 – Environmental Management	RU1 – Primary production
Lot 4 DP113703	0.51	E3 – Environmental Management	RU1 – Primary production
TOTAL	**347.43**		

Local Environmental Plan (LEP)

As previously stated, the site of the proposed development is located within the Federation Council LGA. Federation Council currently adopts the LEPs of the former Shires (Corowa and Urana) in order to make local environmental planning provisions in accordance with the relevant environmental planning instruments under Section 33A of the PE&A Act. The Corowa LEP (CLEP) is the relevant LEP for this proposed development.

As detailed in **Table 2** land parcels comprising the Quarry Site are a combination of land zoned as RU1 – Primary Production, and E3 – Environmental Management. It should be pointed out that all land parcels south of the Black Swan Anabranch are zoned E3 only, these land parcels are set out for extractive development. Land parcels north of the Black Swan Anabranch are a combination of the two zones and nominated for the haul road only. **Figure 8** illustrates the land zoning at the site.

Part 2 of the CLEP provides a summary of the planning provisions for each land zone. The CLEP details that for both RU1 and E3 zoned land "extractive Industries" are "permitted with consent".

Extractive Industries is defined in the CLEP as:

> *Extractive industry means the winning or removal of extractive materials (otherwise than from a mine) by methods such as excavating, dredging, tunnelling or quarrying, including the storing, stockpiling or processing of extractive materials by methods such as recycling, washing, crushing, sawing or separating, but does not include turf farming.*

Extractive materials are defined in the CLEP as:

> *Sand, soil, gravel or similar substances that are not minerals within the meaning of the Mining Act 1992.*

1.7 Relevant Acts and State Planning Policies

Approval of the development is required from the Department of Planning, Industry and Environment in accordance with the EP&A Act 1979. The Project is classified as State Significant Development.

The EP&A Act forms the statutory framework for environmental assessment and planning approval in NSW.

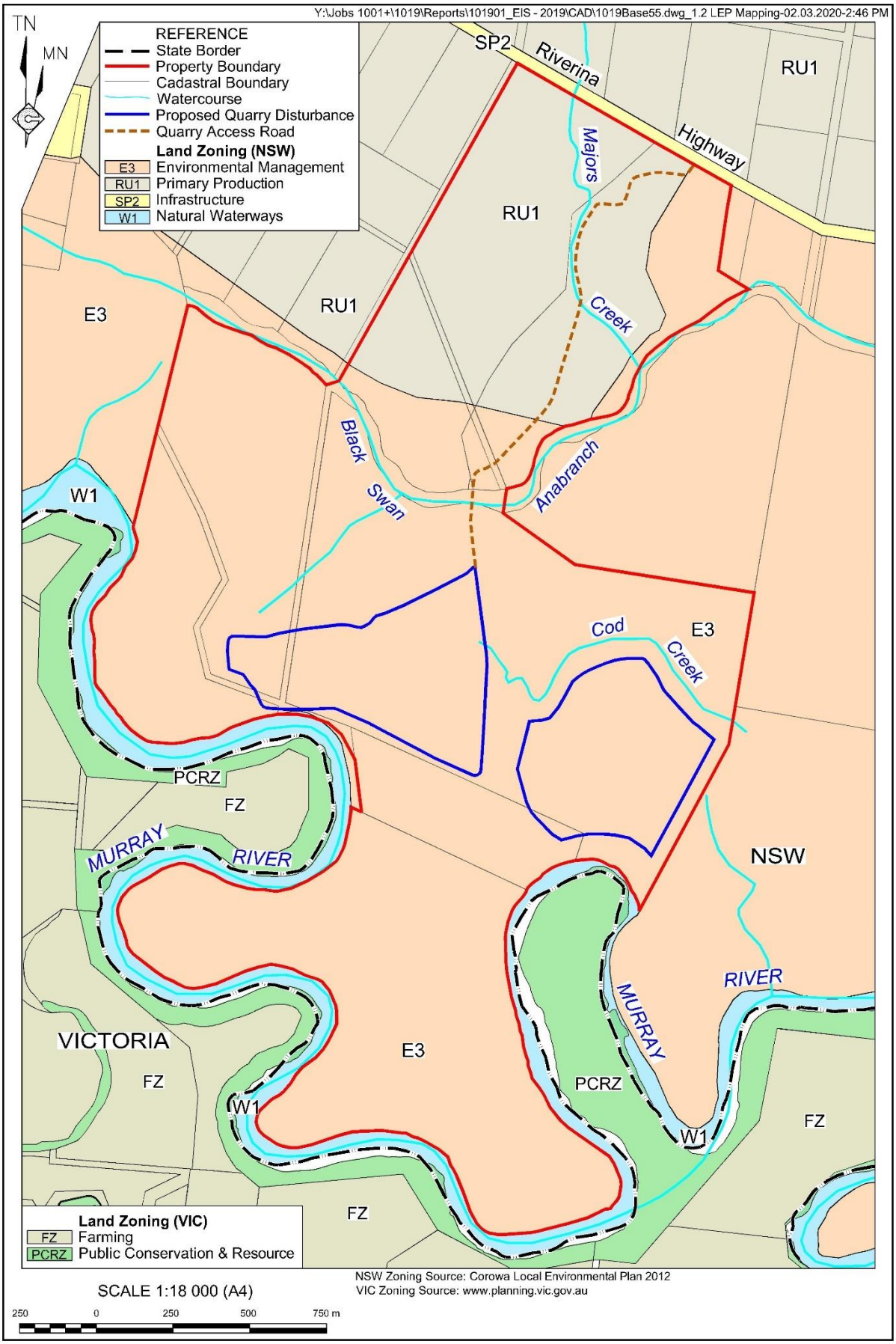


Figure 9 Land use zoning

Part 4 Division 4.1 of the EP&A Act provides a framework for the assessment and approval process of development that is deemed state significant and outlines the relationship of other additional Acts or State Planning Policies that may also need to be considered before consent can be granted. As State Significant Development, the Project must be assessed under the NSW Biodiversity Offset Scheme and a Biodiversity Development Assessment report (BDAR) prepared to assess potential impacts to biodiversity values. The BDAR and assessment must be undertaken in accordance with the Biodiversity Assessment Method (BAM) and consider the need to offset residual impacts to biodiversity values. The following legislation and planning instruments are relevant to the assessment of biodiversity values for the Project.

Commonwealth Legislation

Environmental Protection and Biodiversity Conservation Act (1999) (EPBC Act)

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) covers 'matters of national environmental significance' (MNES). Relevant matters of national environmental significance include:

- listed threatened species and ecological communities; and
- listed migratory species protected under international agreement.

Under the EPBC Act, if a project has the potential to have a significant impact on a MNES, it is required to be referred to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) for assessment as to whether it represents a 'controlled action' and therefore requires approval from the Commonwealth Minister for the Environment.

The Quarry Site is generally highly disturbed. There are no terrestrial Endangered Ecological Communities present at the site. No threatened flora or fauna species will be impacted from the development proposal.

No threatened species are expected to be impacted by the development, therefore no referral was required.

NSW Legislation – Acts

Biodiversity Conservation Act 2016

The BC Act is administered by the BCD and regulates the potential for:

a) Harm any animal that is of, or is part of, a threatened species, population or ecological community;

b) Harm any plant that is of, or is part of, a threatened species, population or ecological community;

c) Damage to critical habitat; or

d) Damage to habitat of a threatened species, population or ecological community.

The likelihood of threatened species occurring within the Quarry Site is low to moderate given the presence of some pockets of suitable habitat, particularly close to the Murray River. No vegetation in the vicinity of the river is proposed for removal and no disturbance is expected to occur to these habitats. It is proposed to replant vegetation in areas that will provide natural corridors for wildlife. A detailed flora and fauna assessment will be undertaken to address relevant matters of consideration.

NSW Legislation –State Environmental Planning Policies

State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44) and State Environmental Planning Policy (Koala Habitat Protection) 2019

The SEARs for the Project require that the provisions of SEPP 44 are considered in the assessment of impacts to biodiversity values. SEPP 44 was repealed on 1 March 2020 through commencement of the SEPP (Koala Habitat Protection) 2019. Given that the SEPP (Koala Habitat Protection) 2019 is an update to SEPP 44 the more recently commenced legislation has been considered, even though this is not required by the SEARs.

Schedule 1 of the SEPP (Koala Habitat Protection) 2019lists Corowa Shire (now Federation Council) as an area that may support core Koala habitat. Cl. 9(1) prevents a consent authority from granting consent to a development application on land identified as core Koala habitat without the preparation of a Koala Plan of Management (KPoM).

Under SEPP (Koala Habitat Protection) 2019, koalas must be accounted for where the subject land:

- occurs within areas identified on the Koala Development Application Map;
- has an area of at least 1ha; and
- does not have an approved koala plan of management which is applicable to the whole or part of the local government area.

Under Clause 9(2)(b) of State Environmental Planning Policy (Koala Habitat Protection) 2019, a Council must take into account:

> *"information, prepared by a suitably qualified and experienced person in accordance with the Guideline, provided by the applicant to the council demonstrating that –*
> *(i) the land does not include any trees belonging to the feed tree species listed in Schedule 2 for the relevant koala management area, or*
> *(ii) the land is not core koala habitat."*

No Koalas were identified in field surveys at the Quarry Site and no breeding population was present. Therefore, the Quarry Site does not contain core Koala habitat.

2. Native Vegetation Extent

2.1 Landscape Features and Bioregion

IBRA Bioregion: – Riverina.

IBRA Sub-region: Murray Fans.

NSW (Mitchell) Landscape unit: Murray Channels and Floodplains.

The buffer area

A large portion of the outer assessment circle (1,500 m radius) to the north of the Study Area is cleared, whilst south of the Study Area there are large patches of River Red Gum herbaceous-grassy very tall forest (PCT 5).

In order to cover the entire impact area, an inner assessment area (Quarry Site ~53.5 ha) was included in the circle of the 1,387 ha outer buffer. Vegetation cover extent is shown in **Figures 10 and 11**.

The extent of native vegetation within the 1,500 m buffer was assessed using ADS-40 digital imagery (Six Maps and Google Earth). The area of the 1,500 m buffer is 1,387 ha. Native vegetation covers 369 ha (27%) which places the area in the <30% class. This figure is an important input for the BAM calculator in determining habitat suitability of the Study Area.

The Quarry Site

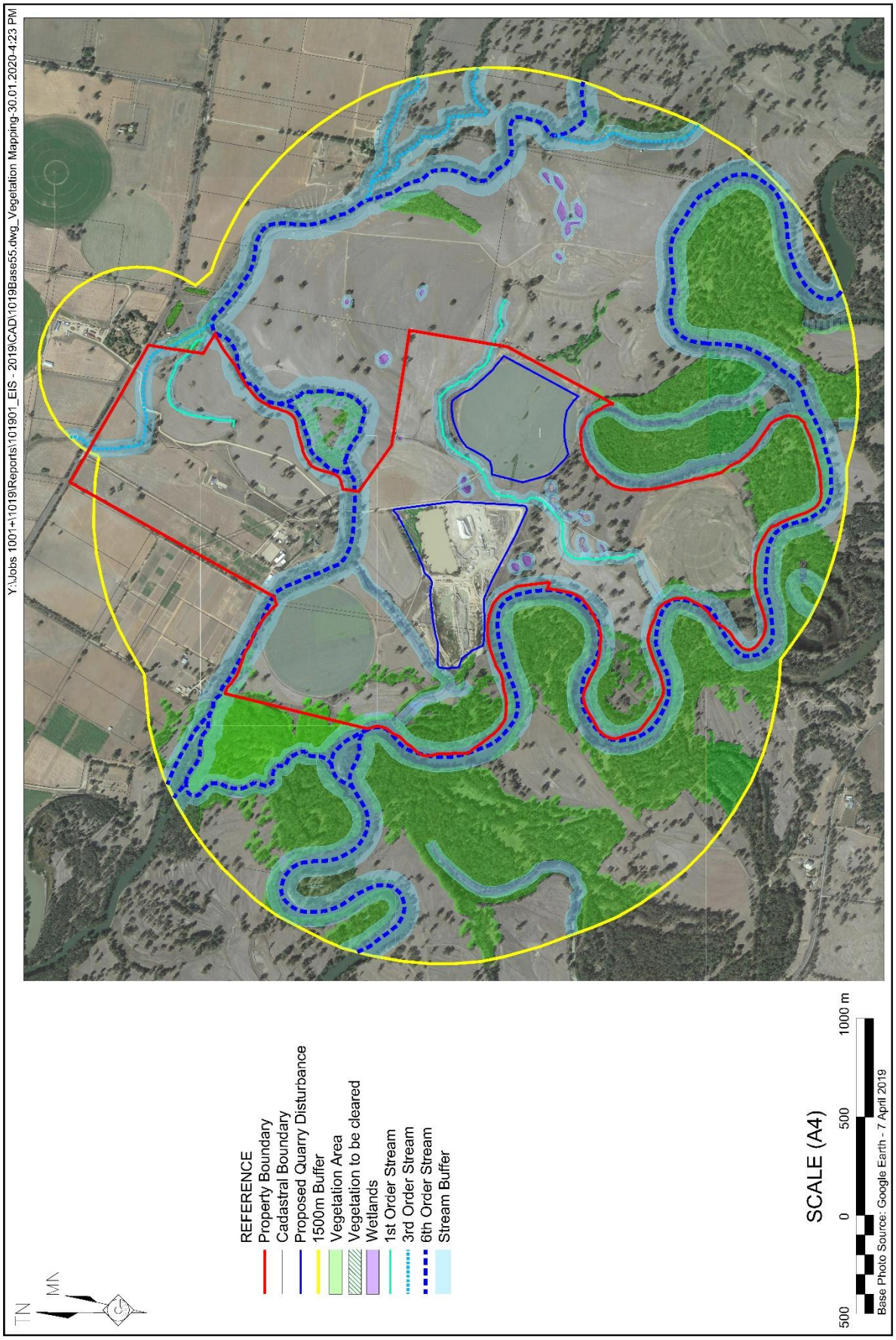
The total area of native vegetation cover in the Quarry Site is less than 1 ha (<2%) of the total 53.5 ha disturbance footprint. It should be noted that within the Quarry Site, Stages 1 to 3 are highly disturbed, Stage 4 is irrigated lucerne and the haul road is located on former cropping land.

Mapped vegetation and aerial imagery

Aerial imagery relied upon for this assessment was captured in September 2019 (sourced via NearMap). Aside from some individual paddock trees that appear to have succumbed to age and wind or have been used as farm timber, there is very little measurable discrepancy between aerial imagery and the extent of mapped vegetation at the time of writing this report.

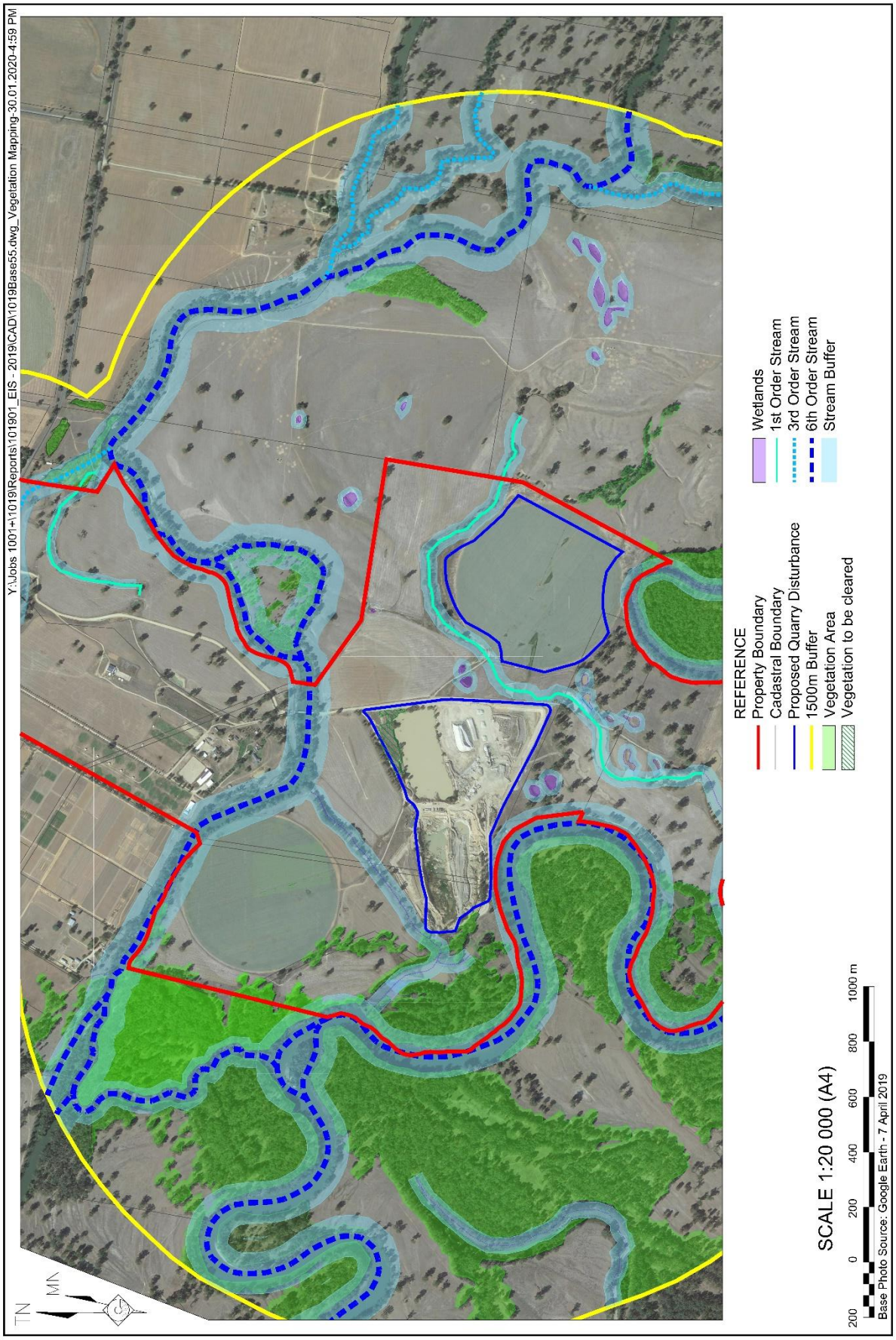
Site context components – determination of buffer area

The buffer area for the BDAR was firstly determined on a site basis taking into account the four stages of pit development with a 1,500 m buffer.



(Google Earth April 2019)

Figure 10 Locality map -1,500 m buffer extent in relation to Quarry Site



(Google Earth April 2019)

Figure 11 Quarry Site overview

2.1.1 Plant Community Types

There are three Plant Community Types represented within the 1,500 m buffer area surrounding the Quarry Site (see **Table 3**). These are listed below with detailed descriptions provided in **Appendix 2**. PCT 5 (and derived PCT 5) is the only PCT within the Quarry Site. The determination of the Plant Community Type was based on aerial photography (NSW SIX mapping) and ground survey using methods recommended by the Office of Environment and Heritage NSW Guide to Surveying Threatened Plants (2016) and related "Field Survey Methods" guidance notes.

Table 3 Plant Community Type, condition, area and percentage native vegetation cover in the 1,500m buffer

Plant Community Type ID	PCT 5 Red Gum	PCT 5 (Derived) Red Gum	PCT 76 Grey box	PCT 165 Stipa Grassland	Water bodies and roads
Vegetation condition	Low-Good - condition	Very Poor condition (Few paddock trees)	Very poor condition (Few paddock trees, crop pasture)	Very poor condition - introduced pasture species dominate (Heavily grazed)	-
Total 1,387 ha	369	5	~5	10	45
Percentage of total vegetated area	27	1	1	<1	2
Percentage native vegetation cover	28		<5	<5	Nil

Plant Community Type ID: PCT 5*:* River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina.

Vegetation Class: Inland Riverine Forests.

Vegetation Formation: Forested Wetlands.

Species: *Eucalyptus camaldulensis subsp. camaldulensis / Acacia dealbata / Bothriochloa macra, Carex tereticaulis, Lachnagrostis filiformis, Hemarthria uncinata var. uncinata.*

Plant Community Type ID: PCT 76: Riverine Western Grey Box grassy woodland of the semi-arid (warm) climate zone.

Vegetation Formation: Grassy Woodlands

Vegetation Class: Floodplain Transition Woodlands

Plant Community Type ID: PCT 165: Derived corkscrew grassland/forbland on sandplains and plains of the semi-arid (warm) climate zone.

Vegetation Formation: Grasslands.

Vegetation Class: Riverine Plain Grasslands.

2.1.2 River System and Wetlands

The Murray River (a >6th order stream) is located to the south of the Quarry Site and the Black Swan Anabranch flows just north of the Quarry Site. The existing Quarry disturbance is within approximately 50m of the Murray River, however under the Project this area would be regenerated to establish a 100m buffer. Major's Creek is an ephemeral third order stream that flows through the northern end of the property, close to the Riverina Highway.

There are two flood runner overflows. Cod Creek runs close to Stage 4 of the Quarry Site and flows into various wetlands to the south of the Quarry Site and may at times of flood or high rainfall empty into the Murray River about 1 km south of the Quarry Site. Another (unnamed) floodrunner is located to the northwest of Stage 1. Both provide ephemeral wetland habitat. These fill on a seasonal basis or when floods occur. The northwest overflow and wetland was previously used to dispose of excess seepage from the pits. The natural overflow watercourses will have a 50 m buffer either side and would be revegetated under the Project (trees and native grassed areas).

Although not listed on the National Register of Important Wetlands, the Murray River and its floodplain contains local wetlands that provide important habitat to both sedentary and migratory species.

2.1.3 Habitat Connectivity

Habitat connectivity is the degree to which a particular site connects different areas of habitat for threatened species and facilitate the movement of those species across their range. The Murray River floodplain and associated remnant vegetation is a major corridor providing terrestrial and aquatic connectivity for fauna movement. The Murray River is a 6th order stream with a 50m buffer and is therefore considered to be a State Significant Biodiversity Link (OE& H 2014) Vegetation alteration since settlement, current and future integrity

Prior to settlement it is likely that substantial parts of the property and roadsides were covered by a canopy of River Red gum (*Eucalyptus camaldulensis*), woodland with wattles, for example, Silver Wattle (*Acacia dealbata*) and some River bottlebrush (*Callistemon sieberi*) at mid-level and a grassy understorey. These communities are found on the surrounding floodplain with some remnant communities on the property, with age classes substantially altered by logging, especially on the river point bars. The condition of the canopy varies, but is generally very healthy in the young to medium age group while some

older paddock trees are showing some signs of senescence. Generally most remaining trees have up to 40+% foliage cover (PFC).

Large tracts of the Howlong district, including the site under consideration have been largely cleared for the establishment of pastures and movement of farm equipment. Aside from good terrestrial and aquatic connectivity along the Murray River, habitat connectivity is now classed as fragmented. On the floodplain some remnant older Red Gums trees remain because they were too big to fell, or they contained defect and hollows that meant they were unsuitable for timber processing.

Several areas along the point bars of the Murray River have been cleared in the past and with the reduced grazing pressure on the lower terraces they are now regenerating. **Figure 12** shows several areas (wetlands and river point bars) that are undergoing substantial regrowth of the River Red Gum community. While this is enhancing habitat and certainly improves the connectivity factors for the river corridor, the connection to the Grey Box woodland areas to the north of the Quarry Site and above the floodplain, remains difficult for ground based native species to traverse without exposure to predation.

Importantly, this project would involve restoring connectivity between the Black Swan Anabranch and the Murray River and establish 100 m wide vegetation buffers on creeks and wetlands within the property.

2.1.4 Areas of Geological Significance and Soil Hazard

Land and soil degradation hazard ratings

The following ratings were determined by site inspection and soil analysis (AES, 2020a)

- Hydrogeology salinity level: *Low;*
- Acid sulphate soil risk: *Very low*;
- Land slip and erosion risk: *High* (but confined) in the Quarry Site pit areas.

Within the Quarry Site the walls of the pits pose a slip hazard because of the sodic nature of the subsoils and the course texture and gravelly nature of subsoil horizons. However, experience from existing operations indicates this has not been an issue.

2.1.5 Areas of Outstanding Biodiversity Value

Areas of outstanding Biodiversity Value (AOBVs) are excluded from the land management framework set out in the *Local Land Services Amendment Act 2016*. This means clearing under the codes is not permitted in an area of outstanding biodiversity value. There are no AOBV areas within the Quarry Site and none identified by OEH in the vicinity (10 km).

2.1.6 Assessment of Patch Size

Patch size was established using NSW SIX Maps satellite imagery. All woody vegetation that would not be defined as being in low condition and less than 100 m apart or less than 30 m in the case of grasslands was visually assessed using scaling. It was determined that for habitat assessment purposes the Study Area is part of the larger Murray River corridor with a patch size >100 ha.

2.1.7 Native and Exotic Vegetation Zones

River Red Gum herbaceous grassy very tall open forest wetland (PCT 5)

Within River Red Gum PCT 5 there is a herbaceous ground cover dominated by grasses and forbs. Grasses can include Warrego Grass (*Paspalidium jubiflorum*), wheatgrass (*Elymus scaber*), Blown Grass (*Lachnagrostis filiformis*) and wallaby grasses (*Austrodanthonia spp*.). Forbs may include *Wahlenbergia fluminalis, Senecio quadridentatus, Ranunculus inundatus, Brachyscome basaltica var. gracilis, Pratia concolor, Rumex brownii, Picris squarrosa and Centipeda cunninghamii*. Sedges can include *Carex tereticaulis, Carex inversa, Eleocharis acuta and Eleocharis pusilla*. Weeds are common in places and include *Hordeum leporinum, Cirsium vulgare, Bromus diandrus, Echium plantagineum, Hypochaeris glabra, Lolium perenne, Lolium rigidum, Medicago polymorpha, Vulpia muralis and Vulpia myuros*. The list of species for the general locality (10 km) and those identified on-site is provided in Appendix 3.

Agricultural land

The major portion of the Quarry Site is classed as "introduced grassland species" and irrigated lucerne (*Medicago sativa*). Notably, except for the large Red Gums and a few understory species of wattle, past grazing and cropping has eliminated ground based native flora that might be considered as important habitat for native species. The open grassed areas of the agricultural land and Quarry Site are dominated by Barley grass (*Hordeum leporinum*), Lucerne (*Medicago sativa),* Rye grass (*Lolium perenne*), Patterson's curse (*Echium plantagineum*), Blackberry (*Rubus fruticosus*) Heliotrope (*Heliotropium europaeum*) and Wireweed (*Polygonum avicular*) typical of grazed agricultural sites on the riverine plain. Scattered remnants of Wallaby grass (*Austrodanthonia Spp*) can be found under and around some trees.

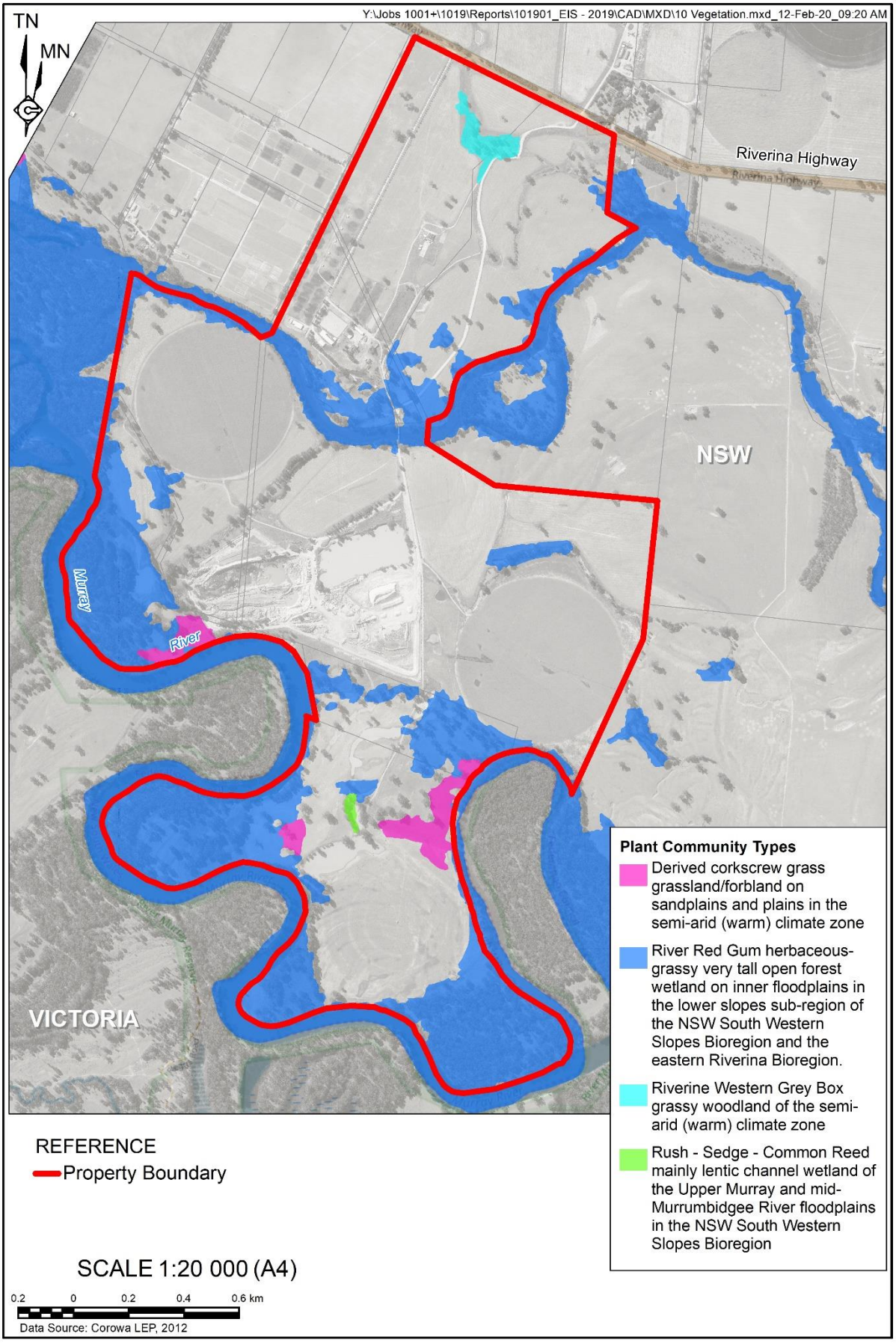


Figure 12 OEH Plant Community Type map of the Riverine Plain and surrounds

Justification of evidence to identify the PCT

Species relied upon for Identification of the Plant Community Type include - in the Upper Stratum: River Red Gum (*Eucalyptus camaldulensis subsp. camaldulensis*) up to 30m height; in the mid stratum, Silver wattle (*Acacia dealbata*) and Dwarf Cherry with (*Exocarpos strictus*), Common sedge (*Carex tereticaulis*) and Red leg grass (*Bothriochloa macra*) in the ground stratum. The vegetation community's location in the landscape on the lower river terrace is also typical of PCT 5 River Red Gum herbaceous – grassy very tall open forest (Bionet Vegetation Classification, 2018).

2.1.8 Threatened Communities and Aquatic Habitat

There are no terrestrial threatened communities listed for the Quarry Site. However, the Lower Murray River Endangered Ecological Community is listed under part 3 of Schedule 4 of the *Fisheries Management Act* 1994 (Department of Primary Industries).

Previous extraction activities have resulted in rainfall, runoff and seepage water collecting in the pits creating two artificial lakes. These lakes may provide a habitat opportunity for Murray Cod (*Maccullochella peeliipeelii*) and other aquatic species such as Yabbies (*Cherax destructor*) and Murray Crayfish (*Euastacus armatus*) that make up the Lower Murray River Endangered Ecological Community. It should be noted that this endangered ecological community includes all native fish and aquatic invertebrates within all "natural" creeks, rivers, and associated lagoons. As such, it might be argued that since the lakes within the development (Quarry Site) are not natural they do not make up part of the lower Murray River Endangered Ecological Community.

2.1.9 Vegetation Integrity

Vegetation integrity may be determined from consideration of the results of plot data recorded during field survey. The area to be cleared that contains less than 20 % cover of the Derived PCT5 Vegetation Zone within the Quarry Site is 1.1 ha (**Figure 8**), which from **Table 4** of the BAM requires at least 1 plot/transect to be established (**Appendix 3**). As a result of extreme past surface soil disturbance of the 1.1 ha area to be cleared in Stage 2 a surrogate BAM plot was established immediately adjacent to the Stage 1 pit area (see **Appendix 7**). The plot was outside the Quarry Site because of difficulties finding a suitable undisturbed area with intact vegetation type of sufficient size and continuity to apply a BAM plot. The plot area contained a vegetation suite similar to the discontinuous areas of Derived PCT 5 on the Quarry Site (**Figure 9**). An assessment (BAM plot methodology) of a patch of remnant/regenerating vegetation near the south west corner of the existing excavation was conducted (Composition 26.3, Structure 51.1, Function 45.6) resulting in a vegetation integrity score of 39.4. Native vegetation cover was determined from the BAM plot to be 36%. Vegetation integrity now and in the future is discussed in more detail in Section 4.2.

Current and future vegetation integrity scores

Vegetation Integrity is made up of species composition, structure and function attributes scored against the benchmark figures for the plant community type (PCT).

PCT 5 *Common Name* – River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.

The vegetation integrity survey plot provided the integrity score for the site that was selected as surrogate representative of derived PCT5. No vegetation plots were established for exotic grassed areas and planted non-indigenous vegetation.

An assessment (BAM plot methodology) of a patch of remnant/regenerating vegetation near the south west corner of the existing excavation was conducted (Composition 26.3, Structure 51.1, Function 45.6) resulting in a vegetation integrity score of 39.4.

Table 4 Vegetation integrity scores before and after development

Vegetation Zone No	Plant community type	Condition Class	Area impacted	Vegetation integrity score prior to development	Vegetation integrity score after development
1	PCT 5 River Red Gum herbaceous-grassy very tall open forest wetland	Disturbed	1.1	39.4	0

2.1.10 Habitat suitability

Habitat suitability was determined directly from the Threatened Biodiversity Data Collection as indicated in Section 6.1 of the Biodiversity Assessment Model (BAM), the published literature and related information, as well as discussions with the respective threatened species experts.

A BioNet search for flora and fauna species that may be present within the Study Area and therefore indicate the presence of suitable habitat, was conducted and species were identified that could occur within the general locality (~10 km) or wider area where applicable, as well as species that are likely to be found within or adjacent to the property. Aside from the Red Gum forest areas the wider agricultural area, flood runners, ephemeral streams (Majors Creek) and roadside reserves were investigated.

2.1.11 Vegetation Abundance

The occurrence of flora species within the Study Area has been assessed and a list of species found in the area can be viewed in **Appendix 3**, with specific study site species identified during the vegetation assessment highlighted in yellow.

In terms of abundance of native vegetation, River Red Gum (*Eucalyptus camaldulensis*) vegetation communities (Plant Community Type PCT 5) once dominated the upper stratum of the floodplain and still does, but to a vastly more limited extent, than its abundance prior to European settlement.

The abundance and integrity of the vegetation populations in the footprint area (and the haul road) have been severely compromised by weed invasion, grazing, soil excavation and grading, ploughing and other agricultural activities. In areas mostly well away from the development footprint remnant patches are present on the points of the river, and isolated large individuals are still present in several paddocks. At the western end of the disturbance footprint there are only a few (5) older red gums with habitat potential. These trees will be retained and protected for their potential site habitat and as parent seed trees. **Table 4** presents a summary of the outcomes of survey of River Red Gum (*Eucalyptus camaldulensis*) within an area of approximately 60 ha) including the proposed disturbance area and the land adjacent to the haul road. Detailed vegetation assessment information is provided in Appendix 11.

Table 5 Subject land Red Gum vegetation age class, size, numbers and logs with hollows

Dominant species	Age Class (Years)	Number	Diameter (DBH cm)	Height/ Spread (m)	Percent foliage cover	Hollows	Logs with hollows
Eucalyptus camaldulensis	5-25	>120	10-35	3-12/ 1~8	25-35	No	No
Eucalyptus camaldulensis	25-50	33	35-95	6-20/ 4~16	20-30	No	No
Eucalyptus camaldulensis	~200	1	195	20+/ 17	20-30	Developing	No
Eucalyptus camaldulensis (Haul road)	200-400	27	110-250	20-25/ 15~25	20-25	Numerous	No

There are also a few planted native and exotic species of trees around the pit areas these include Willows (*Salix sp*) Paulownia (*Paulownia kawakamii*) Narrow-leaved Peppermint (*Eucalyptus nicholii*) and Red box (*Eucalyptus polyanthemos*).

It would appear that previous occupiers had made a very conscientious effort to “clean up” the entire property with a very notable absence of logs on the ground under old trees and around wetland sites.

There is only minor encroachment (9.5 m) of the tree protection zone of two remnant trees adjacent to the Quarry haul road (Details in **Appendix 11**).

2.1.12 Floristic Survey

Vegetation mapping and plot survey

Initial review of the Plant Community Type and vegetation integrity was based on aerial photography (NSW SIX mapping) and confirmed through ground survey using methods recommended by the Office of Environment and Heritage NSW Guide to Surveying Threatened Plants (2016) and related “Field Survey Methods” guidance notes.

The area of the Derived PCT5 Vegetation Zone 1 within the Quarry Site is less than 1.1 ha, which from Table 4 of the BAM requires at least 1 plot/transect to be established (**Appendix 3**). A qualitative approximately 10 m spaced vegetation assessment meander was conducted across the extensively disturbed development area which principally contained volunteer exotic ground cover species.

As discussed previously, in order to be able to run the BAM Calculator a surrogate BAM plot was established immediately adjacent to the Stage 1 pit area (see **Appendix 6**). The plot was outside the Subject Site area because of difficulties finding a suitable undisturbed area with intact vegetation type of sufficient size and continuity to apply a BAM plot. The plot area contained a vegetation suite similar to the discontinuous areas of Derived PCT 5 on the Quarry Site (**Figure 11**).

2.1.13 Paddock Trees

Within the subject land there is a total of 43 large trees (>20 cm DBH) most of which would be classed as “Paddock Trees”.

Paddock trees are defined in Appendix 1 of (BAM 2017) as follows:

- *The trees located on Category 2 land are surrounded by Category I land on the regulatory maps under the Biodiversity Conservation Act, or*
- *The native vegetation that comprises the groundcover is:*
    - *Less than 50% of the cover of indigenous species of vegetation, and*

- *Not less than 10% of the area is covered with vegetation (whether dead or alive), and the assessment is made at the time of year when the proportion of the amount of indigenous vegetation in the area to the amount of non-indigenous vegetation in the area is likely to be at its maximise and*

- *The foliage cover for the tree growth form group is less than 25% of the benchmark for tree cover for the most likely plant community type, or*
- *It is a tree more than 50m away from any living tree that is greater than 20 cm DBH and the tree is located on Category 2 land that is surrounded by Category 1 land; or it is in a group of 3 or fewer living trees within a distance of 50m of each other, that in turn , are greater than 50 m from the next living tree that is greater than 20 cm DBH and located on Category 2 land that is surrounded by Category 1 land.*

The Subject Land is mapped buy OEH as being excluded from Local Land Services Act 2013 (LLS).

Individual tree assessment methodology was based on parameters including tree height, tree diameter, canopy diameter, percent foliage cover, hollows, logs on the ground (length diameter and hollows where present), ground cover and any intermediate species present. The non-indigenous trees on the Quarry Site were identified, but were not assessed in detail. Detailed information relating to individual trees is provided in **Appendix 11**.

3. Threatened Flora and Fauna

3.1 Desktop Review

3.1.1 Introduction

A desktop review of the potential for threatened species was conducted in order to provide both context and an understanding of biodiversity values within the local area and the Quarry Site.

The review involved an consideration of:

- Bionet Vegetation Classification and BAM calculator – for threatened species associated with the relevant PCT.
- On-line database search for threatened flora and fauna, migratory species within 10 km of the Quarry Site and listed under the Commonwealth *Environment and Biodiversity Conservation (EPBC) Act 1999 (Accessed 10 May 2018)* and the *NSW Biodiversity Conservation Act 2016.*
- Discussions with local LandCare and Local Land Services personnel; Quarry personnel and leading experts regarding threatened species;
- An EPBC Act Protected Matters Report (**Appendix 3**).

Habitat suitability was determined directly from the Threatened Biodiversity Data Collection as indicated in Section 6.1 of the Biodiversity Assessment Model (BAM), the published literature and related information, as well as discussions with the respective threatened species experts.

A BioNet search for flora and fauna species was conducted and species were identified that could occur within the general locality (~10 km) or wider area where applicable, as well as species that are likely to be found within or adjacent to the property. Aside from the Red Gum forest areas the wider agricultural area, flood runners, ephemeral streams (Majors Creek) and roadside reserves were investigated.

3.1.2 Ecosystem Credit Species and Habitat

The Bionet Vegetation Assessment Tool and BAM Calculator were used to establish which ecosystem credit species are associated with the PCTs within the broader Study Area. Ecosystem Credit Species that are reliably predicted to occur within the selected PCTs are assumed to occur on site unless habitat has been substantially impacted or removed.

Table 5 presents the ecosystem credit species that are predicted to occur within Vegetation Type (PCT 5) - River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and

the eastern Riverina Bioregion. The suitability of the habitat within or close to the Quarry Site was assessed in accordance with Section 6.2 of the BAM.

Within a 10 km radius of the Quarry Site there are seven vulnerable fauna species and one flora species listed as endangered under the NSW Biodiversity Conservation Act 2016. Under the EPBC Act there is one species listed as Vulnerable and another listed as Endangered. There are no threatened communities listed for the search area on the OEH Bionet database, but the Murray River Aquatic Community is listed by the Department of Industry - Water.

A list of identified ecosystem credit species (**Table 5** and BAM Calculator Reports **Appendix 12**) and species credit species that may be present within the Quarry Site is presented in **Table 6**. The Calculator Report indicates that no survey is required and that Ecosystem Credits apply.

Table 6 Ecosystem Credit Species

Common Name	Scientific Name	Habitat present at or close to site
Australian Painted Snipe	*Rostratula australis*	Yes
Barking Owl	*Ninox conivens*	Yes
Black-chinned honeyeater	*Melithreptus gularis*	Yes
Dusky Woodswallow	*Artamus cyanopterus*	Yes
Flame Robin	*Petroica phoenicea*	Yes
Hooded Robin (south-eastern form)	*Melanodryas cucullata*	Yes
Koala	*Phascolarctos cinereus*	Yes
Little Eagle	*Hieraaetus morphnoides*	Yes
Little Lorikeet	*Glossopsitta pusilla*	Yes
Little Pied Bat	*Chalinolobus picatus*	Yes
Painted Honeyeater	*Grantiella picta*	Yes
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*	Yes
Regent Honeyeater	*Anthochaera phrygia*	Yes
Scarlet Robin	*Petroica boodang*	Yes
Spotted Harrier	*Circus assimilis*	Yes
Superb Parrot	*Polytelis swainsonii*	Yes
Swift Parrot	*Lathamus discolor*	Yes
Turquoise Parrot	*Neophema pulchella*	Yes
Varied Sittella	*Daphoenositta chrysoptera*	Yes
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Yes
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	Yes

Table 7 List of Species Credit Species, habitat and search requirements

Common Name	Species Name	Preferred Habitat	Preferred habitat present at or near the site (Justification)	Species requiring further assessment
Fauna				
Large (Eastern) Bentwing Bat	*Miniopterus orianae oceanensis*	Forested areas	Yes, but probably not breeding nearby from Species profile information	Yes
Sloane's Froglet	*Crinia Sloanei*	Wetlands, rivers and creeks	Possible within the Quarry Site and some wetlands nearby	Yes
Spotted Tailed Quoll	*Dasyurus maculatus*	Recorded across a range of habitat types, including inland riparian forest.	Possible nearby - Yes	Yes
Squirrel Glider	*Petaurus norfolcensis*	Woodland and forested areas	Possible – Yes.	Yes
Swift Parrot	*(Lathamus discolor)*	Woodland and forested areas	Possible – Yes.	Yes
White bellied Sea Eagle	*Haliaeetus leucogaster*	Rivers, lakes and wetlands, marine environments.	Possible - Yes	Yes
Flora				
Austral Pillwort	*Pilularia novae-hollandiae*	Shallow swamps and waterways	Not observed in the activity area, but may be present in wetlands nearby	
Small Scurf Pea	*Cullen parvum*	River Red Gum Woodland or Box-Gum Woodland, sometimes on grazed land table drains or adjacent to drainage lines	Not observed in the activity area (10 km), but may be present close to wetlands nearby	Yes

3.2 Candidate and Other Threatened Species Survey

Table 8 presents the species that have potential to be present within the Quarry Site and require targeted survey.

Table 8 BioNet and BAM Candidate Species records and survey method/timing

Common name **(Sources: BAM and BioNet)**	**Species name**	**Habitat** **BioNet and BAM records**	**Biodiversity Risk rating**	**Maintain as candidate species** **Survey method** **Months to search**
Sloane's Froglet	*Crinea sloanei*	Inundated areas 2 records 10 km NE of subject site in 2013, 2016	1.5	Yes. Site surveys and recording Jul, Aug
Superb Parrot	*Polytelis swainsonii*	Woodland 4 records NE and NW of subject site 1. 2014, 2015, 2016,2017	3	Yes - Suitable habitat exists Field observation Sept, Oct, Nov
Swift Parrot	*Lathamus discolor*	Mostly occurs on coast and SW Slopes. No BioNet record within 10 km of Quarry Site (Site not a SAII* area in OEH mapping 2018)	3	Yes – Potential forage area Site surveys May, June, July, Aug
Southern Myotis	*Myotis macropus*	Known to occur along the Murray River, but no record within 10 km of Quarry Site	2	Yes – Potential forage area Anabat recordings Jan, Feb, Mar, Nov, Dec
Brush-tailed Phascogale	*Phascogale tapoatafa*	No BioNet record within 10 km of Quarry Site	2	Yes – Potential breeding, forage area Spotlight, hollow watch. All months
Koala	*Phascolarctos cinereus*	No BioNet record within 10 km of Quarry Site	2	Yes – Potential forage area Field random search and spotlighting, scat search. All months
Large (Eastern) Bentwing Bat	*Miniopterus orianae oceanensis*	Forested areas 1 record in forest close to Howlong	2	Yes, but probably not breeding nearby from Species profile information (OEH). Anabat recordings Jan, Feb, Mar, Nov, Dec
Powerful Owl	*Ninox strenua*	Woodland and open sclerophyll forest to tall open wet forest. No BioNet record within 10 km of subject site of Quarry Site	2	Yes – Potential forage area. Field observation and spotlighting May, June July , Aug
Regent honeyeater	*Anthochaera phrygia*	No BioNet record within 10 km of Quarry Site (Site not a SAII* area in OEH mapping 2018)	3	Yes – Potential forage site. Field observation Sept, Oct, Nov, Dec

Table 8 (Cont'd) BioNet and BAM Candidate Species records and survey method/timing

Common name **(Sources: BAM and BioNet)**	**Species name**	**Habitat** **BioNet and BAM records**	**Biodiversity Risk rating**	**Maintain as candidate species** **Survey method** **Months to search**
Square-tailed Kite	*Lophoictinia isura*	Open fields/woodland. No BioNet record within 10 km of Quarry Site	1.5	Yes – Potential forage site. Field observation Jan, Sept, Oct, Nov, Dec
Squirrel Glider	*Petaurus norfolcensis*	No BioNet record within 10 km of Quarry Site	2	Yes – Potential forage area Spotlight, hollow watch. All months
Superb Parrot	*Polytelis swainsonii*	4 records NE and NW of Quarry Site. 2014, 2015, 2016, 2017	2	Field observation Sept, Oct, Nov
Spotted–tailed Quoll (Bionet listed)	*Dasyurus maculatus*	Appears as a vagrant occurrence Nearest recorded sighting in Howlong township 5 km NW of Quarry Site	Undetermined	Yes – Potential forage area. Field observation, scat search, IR/motion cameras. All months
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Riparian areas and wetlands 1 record 10 km NE of Quarry Site in 2016	2	Yes – Potential forage area Field observation Jul, Aug, Sept, Oct, Nov, Dec
Austral Pillwort (Bionet listed)	*Pilularia novaehollandiae*	Closest record is 4 km NW of the Quarry Site	Undetermined	Field meander search April, May June Sept, Oct, Nov
Small Scurf - pea	*Cullen Parvum*	No BioNet record within 10 km of Quarry Site	2	Yes - but unlikely due to excessive ground disturbance. Field meander and transect search Jan, Feb, Dec
* SAII – Regent Honeyeater – Not present and Quarry Site is not a Serious and Irreversible Impact Area.				

3.2.1 Survey Methodology

In order to determine the biodiversity values of the Quarry Site and impacts of the development, a site and area survey were undertaken to confirm the mapped vegetation community and included survey for flora and fauna, with a focus on threatened species. The area was assessed using guidelines and procedures relating to the *Biodiversity Conservation Act 2016*.

The flora and fauna surveys of the Quarry Site were undertaken over various dates between 1 February 2018 to 28 September 2018. Detailed summaries of the survey effort are provided in the following subsections.

Active searching for fauna was undertaken; this included direct observation, investigation under rocks and logs, examination of tracks and scats and identifying calls, as well as recording calls of frog species (**Appendix 8**). Anabat recordings were used to identify bat species (Report - **Appendix 9**). All species of fauna observed during the assessment were noted. Particular attention was given to searching for threatened species in their likely habitats. Infra-red movement cameras were used in assessing the range of species moving in the vicinity of the Study Area.

Survey techniques were generally as outlined in the BAM and the NSW Guide to Surveying Threatened Plants (2016) and Threatened Biodiversity Survey and Assessment Guidelines (DECC 2004). Targeted surveys included survey within and adjacent to the Study Area to provide a context for any identified local populations given connectivity with larger areas of vegetation and the Murray River corridor. Targeted surveys were conducted by first identifying species habitat requirements and secondly searching in those habitats at times that might provide evidence of the presence of the species being investigated.

An overview of the survey effort and timing is presented in **Table 9**.

Table 9 Flora and fauna species survey timetable

Page 1 of 2

Date	Time	Activity	Weather
Thursday 01-02-2018	1000-1200 1230-1645	Site inspection Vegetation assessment and mapping (Treed sites in Study Area) Avifauna observations (Superb parrot search)	Clear, calm – wind slightly SE, 22^{0}C full moon
Friday 9-02-19	0930-1600	Ground vegetation assessment (cleared areas along with cultural heritage survey)	Slight cloud S10km/hr 30^0+C Daytime only
Thursday 1-03-2018	1000-1245 1503-1730 2000- 2200	Set up Anabat equipment Avifauna observations Spotlight/ frog search	Clear Wind S 10 km/hr 20^{0}C Full moon
Wednesday 07-03-2018	1300-1330 1330-1740 1800-1955	Collect Anabat data records Avifauna observations. Parrot survey (Haul road). Vegetation assessment (Haul road & agricultural areas) Establish movement/IR field cameras (Spotted Tailed Quoll search)	Clear, Wind S 7 km/h 20^{0}C No moon
Tuesday 17-04-2018	1000-1345 1430-1700 1930-2115	Install movement/IR Cameras Soil profile assessment BAM Vegetation Murray buffer lot assessment Spotlight/ frog search Hollows watching (Haul Road and south of Quarry Site). Spotlight and frog search.	Overcast Wind light SW 5-10 km/hr 25^{0}C No moon
Tuesday 8-05-2018	1000 -1030	Collect movement/IR camera	Clear Wind east 10Km/h 17^{0}C

Table 9 (Cont'd) Flora and fauna species survey timetable

Date	Time	Activity	Weather
Wednesday 18-07-2018	1430-1700	Avifauna observations Survey along Murray River Search wetlands margins and drains (Targeting Austral Pillwort Sloane's Froglet) Wetlands to west and Cod Ck	NE 10km/hr 10^0C Moon setting
Thursday 26-07-2018	1900-2000	Spotlight/ frog search (targeting Sloane's Froglet) – Major's Ck	Slight overcast cool 10^OC Full moon
Friday 27-07-2018	0900-1130	Avifauna observations Search wetlands margins and drains (Targeting Austral Pillwort) 0800-0900 Wetland near Lucerne & Cod Ck. Wetland bird life observations	Slight overcast Wind E 2-4km/hr cool 7-12^{O}C Full moon
Friday 28-09-2018	1730-2030	Frog search (Targeting Sloane's Froglet)	Moon rising Slight overcast cool 12^{O}C
Saturday 29-09-2018	0630-1100	Avifauna observations (targeting Superb parrot) Frog search	Slight overcast cool 10^OC
Searches conducted by P. Clinnick (Consultant ecologist) and M. Aarts (Technical assistant)			

Spotlighting:

Spotlighting was conducted using a Lightforce Hand Held 170 Striker 17.5 cm hand held spotlight with a useful range of about 250 m. LED head torches were used for close range investigations (e.g. frogs). Spot light searches were conducted on foot and by slow moving vehicle. In searching for amphibians the spotlighting surveys focused on wetlands and dams; while for terrestrial and arboreal fauna the spotlighting was conducted in the areas of vegetation containing mature trees especially those with hollows.

The spotlighting time amounted to approximately 15 person hours with the targets being amphibians, terrestrial and arboreal mammals as well as nocturnal bird species.

Target species: Sloanes Froglet *(Crinia sloanei),* Powerful Owl *(Ninox strenua),* Brush-tailed Phascogale *(Phascogale tapoatafa), Squirrel Glider (Petaurus norfolcensis)* Koala *(Phascolarctos cinereus).*

Nocturnal playback

The calls of the target species were played intermittently for five minutes from a Samsung Galaxy A5 and played through a UE 2 (~90 dBA), followed by five minutes listening for responses. The calls were discernible for about 1 km from the two broadcast sites. The playback sessions were followed up by spotlighting in the vicinity where the target species were deemed likely to occur.

Target species :Sloanes Froglet *(Crinia sloanei),* Powerful Owl *(Ninox strenua), Squirrel Glider (Petaurus norfolcensis),* Koala *(Phascolarctos cinereus).*

Indicators of fauna presence

During searches other physical indicators of the presence of amphibians, birds and marsupials were sought, these included:

- Audible reception of calls;
- Burrows, tracks and diggings;
- Evidence of feeding scars or scratch marks on trees (especially eucalypts);
- Nests in trees;
- Regurgitated pellets and skeletal material;
- Species scats especially in likely markings areas.

3.2.2 Amphibian and bat survey

Target Species: Sloane's Froglet (*Crinia sloanei*), Large (Eastern) Bentwing Bats (*Miniopterus orianae oceanensis) and* Southern Myotis (*Myotis macropus)*

The survey work was conducted in accordance with the Threatened Species Survey and Assessment Guidelines: Fields Survey methods for Fauna – Amphibians (DECC 2009). Call back was made using the Australian Museum Frog database calls on a Samsung Galaxy A5 and played through a UE 2 (~90 dBA) speaker. Any unrecognised calls were recorded and sent to the Australian Museum for analysis. **Table 10** lists the times and areas of targeted survey and search for amphibian and bat survey, including for Sloane's Froglet and **Figure 13** presents the survey effort. Detailed feedback from the Australian Museum is presented in **Appendix 7**.

Anabat recordings over six nights (1-6/03/18) indicated no calls were definitively from Large (Eastern) Bentwing Bats or Southern Myotis (both threatened species). A detailed analysis of microbat calls was conducted by Balance Environmental and is presented in **Appendix 9**. Recorded call sequences are presented in **Appendix 9**.

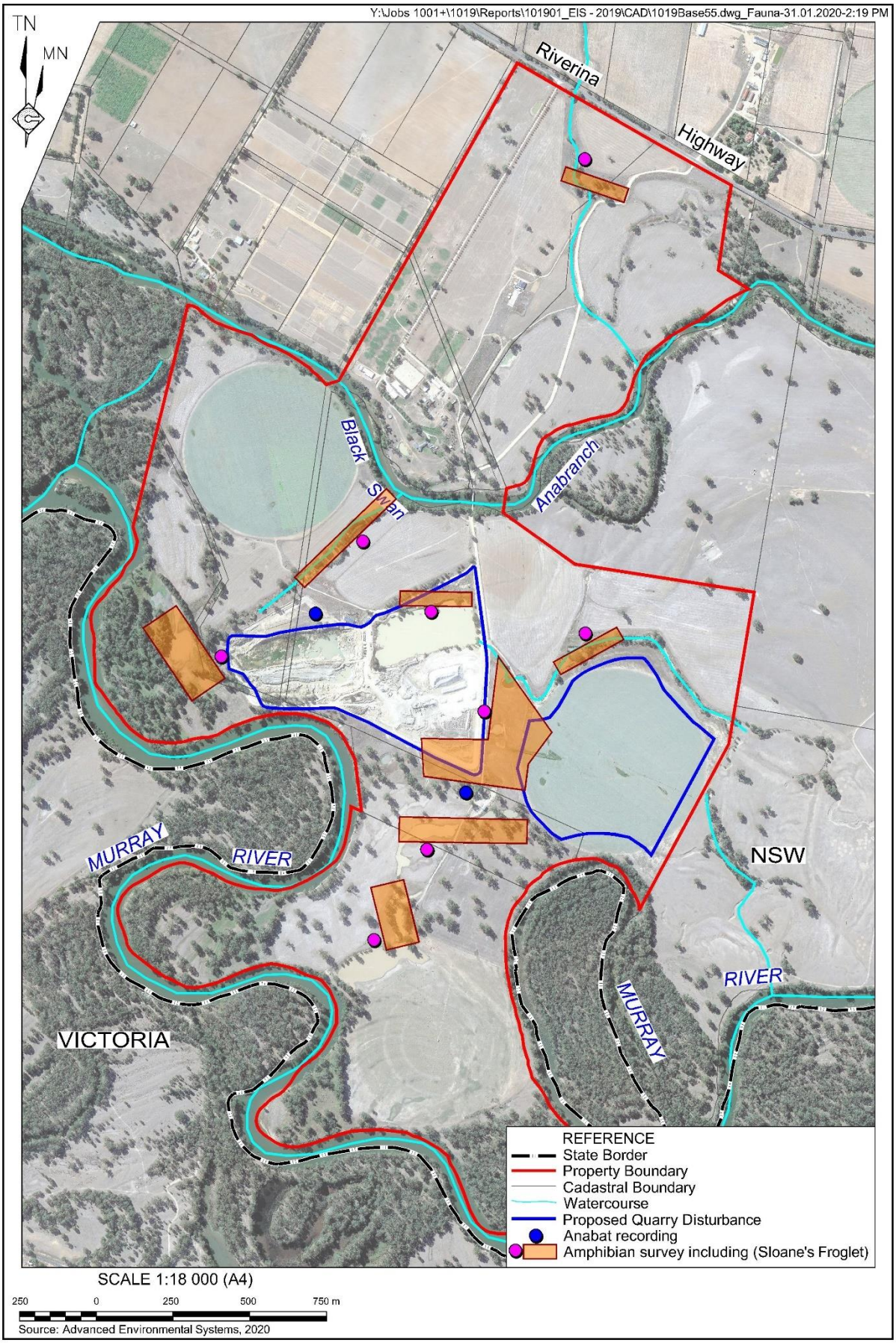


Figure 13 Amphibian and bat survey locations

Table 10 Amphibian and Bat Survey Effort

Date	Time	Activity	Weather
Thursday 1-03-2018	2000- 2200	Sloane's Froglet search debris and vegetation south of Quarry Site (>300 m water edge)	Clear. Wind S 10 km/hr 20^{0}C. Humidity ~ 35%. Full moon. Previous rain 25/26 Feb 13 mm. Water temp ~20^{0}C.
1 to 6-03-2018	6 nights	Anabat recording	Generally clear, Dry. Day temp ~30^{0}C; night temp~19^{0}C.
Tuesday 17-04-2018	1930-2115	Nocturnal spotlighting random frog (movement and eye shine) and bat search with listening surveys at Cod Creek and area south of Quarry Site (> 450 m along water edge)	Overcast. Wind light SW 5-10 km/hr 13-17^{0}C. Humidity ~45%. No moon. Previous rain 14/15 April ~5 mm. Water temp ~15^{0}C.
Wednesday 18-07-2018	1430-1700	Wetlands and log debris to west of Quarry Site and Cod Ck	Clear. NE 10 km/hr 10^{0}C Humidity ~70-80%. Moon setting. Early morning rain 1mm. Water temp ~12^{0}C.
Thursday 26-07-2018	1900-2000	Spotlight/ frog and bat search - 30 minute playback and listening survey – Major's Ck near highway, Cod Creek and wetlands on east side of Stage 3	Slight overcast. Calm. cool ~10^{O}C. Humidity ~70-80%. Full moon. Previous rain 24/25th July 5mm. Water temp ~10-12^{0}C.
Friday 27-07-2018	0900-1130	Frog search wetlands margins and track drains. Wetland near lucerne and Cod Creek. Stage 1,2,3 surrounds	Slight overcast Wind E 2-4 km/hr cool 7-12^{O}C Full moon. Trace of rain overnight. Water temp ~10-12^{0}C
Friday 28-09-2018	1730-2030	Frog search – (Site 4) B/w Stage 3 and 4 - wetland and log debris south of Quarry Site (Site 3)	Partly cloudy Wind W 10 km/h. Cool 12^{O}C Humidity ~70-80%. Moon rising. Previous rain 7th Sept 24 mm. Water temp ~12^{0}C
Saturday 29-09-2018	0630-1100	Frog search – Cod Creek and nearby shallow dams. Playback calls 30 min	Slight overcast cool 10^{O}C. Humidity ~70-80%. Moon rising. Previous rain 7th Sept 24 mm. Water temp ~12^{0}C
Friday 12-10-2018	1600-2030	Froglet search – Stage 1,2 3 surrounds	Clear 13-15^{0}C Humidity ~70-80%. Moon rising. Previous rain 10/11 Oct 3 mm. Water temp ~14-15^{0}C

3.2.3 Avifauna Survey

Target species:

Powerful Owl (*Ninox strenua)*

Regent honeyeater (*Anthochaera phrygia)*

Swift Parrot (*Lathamus discolor)*

Superb Parrot *(Polytelis swainsonii)*

Square-tailed Kite *(Lophoictinia isura)*

White-bellied Sea Eagle (*Haliaeetus leucogaster)*

Avifauna observations totalled over 15 hours including 3.5 hours nocturnal survey, but were usually in conjunction with other fauna observation. Particular attention was paid to searching for "whitewash" faecal or skeletal material on the ground that might indicate potential owl or raptor roosting sites. **Figure 14** and **Table 11** present a summary of the avifauna survey effort.

Table 11 Avifauna Survey Effort

Date	Time	Activity	Weather
Thursday 01-02-2018	1230-1645	Avifauna observations (especially targeting Superb Parrot) of hollow bearing trees and forage areas	Clear, calm – wind slightly SE, 22^{0}C full moon at night
Thursday 1-03-2018	2000- 2200	Spotlight/ playback search (Powerful Owl)	Clear. Wind S 10 km/hr 20^{0}C. Humidity ~ 35%. Full moon. Previous rain 25/26 Feb 13 mm. Water temp ~20^{0}C.
Wednesday 07-03-2018	1300-1330	Avifauna observations. (targeted Superb Parrot (Haul road)	Clear, Wind S 7 km/h 20^{0}C No moon
Tuesday 17-04-2018	1700-1915	Hollows watching (Haul road and south of Quarry Site)	Overcast Wind light SW 5-10 km/hr 13-17^{0}C No moon
Wednesday 18-07-2018	1430-1700	Observation of avifauna dams, wetlands and treed areas	NE 10km/hr 10^{0}C Moon setting
Thursday 26-07-2018	1900-2000	Spotlight/playback surveillance (Powerful Owl - accompanied by Sloane's Froglet search) Major's Ck near highway, Cod Creek and wetlands on east side of Stage 3 and large remnant nearby trees on south end of Quarry Site.	Slight overcast. Calm. cool ~10^{O}C. Humidity ~70-80%. Full moon. Previous rain 24/25th July 5mm. Water temp ~10-12^{0}C.
Friday 27-07-2018	0900-1130	Avifauna observations - Wetland near Stage 4 & Cod Creek.	Slight overcast Wind E 2-4 km/hr cool 7-12^{O}C Full moon. Trace of rain overnight. Water temp ~10-12^{0}C
Saturday 29-09-2018	0630-1100	Avifauna (potential forage areas observation targeting Superb Parrot)	Slight overcast cool 10^{O}C. Humidity ~70-80%. Moon rising. Previous rain 7th Sept 24 mm. Water temp ~12^{0}C

3.2.4 Terrestrial and arboreal fauna survey

Target species: Brush-tailed Phascogale *(Phascogale tapoatafa),* Squirrel Glider *(Petaurus norfolcensis)* Koala *(Phascolarctos cinereus),* Spotted-tailed Quoll *(Dasyurus maculatus).*

Terrestrial and arboreal fauna survey involved both slow vehicle traverses across the wider agricultural area and walking across through Red Gum forest areas and adjacent to flood runners, ephemeral streams (Majors Creek) and roadside reserves.

For each of the groups of amphibians, avifauna and terrestrial/arboreal fauna the methodology used to identify if the fauna /flora was present is presented below.

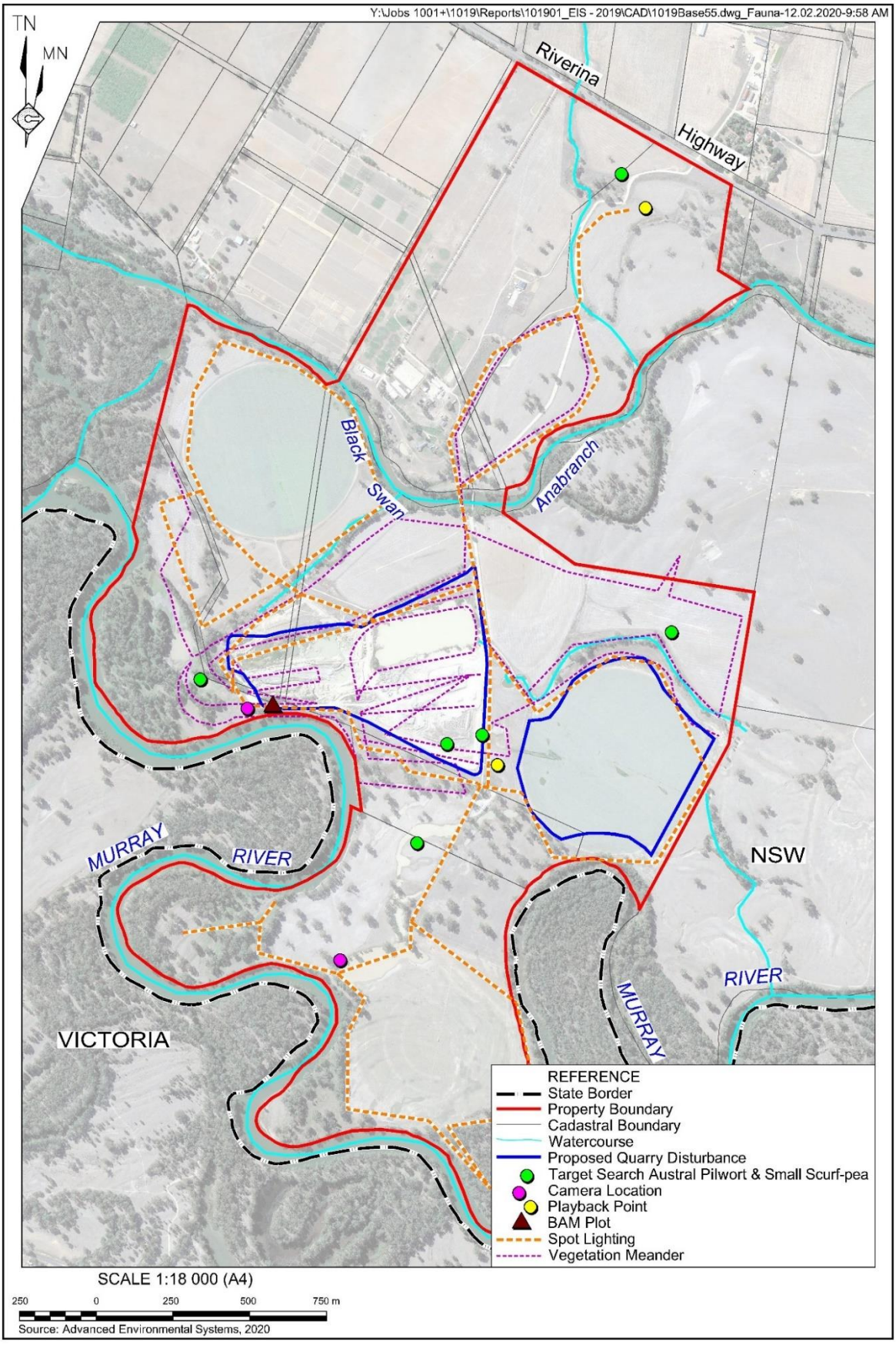


Figure 14 Avifauna survey locations and transects

Spotlighting:

Spotlighting was conducted using a Lightforce Hand Held 170 Striker 17.5 cm hand held spotlight with a useful range of about 250 m. LED head torches were used for close range investigations (e.g. frogs). Spot light searchers were conducted on foot and by slow moving vehicle. In searching for amphibians the spotlighting surveys focused on wetlands and dams; while for terrestrial and arboreal fauna the spotlighting was conducted in the areas of vegetation containing mature trees especially those with hollows.

The spotlighting time amounted to approximately 15 person hours with the targets being amphibians, terrestrial and arboreal mammals as well as nocturnal bird species.

Target species: Sloanes Froglet *(Crinia sloanei),* Powerful Owl *(Ninox strenua),* Brush-tailed Phascogale *(Phascogale tapoatafa), Squirrel Glider (Petaurus norfolcensis)* Koala *(Phascolarctos cinereus)*

Nocturnal playback

The calls each of the target species were played intermittently for five minutes from a Samsung Galaxy A5 and played through a UE 2 (~90 dBA), followed by five minutes listening for responses. The calls were discernible for about 1 km from the two broadcast sites. The playback sessions were followed up by spotlighting in the vicinity where the target species were deemed likely to occur.

Target species :Sloanes Froglet *(Crinia sloanei),* Powerful Owl *(Ninox strenua), Squirrel Glider (Petaurus norfolcensis),* Koala *(Phascolarctos cinereus).*

Indicators and signs of fauna presence

During searches other physical indicators of the presence of amphibians, birds and marsupials were sought, these included:

- Audible reception of calls;
- Burrows, tracks and diggings;
- Evidence of feeding scars or scratch marks on trees (especially eucalypts);
- Nests in trees;
- Regurgitated pellets and skeletal material;
- Species scats especially in likely markings areas.

Figure 15 and **Table 12** present a summary of the terrestrial fauna survey effort.

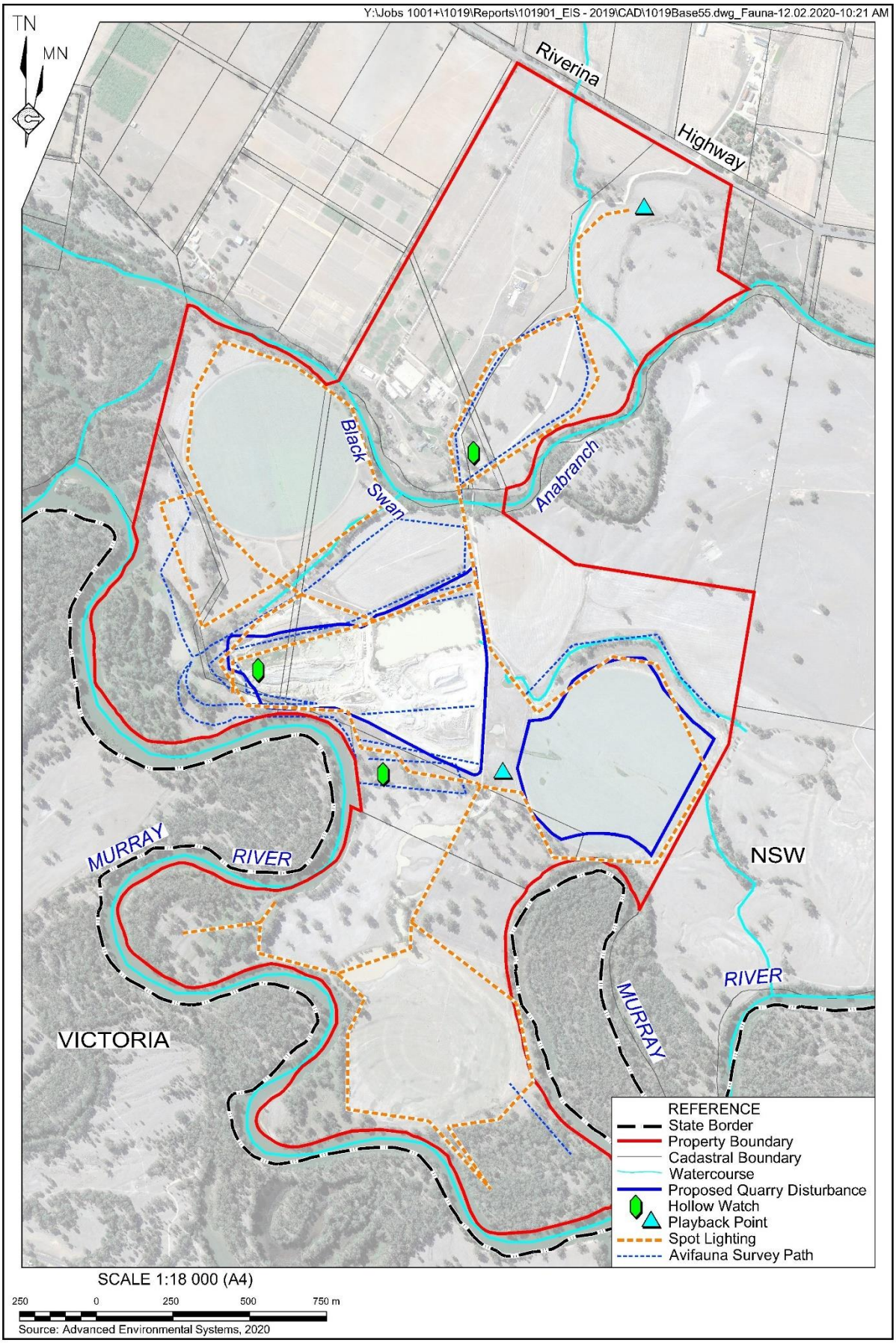


Figure 15 Terrestrial survey locations and transects

Table 12 Terrestrial Fauna Survey Effort

Date	Time	Activity	Weather
Wednesday 07-03-2018	1330-1740 1800-1955	Establish movement/IR field cameras (Spotted-tailed Quoll and other terrestrial /arboreal species search) in areas to west and south of Quarry Site	Clear, Wind S 7 km/h 20^{0}C Humidity ~60%. No moon. Previous rain 25/26 Feb 13 mm Water temp ~16.
Tuesday 8-05-2018	10.00	Collect movement/IR cameras	Clear Wind east 10Km/h. 17^{0}C
Tuesday 17-04-2018	1700-1915 1930-2115	Hollows watching Spotlight/playback (Haul road and south of Quarry Site)	Overcast. Wind light SW 5-10 km/hr 13-17^{0}C No moon
Thursday 26-07-2018	1900-2000	Spotlight/frog search Major's Creek, Cod Creek and wetlands on east side of Stage 2	Slight overcast cool 10^{O}C Full moon
Friday 28-09-2018	1730-2030	Frog search (Targeting Sloane's Froglet) and other terrestrial/arboreal target species playback	Moon rising Slight overcast cool 12^{O}C
Saturday 29-09-2018	0630-1100	Avifauna observations (targeting Superb Parrot) Frog search	Slight overcast cool 10^{O}C
Friday 12-10-2018	1600-2030	Targeted Sloane's Froglet	Clear 13-15^{0}C

3.3 Survey Results

3.3.1 Habitat

The Plant Community Type (PCT) identified within the Quarry Site is *River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion* (PCT 5; OEH 2018).Given the highly disturbed nature of the Quarry Site (due to existing operations or agricultural practices) it is unlikely that the areas that would be disturbed for the Project would provide roosting or breeding habitat for the species identified for assessment. The remaining vegetation within the Quarry Site occurs in small patches or isolated trees. The existing quarrying operations have developed two extraction areas that hold water, however these are not suitable habitat for wetland vegetation or wetland species such as the Sloane's Froglet in their current condition.

Notwithstanding this, some threatened species may be present within the Quarry Site from time to time when foraging in remnant trees or transiting the area.

3.3.2 Threatened Flora and Fauna

The results of field surveys within the Quarry Site and surrounds have been separated into the following groups.

- Flora – **Table 13**.
- Terrestrial fauna – **Table 14**
- Nocturnal fauna – **Table 15**
- Wetland fauna – **Table 16**

Each of the results tables presents the species identified, its listing status under the *Biodiversity Conservation Act 2016* or the *Environmental Protection and Biodiversity Conservation Act 1999* and whether the species is considered to be an exotic species. It is noted that Schedule 5 of the *Biodiversity Conservation Act 2016* provides for the protection of all native amphibians, birds, mammals and reptiles.

No threatened species listed under the *Biodiversity Conservation Act 2016* or the *Environmental Protection and Biodiversity Conservation Act 1999* were identified during the field surveys.

Table 13 Flora Field Survey Results

Family	Scientific Name	Exotic	Common Name	Listing Status
Amaranthaceae	*Amaranthus viridis*	*	Green Amaranth	None
Asteraceae	*Arctotheca calendula*	*	Capeweed	None
Asteraceae	*Arctotheca calendula*	*	Capeweed	None
Asteraceae	*Conyza bonariensis*	*	Flaxleaf Fleabane	None
Asteraceae	*Sonchus asper*	*	Prickly Sowthistle	None
Asteraceae	*Taraxacum officinale*		Dandelion	None
Asteraceae	*Xanthium spinosum*	*	Bathurst Burr	None
Boraginaceae	*Echium plantagineum*	*	Patterson's Curse	None
Cruciferae	*Lepidium campestre*		Pepperwort	None
Cyperaceae	*Cyperus eragrostis*	*	Umbrella Sedge	None
Fabaceae (Faboideae)	*Medicago polymorpha*	*	Burr Medic	None
Fumariaceae	*Fumaria muralis*		Smoke weed	None
Iridaceae	*Romulea rosea var. australis*	*	Onion Grass	None
Juncaceae	*Juncus usitatus*		Common Rush	None
Lamiaceae	*Mentha arvensis?*	*	Wild mint	None
Leguminosae	*Vicia hirsuta*		Hairy vetch	None
Malvaceae	*Malva neglecta*		Pink Mallow	None
Myrtaceae	*Callistemon sieberi*		River bottlebrush	None
Myrtaceae	*Eucalyptus camaldulensis*		River Red Gum	None
Poaceae	*Aristida ramosa*		Purple Wiregrass	None
Poaceae	*Austrostipa spp.*		Speargrass	None
Poaceae	*Avena fatua*	*	Wild Oats	None
Poaceae	*Bromus diandrus*	*	Great Brome	None
Poaceae	*Chloris truncata*		Windmill Grass	None
Poaceae	*Cynodon dactylon*		Common Couch	None
Poaceae	*Dactylis glomerata*	*	Cocksfoot	None

Table 13 (Cont'd) Flora Field Survey Results

Family	Scientific Name	Exotic	Common Name	Listing Status
Poaceae	*Enteropogon acicularis*		Curly Windmill Grass	None
Poaceae	*Hordeum leporinum*	*	Barley Grass	None
Poaceae	*Lolium multiflorum*	*	Italian Ryegrass	None
Poaceae	*Lolium rigidum*	*	Wimmera Ryegrass	None
Poaceae	*Paspalum dilatatum*	*	Paspalum	None
Poaceae	*Panicum coloratum*	*	Blue Panicgrass	None
Poaceae	*Panicium decompositum*		Native millet	None
Poaceae	*Paspalum distichum*		Water Couch	None
Poaceae	*Phalaris aquatica*	*	Phalaris	None
Poaceae	*Austrodanthonia caespitosum*		Ringed Wallaby Grass	None
Polygonaceae	*Acetosella vulgaris*	*	Sheep Sorrel	None
Polygonaceae	*Polygonum erectum*	*	Wireweed	None
Polygonaceae	*Rumex crispus*	*	Curled Dock	None
Rosaceae	*Rubus ulmifolius*	*	Blackberry	None
Solanacea	*Solanum pseudocapiscum*	*	Maideira Winter Cherry	None
Verbenaceae	*Verbena bonariensis*	*	Purpletop vervain	None

Table 14 Terrestrial Fauna Survey Results (Dry Areas - Quarry Surrounds)

Family	Scientific Name	Exotic	Common Name	Listing Status
Falconidae	*Falco cenchroides*		Nankeen Kestrel	NSW - Protected
Alcedinidae	*Todiramphus sanctus*		Sacred Kingfisher	NSW - Protected
Meliphagidae	*Manorina melanocephala*		Noisy Miner	NSW - Protected
Campephagidae	*Coracina novaehollandiae*		Black-faced Cuckoo-shrike	NSW - Protected
Artamidae	*Cracticus tibicen*		Australian Magpie	NSW - Protected
Artamidae	*Strepera graculina*		Pied Currawong	NSW - Protected
Rhipiduridae	*Rhipidura leucophrys*		Willie Wagtail	NSW - Protected
Corvidae	*Corvus coronoides*		Australian Raven	NSW - Protected
Monarchidae	*Grallina cyanoleuca*		Magpie-lark	NSW - Protected
Corcoracidae	*Corcorax melanorhamphos*		White-winged Chough	NSW - Protected
Hirundinidae	*Hirundo neoxena*		Welcome Swallow	NSW - Protected
Hirundinidae	*Petrochelidon ariel*		Fairy Martin	NSW - Protected
Sturnidae	*Sturnus vulgaris*	*	Common Starling	None
Motacillidae	*Anthus novaeseelandiae*		Australian Pipit	NSW - Protected
Cacatuidae	*Cacatua galerita*		Sulphur-crested Cockatoo	NSW - Protected
Cacatuidae	*Eolophus roseicapillus*		Galah	NSW - Protected
Elapidae	*Pseudonaja textilis*		Eastern Brown Snake	NSW - Protected

Table 15 Fauna Survey Results (Nocturnal Surveys)

Family	Scientific Name	Exotic	Common Name	Method	Listing Status
Cervidae	*Cervus elephus*	*	Sambur Deer	Camera	None
Strigidae	*Ninox novaeseelandiae*		Southern Boobook	Heard	NSW - Protected
Tytonidae	*Tyto javanica*		Eastern Barn Owl	Spotlight	NSW - Protected
Pseudocheiridae	*Pseudocheirus peregrinus*		Common Ringtail Possum	Spotlight	NSW - Protected
Phalangeridae	*Trichosurus vulpecula*		Common Brushtail Possum	Spotlight	NSW - Protected
Canidae	*Vulpes*	*	Fox	Camera and spotlight	None
Molossidae	*Austronomus australis*		White-striped Freetail-bat	Anabat recording	NSW - Protected
Molossidae	*Mormopterus (Ozimops) planiceps*		Little Mastiff-bat	Anabat recording 1-6/03/18	NSW - Protected
Molossidae	*Mormopterus (Ozimops) ridei*		Eastern (Ride's) Free-tailed Bat	Anabat recording 1-6/03/19	NSW - Protected
Vespertilionidae	*Chalinolobus gouldii*		Gould's Wattled Bat	Anabat recording 1-6/03/20	NSW - Protected
Vespertilionidae	*Chalinolobus morio*		Chocolate Wattled Bat	Anabat recording 1-6/03/21	NSW - Protected
Vespertilionidae	*Scotorepens balstoni*		Inland Broad-nosed Bat	Anabat recording 1-6/03/22	NSW - Protected
Vespertilionidae	*Vespadelus darlingtoni*		Large Forest Bat	Anabat recording 1-6/03/23	NSW - Protected
Vespertilionidae	*Vespadelus vulturnus*		Little Forest Bat	Anabat recording 1-6/03/24	NSW - Protected
Vespertilionidae	*Scotorepens greyii*		Little Broadnosed Bat	Anabat recording 1-6/03/25	NSW - Protected
Macropodidae	*Macropus giganteus*		Eastern Grey Kangaroo	Camera and spotlight	NSW - Protected

Table 16 Fauna Survey Results (Wetland Survey)

Family	Scientific Name	Exotic	Common Name	Listing Status
Anatidae	*Anas gracilis*		Grey Teal	NSW - Protected
Anatidae	*Anas superciliosa*		Pacific Black Duck	NSW - Protected
	Chenonetta jubata		Australian Wood Duck	NSW - Protected
Anatidae	*Tadorna tadornoides*		Mountain Duck	NSW - Protected
Podicipedidae	*Tachybaptus novaehollandiae*		Australasian Grebe	NSW - Protected
Columbidae	*Ocyphaps lophotes*		Crested Pigeon	NSW - Protected

Table 16 (Cont'd) Fauna Survey Results (Wetland Survey)

Family	Scientific Name	Exotic	Common Name	Listing Status
Phalacrocoracidae	*Microcarbo melanoleucos*		Little Pied Cormorant	NSW - Protected
Phalacrocoracidae	*Phalacrocorax sulcirostris*		Little Black Cormorant	NSW - Protected
Phalacrocoracidae	*Phalacrocorax varius*		Pied Cormorant	NSW - Protected
Pelecanidae	*Pelecanus conspicillatus*		Australian Pelican	NSW - Protected
Ardeidae	*Ardea modesta*		Eastern Great Egret	NSW - Protected
Ardeidae	*Ardea pacifica*		White-necked Heron	NSW - Protected
Ardeidae	*Egretta novaehollandiae*		White-faced Heron	NSW - Protected
Threskiornithidae	*Platalea flavipes*		Yellow-billed Spoonbill	NSW - Protected
Threskiornithidae	*Threskiornis molucca*		Australian White Ibis	NSW - Protected
Accipitridae	*Haliastur sphenurus*		Whistling Kite	NSW - Protected
Myobatrachidae	*Crinia parinsignifera*		Eastern Sign-bearing Froglet	NSW - Protected
Myobatrachidae	*Crinia parinsignifera*		Common eastern froglet	NSW - Protected
Pelodryadidae	*Litoria verreauxii*		Whistling Tree Frog	NSW - Protected
Myobatrachidae	*Limnodynastes peronii*		Brown-striped Frog	NSW - Protected
Myobatrachidae	*Limnodynastes tasmaniensis*		Spotted Grass Frog	NSW - Protected
Myobatrachidae	*Limnodynastes dumerilii*		Eastern Banjo Frog	NSW - Protected

3.4 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment and Biodiversity Conservation (EPBC) Act 1999* contains a list of threatened and migratory species together with ecological communities. A EPBC Act Protected Matters Report (**Appendix 5**) was generated for the Quarry Site and indicated that it is possible that there are many listed species that could occur in the area, however the desktop search and discussions with local sources of relevant information indicate that the three most likely EPBC species are the Sloane's froglet (*Crinia sloanei*) the Spotted Tailed Quoll (*Dasyurus maculatus*), the Superb Parrot (*Polyteis swainsonii*) and the wetland plant Austral Pillwort (*Pilularia novae-hollandiae*). If there is the potential for a significant impact on nationally threatened species or communities, or listed migratory species then under the Act a referral to the Minister should be considered.

The Spotted Tailed Quoll is listed as endangered under the Commonwealth *EPBC Act 1999.* It is possible that it could be resident in the area or transit the area. The Superb Parrot is listed as vulnerable under the *EPBC Act 1999* and has been recorded in the Howlong locality.

Neither the Quarry Site nor its associated activities constitute a key threatening process, as listed in the Commonwealth *EPBC Act 1999* or are likely to have a significant impact on nationally threatened species or communities.

The development and associated activities within the property pose no identified threats to flightpath integrity for threatened species of bat or birds. Any species present are likely to be overflying site activities.

A letter from the then Commonwealth Department of the Environment and Energy (now DAWE) (dated 4 May 2018) is provided as **Appendix 5**. The outcomes of this consultation were that based on the information presented, DAWE did not intend to request that the proposed action be referred. Since this correspondence was received it is noted that the Sloane's Froglet has been listed as endangered under the EPBC Act.

Given that impacts associated with the Project would be limited to minor vegetation clearing, it is not considered likely that a significant impact to threatened species would occur. In fact, the progressive development of wetland areas may provide future suitable habitat for these species.

4. Assessment of Environmental Impacts

4.1 Potential Threatened Species Impacts

Impact assessment for biodiversity values and development of appropriate recommendations applies the avoid, minimise and offset hierarchy and requires assessment of direct and indirect impacts associated with the proposed activities on the Quarry Site. It also provides the calculation of offset requirements for all residual impacts of the Quarry Site.

In considering the environmental impacts of the development two focus areas are covered in the ground search and investigations, these being the immediate 'Quarry Site' and the wider Study Area which takes in the area within 1,500 m of the actual Quarry Site. In assessing the potential for threatened species being present, the desktop search area was expanded to approximately 10 km from the Quarry Site.

The possible environmental impact activities relevant to flora and fauna include:

1. Extraction area development and use of processing, stockpiling and loading areas;
2. Bridge refurbishment; Noise and dust from trucks and processing;
3. Clearing of small vegetation patches and isolated trees;
4. Construction of new levee banks;
5. Infill of part of Stage 1 to form part of the 100 m Murray River buffer; and
6. The Haul Road.

4.1.1 Pit Development and Use of Processing, Stockpiling and Loading Area

Fraser Construction Earthmoving maintain a policy of avoiding and, where necessary, minimising environmental impacts associated with the development of the site. The proposed extension includes the stockpiling and loading areas located within the existing disturbance footprint and disturbance of areas entirely within land that has been previously used for irrigated dairy production and cropping. In addition, there is a plan to reinstate and protect substantial areas of wetlands within and close to the Quarry Site.

Figure 4 and **Figure 16** present the area of intended vegetation clearing for the Project (total of 1.1ha) which will include predominantly introduced grasses and forbes and two Red gums (no hollows). Potential indirect impacts associated with Quarry operations includes the following.

- Noise or dust from machinery impacting vegetation in areas adjacent to the Quarry.
- Inadvertent damage to vegetation in areas adjacent to the Quarry.
- Transport of weeds and pathogens from the Quarry Site into vegetation in areas adjacent to the Quarry.

- Animal strike from road transport vehicles or machinery.
- Increase in risk of feral animal presence where these species are attracted to operating areas.
- Increased risk of bushfire in areas adjacent to the Quarry.

4.1.2 Bridge Refurbishment

Recommendations in relation to the bridge refurbishment and eventual replacement were suggested by an engineering consultant (Street, 2017). The Applicant has accepted the need to undertake these remedial works for ongoing operations.

These works may result in indirect impacts to flora and fauna in the vicinity of the bridge.

4.1.3 Clearing of Small Vegetation Patches and Isolated Trees

An area of approximately 1.1 ha will be cleared including two red gums (**Figure 16**, **Figure 17** and **Figure 18**). The ground cover less than 25 % native grasses and forbs. The area has been highly disturbed in the past as a result of farm equipment and hay being stored on much of the site.

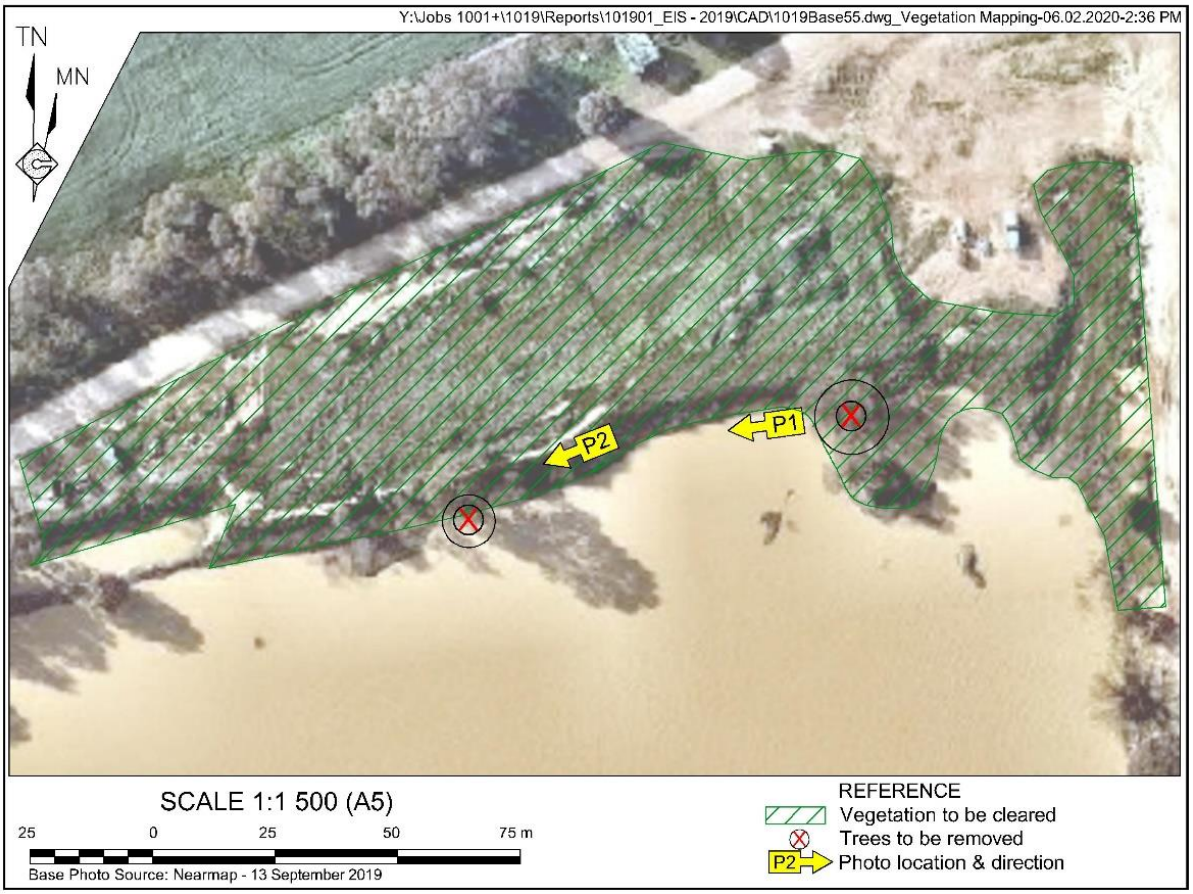


Figure 16 Area to be cleared (~1.1 ha) with Red Gum (*E.camaldulensis*) polygons marked as circles

Figure 17 View west of area to be cleared (P1)

Figure 18 View vegetation to be removed (P2)

4.1.4 Construction of new levee banks

New levee banks are to be constructed around the perimeter of the four stages of the development (**Figure 19**). The levee banks will prevent the ingress of water during flood events and to prevent any materials being washed down stream. As detailed in flood modelling contained in the EIS, levee banks will be constructed to a height of 142.7 m AHD.

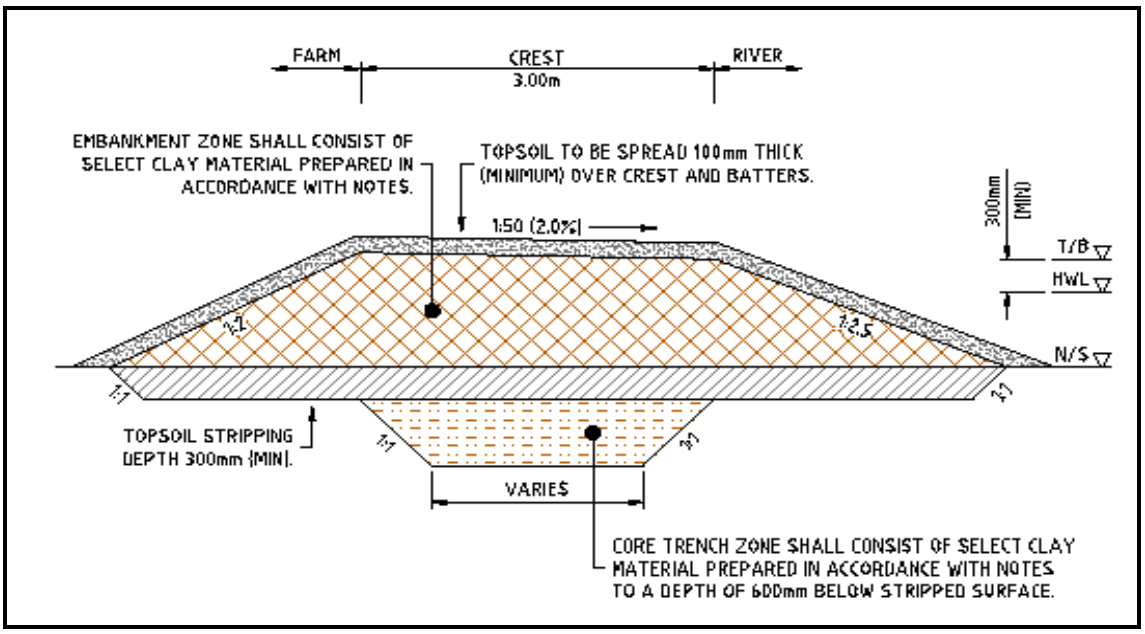


Figure 19 Levee bank profile (not to scale)

4.1.5 Creating a 100 m Buffer to the Murray River

The creation of a buffer between operations and the Murray River would reduce water incursions that currently occur from the river when it is at high flow to supply local and downstream irrigation requirements.

The various stages (1 - 4) of the Quarry Site would be excavated to a maximum elevation of 119m AHD and progressively rehabilitated.

Under the Project, all runoff will be contained within the Quarry Site by levees set to a height above the 1:100 year flood level. The pits will be pumped out by transferring water from one side of the dividing bank to the other (i.e. Stage 1 will be pumped into Stage 2 water storage and vice versa at a later date). The fines that are generated from the gravel and sand sorting process would be used together with some of the overburden material (clay material at 0.2 - 3 m depth) from stages 3 and 4 to fill the south east corner of Stage 1. Thus an adequate buffer can be created which will reduce the chances of the river making an incursion into the pit area and causing potential issues with water quality downstream.

4.1.6 The Haul Road

The haul road is used to convey sand and gravel from the processing area a distance of 2 km to the Murray Valley Highway. The road is approximately 10 to 12 m in width to allow trucks to safely pass in either direction (see **Figure 20**). The road crosses through cropping land that was previously used for irrigated dairy production. There are 17 old Red gums (*Eucalyptus camaldulensis*) that are located in the vicinity of the road.

All the paddock trees within close proximity to the haul road were assessed for hollows. The size and height of the trees meant that the size of some of the hollows could not always be determined with certainty. All the old trees are assumed to have some hollows that may provide habitat to various fauna species (Nesting birds, bats, and reptiles). As these trees would not be disturbed for the Project, detailed assessment of this vegetation is not required.

The access road has been located to avoid the Structural Root Zone of the all remnant trees, although the Tree Protection Zone (TPZ) is partly compromised in a few instances. This was the best option that could be implemented and has substantially less impact than would have been the case with using the original road alignment.

Vegetation and resident fauna along the haul road may be subject to indirect impacts such as noise and dust generation, however, trees near the haul road are not subject to significant disturbance because of the low travel speed of the trucks (<40 km/hr) and smooth road surface that eliminates the 'rattle' of empty trailers. Dust is not a significant issue because the road is wet down throughout summer and at other times as required. Specific measures to ensure the protection of wildlife are outlined in Section 7. Noise levels across the site would be monitored at least annually and deposited dust levels monitored monthly.

Figure 20 Haul road constructed in cropping land to avoid impacts on remnant red gums

4.2 Prescribed and Other Impacts on the Habitat of Threatened Species or Ecological Communities

Consideration was given to the presence of:

- Rocks, karst, caves, crevices, cliffs and other geological features of significance;
- Human made structures and non-native vegetation.

In this instance there are no geological features of significance. Non-native vegetation consists of a few introduced tree species, but mostly introduced weeds and pasture species, including lucerne.

The quarry pits and water therein could be considered human made structures. Their relevance is discussed in Section 4.6.3, but there is no detrimental prescribed or other impacts arising from their presence in relation to the habitat of threatened species or ecological communities. The reconstruction of existing and installation of new levees will ensure that potential water quality impacts on the river system do not occur. The net impact of events beyond a 1:100 year flood are of insignificant consequence compared to the impacts arising from other sources, such as river bank and road surface erosion across the wider Hume Catchment.

4.3 Impact to Threatened Species Abundance and Movement

Threatened species abundance relates to the occurrence and abundance of threatened species or threatened ecological communities, or their habitat, at a particular site.

Threatened species movement is the degree to which a particular site contributes to the movement of threatened species to maintain their lifestyle.

Table 17 presents a summary of the identified abundances of species credit species and habitat presence identified through desktop review and field survey. The following subsections present a summary assessment of abundance and potential movement of species credit species within the Quarry Site.

Sloane's Froglet (*Crinia sloanei*) has been recorded from widely scattered sites in the floodplains of the Murray-Darling Basin, with the majority of records in the Darling Riverine Plains, NSW South Western Slopes and Riverina bioregions in New South Wales. Sloane's Froglet has not been recorded recently in the northern part of its range and has only been recorded infrequently in the southern part of its range in NSW. **Figure 22** presents the records for the local area and **Figure 22** presents key management areas for the species.

Table 17 Species Credit Species abundance

Common Name	Species Name	NSW status (TSC Act)	Comm. Status (EPBC Act)	Likelihood of habitat occurrence	Abundance within Quarry Site	Abundance in locality (~10 km)
Fauna						
Sloane's Froglet	*Crinia Sloanei*	Vulnerable	Endangered	Possible	Not observed	Five records
Large (Eastern) Bentwing-bat	*Miniopterus orianae oceanensis*	Vulnerable		Unlikely	Not observed	One record
Spotted Tailed Quoll	*Dasyurus maculatus*	Vulnerable	Endangered	Possible	Not observed	One record
White bellied Sea Eagle	*Haliaeetus leucogaster*	Vulnerable		Likely	Not observed	One record
Flora						
Austral Pillwort	*Pilularia novae-hollandiae*	Endangered		Possible	Not observed	No record

Abundance

At a number of sites where records are verified by museum specimens, the species has not been subsequently detected during more recent frog surveys in the vicinity (e.g. Holbrook, Nyngan, Wagga Wagga and Tocumwal). The low number of sites, low number of recorded individuals per site, and the low proportion of records of this species in regional surveys all indicate that a moderately low number of mature individuals exist. The apparent loss from previous recorded sites and decline in recording rates indicates that this is not just a rare or uncommonly encountered species, but that there has been a reduction in population size and range. The reasons for the decline could be manyfold, including seasonal conditions (rainfall, temperature and timing of climatic events) as well as urbanisation resulting in habitat destruction. The Amphibian Research Centre (Frogs.org.au) indicates that Sloane's Froglet uses logs and other debris for shelter and calls from the water supported by vegetation. The shortage of debris and floating vegetation at the Study Area may explain the reasons why the species has not been readily observed.

Calls are generally only heard from May to November, so despite recordings being conducted, its presence or absence is difficult to determine. According to Hunter and Waudby (2017) important populations exist on the outskirts of Corowa and Albury. In addition, the NSW OEH BioNet (2018) indicates that there are records both east and west of the study site.

Threats include:

- Habitat fragmentation due to clearing and grazing;
- Habitat destruction due to urbanisation and firewood gathering.

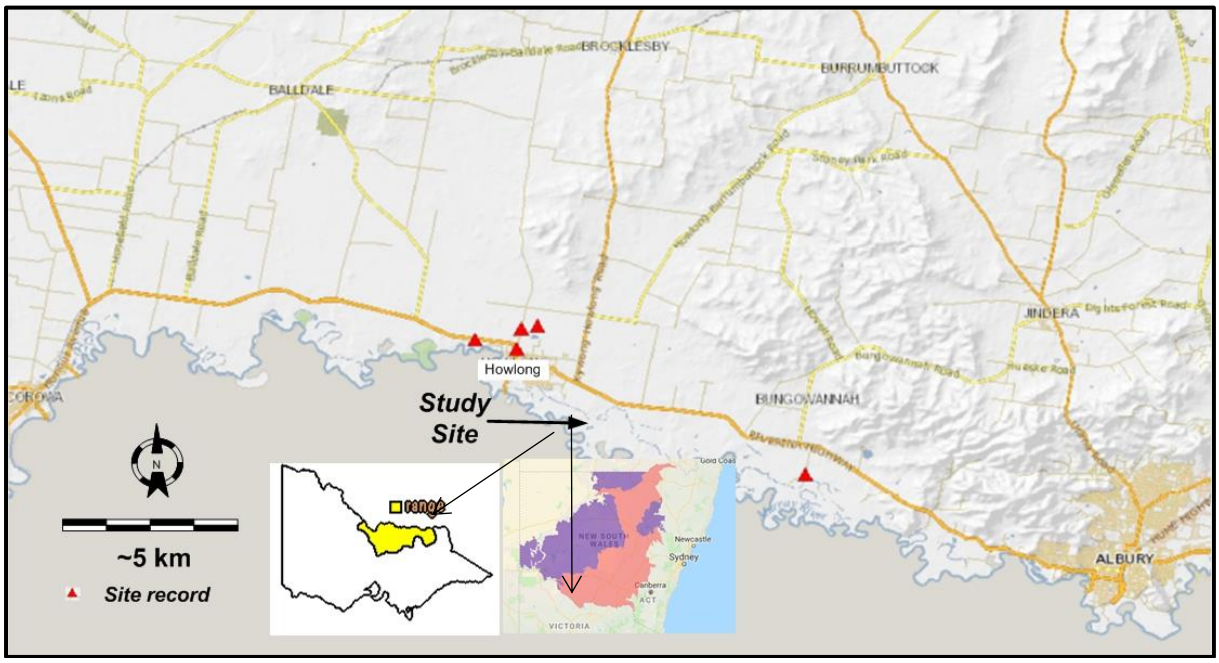


Figure 21 Records and extent of populations of Sloane's Froglet in the Howlong area and in NSW (Red – known, Purple –predicted) and Victoria (Yellow)

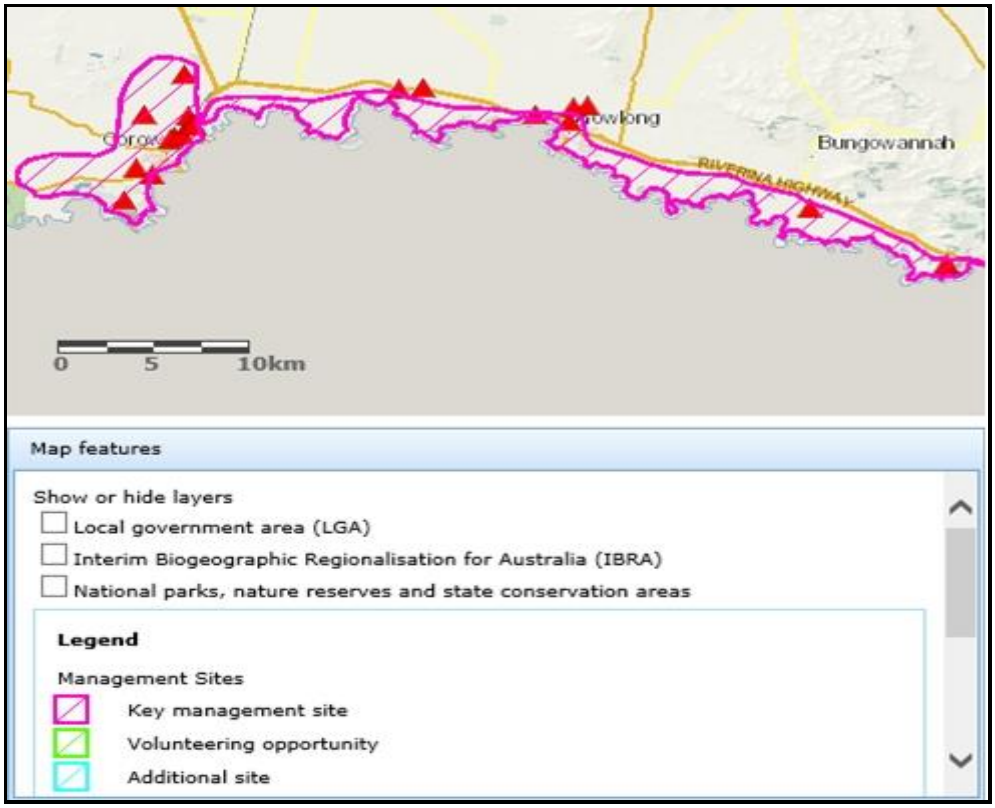


Figure 22 Key management sites (hatched areas) and recorded presence (Red triangles) for Sloane's Froglet (OEH 2018)

Movement

Sloane's Froglet is probably very mobile if there is adequate or above average rainfall that generates runoff. Inundation is important for the movement of frogs across the landscape. It has been reported that ponds are used like stepping stones in the Thurgoona area near Albury (Knight 2014) and that autumn rain is also important in the movement and breeding cycle of Sloane's Froglet. Failure of the 2018 autumn break would no doubt be a factor in the failure to observe the species.

Impact

The species population and even individuals would not be expected to be significantly impacted by the proposed quarrying activities since the species is not reliant solely on the Quarry Site for breeding habitat and food sources. The existing man-made lakes (**Figures 3 and 4**) are not the most suitable habitat for the froglet because it relies on shallow areas with a wetting and drying regime. Moreover, similar degraded water bodies have been classed as unsuitable because of the lack of aquatic plant life that the froglet relies on for breeding (Knight 2014).

Importantly, a program of progressive rehabilitation and revegetation of existing nearby natural wetlands habitat and exposed drainage lines would protect and enhance habitat availability for the froglet.

Hunter and Waudby (2017) have indicated that maintaining a network of large and connected wetlands is critical to ensure that remaining Sloane's froglet populations are viable in the long term. Across the property Study Area there will be new wetlands developed that will be designed to suitable depths and appropriately stocked with aquatic plants that will facilitate breeding conditions for the Sloan's Froglet, thus ensuring that if there is a local population it remains viable.

Site activities planned to assist the species

It should be taken into account that revegetation will incorporate a range of habitat types, including unshaded areas for froglet habitat as well as litter and log debris distributed around wetland areas.

White-bellied Sea Eagle (*Haliaeetus leucogaster*)

The white-bellied sea eagle is an opportunistic carnivore and consumes a wide variety of animal prey and has been observed by the author in other locations eating carrion. It prepares for the strike by holding its feet far forward (almost under its chin) and then strikes backwards while simultaneously beating its wings to lift upwards. The white-bellied sea eagle may also dive from its perch and briefly submerge to catch fish near the water surface (Marchant and Higgins 1993).

Abundance

The White-bellied Sea Eagle is distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin (**Figure 23**). In New South Wales it is widespread along the east coast and along all major inland rivers and waterways. White-bellied sea eagles are reportedly rare along the Murray River where it was once common (OEH 2018). The birds have been reported to catch fish, water-dwelling reptiles such as the eastern long-necked turtle and Australian water dragon, and water birds such as ducks, grebes and coots (DSE 2011).

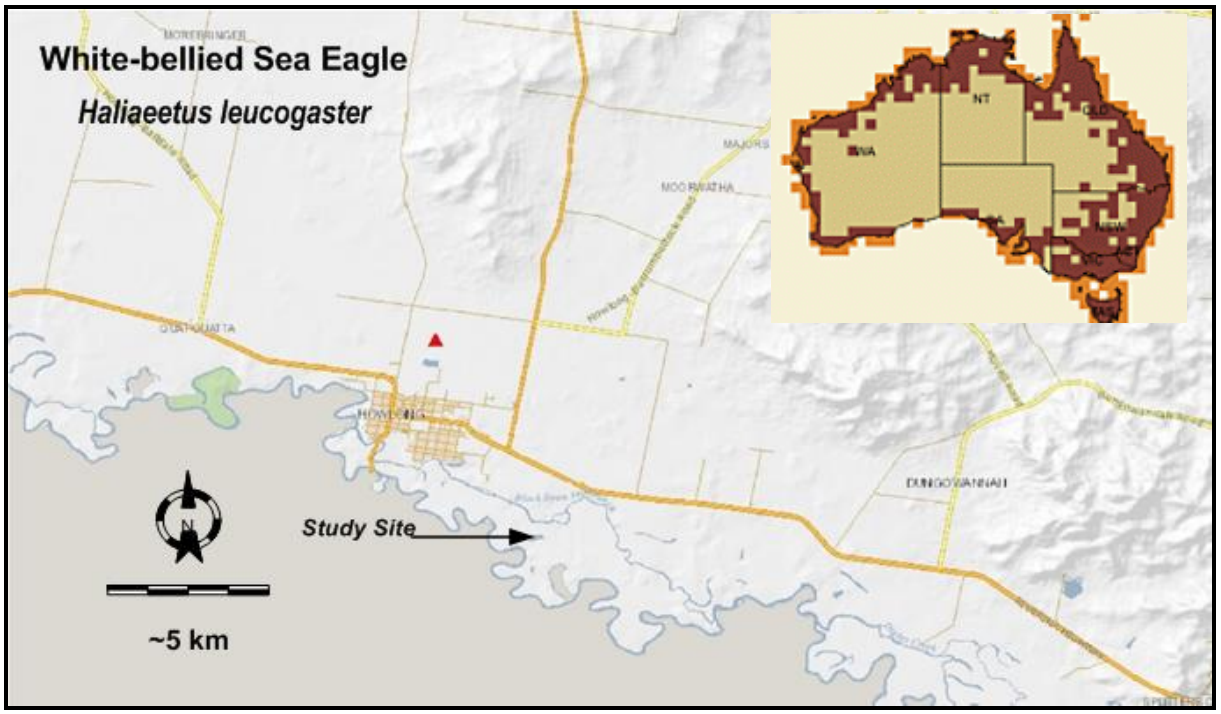


Figure 23 Record of occurrence of White –bellied Sea Eagle in the Howlong area and Australian distribution (dark brown pixels) (NSW BioNet Atlas 2018. Australian distribution maps - Birds in Backyards 2018)

Movement

The birds are generally sedentary and territorial but have been reported to travel long distance and may move around in search of waterbodies as some areas dry up. Young birds generally disperse more than 50 km from the parent site (Marchant and Higgins 1993).

Impact

Quarry activities on the species and even individuals from the specific quarry activities will be insignificant.

Site activities planned to assist the species

In the unlikely event that any nesting occurs close to the activity site, prescriptions will be put in place to ensure adequate protection for the species and the surrounding habitat.

Spotted Tailed Quoll *(Dasyurus maculatus)* has been recorded across a range of habitat types, including inland riparian forest (OEH Website 2018) and are sometimes seen in open country, or on grazed areas and rocky outcrops. They are mainly solitary animals, and will make their dens in rock shelters, small caves, hollow logs and tree hollows. They use these dens for shelter and to raise young.

The Spotted Tailed Quoll is a generalist predator with a preference for medium-sized (500 g to 5 kg) mammals. Quolls consume a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits, reptiles and insects as well as carrion and domestic fowl. Quolls are mostly nocturnal, although they will hunt during the day.

Abundance

The numbers of Spotted Tailed Quolls in the area, based on recorded sightings would seem to be very few. The number of sightings drops off substantially across the western plains and away from the foothills and higher elevation ranges (see **Figure 24**). Two sets of wildlife cameras placed about 1 km apart, along the riparian zone of the river recording from 24th March to 7th April did not record any quolls.

Movement

Although quolls spend most of the time roaming and hunting on the ground, they also climb trees to hunt possums and gliders in tree hollows and prey on roosting birds. They can move up to several kilometres in a night and may have quite large territories. Within their territories, they will have latrine sites where they defecate. These are often in exposed areas, such as on rocky outcrops, rocky stream beds or banks. Such sites may be visited by multiple individuals and can be recognised by the accumulation of the sometimes characteristic ‘twisty-shaped’ faeces deposited by animals.

The quolls have been recorded across a range of habitat types, including inland riparian forest as far west as Boundary Bend.

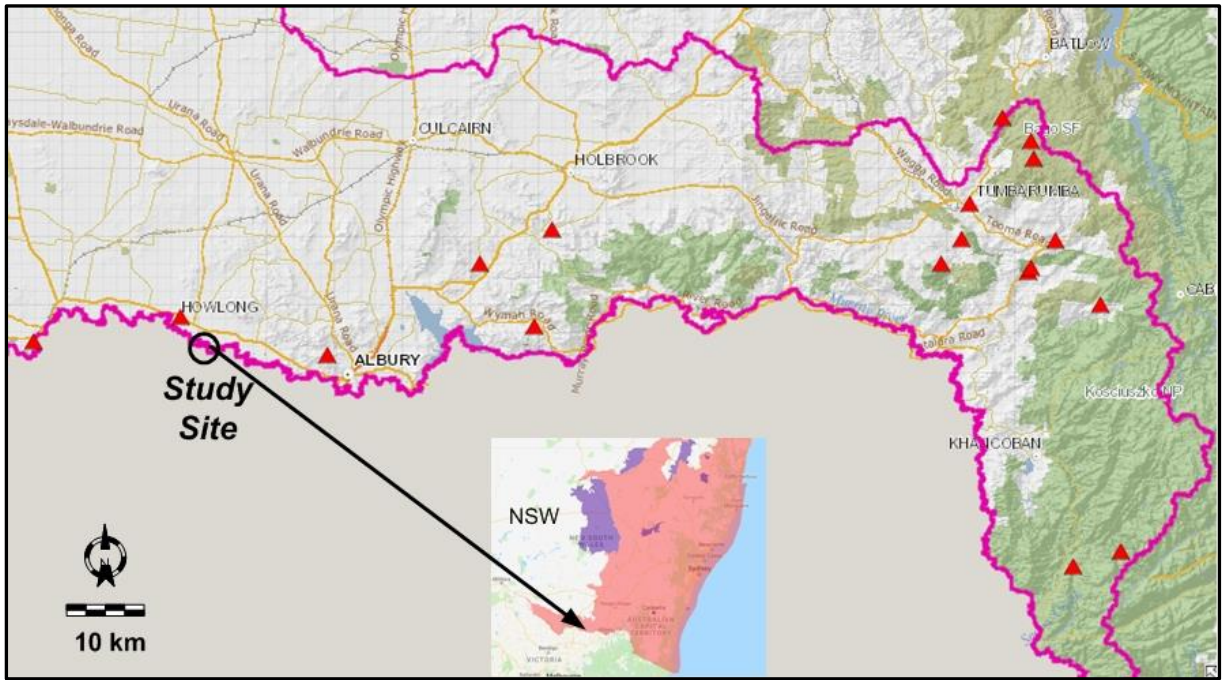


Figure 24 Spotted Tailed Quoll local extent

(Site west of Howlong is western extent listed in the BioNet Atlas 2018)

Females occupy home ranges up to about 750 ha and males up to 3,500 ha. They are known to traverse their home ranges along densely vegetated riparian corridors (OEH Website 2018). The vegetation along the Murray River corridor is a likely conduit for their movement rather than traversing open woodland onto higher ground where food sources are likely to be scarce.

Impact

In relation to quolls, the quarry activities are not significant, either to any local population, the species or individuals because of the largely nocturnal habitat of the quoll and its preference for well vegetated areas (away from the activity area).

Site activities planned to assist the species

In the unlikely event that any quolls were discovered close to the site then site prescriptions will be put in place to ensure adequate protection for the species and their surrounding habitat. This may include key ecological attributes being developed and improved to facilitate population growth in accord with the National Recovery Plan.

Large (Eastern) Bentwing Bats (*Miniopterus orianae oceanensis)* and **Southern Myotis** *(Myotis macropus)* use caves as their primary roosting habitat, they also use derelict mines, storm-water tunnels, buildings and other man-made structures. Anabat recordings over six nights indicated no calls were definitively from Large Bentwing Bats or Southern Myotis. In the case of the Eastern Bentwing Bat, many calls were very similar to the Large Forest Bat (*Vespadelus darlingtoni*) (Pers. Comm. Ford 2018).

Abundance

Based on there being only one record of the Large Bentwing Bat near Howlong and no positive recordings from the site during the survey, it appears that the species is not abundant in the area.

The Southern Myotis *(M. macropus)* is known to occur along the Murray River (**Figure 25**). It was not recorded during survey of the Quarry Site.

Movement

Eastern Bentwing Bats hunt in forested areas, catching moths and other flying insects above the tree tops. They use maternity caves that have very specific temperature and humidity regimes and outside of the breeding season (spring and summer) populations disperse within about 300 km range of maternity caves (OEH Website 2018).

The Southern Myotis may forage over farm dams such as those nearby to the detector location.

Impacts

Quarry activities and their impact on the Eastern Bentwing Bat and Southern Myotis populations do not represent any threat and are therefore not significant because there is no (known) breeding area close by and they predominantly feed over forested areas dusk/twilight and during the night. Moreover, since they are twilight and night feeders that will not be impacted by extraction activities.

Site activities planned to assist the species

In the event that any Eastern Bentwing Bats or Southern Myotis were discovered close to the site then site prescriptions and appropriate actions will be conducted to ensure adequate protection for the species and their habitat.

Figure 25 Record of the Eastern Bentwing Bat (*Miniopterus Schreibersii oceanensis)*in the Howlong area

Regent Honeyeater (*Anthochaera Phrygia*)

Abundance

The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. The species can also be found in drier coastal woodlands and forests in some years. Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests. The species has not been recorded within 10 km of the Quarry Site (NSW OEH BioNet, 2018).

Impact

Any impacts on the species and even individuals from the specific quarry activities would be insignificant since the species is not reliant on the specific area for food sources and potential habitat surrounding the Quarry Site will be retained, extended and protected. There are no breeding sites in the vicinity and there is no Serious and Irreversible Impacts likely (OE& H mapping enquiry Dec 2018).

Activities to assist the species

Retain, protect and extend nesting and foraging habitat with revegetation and retention of remnant Red gums.

Movement

If present, the species could forage widely across the broader areas of woodland and possible open grassy floodplain and Grey Box areas when various tree species are flowering. In the last 10 years Regent Honeyeaters have been recorded in urban areas around Albury where woodlands tree species such as Mugga Ironbark and Yellow Box were planted 20 years ago. Colour-banding of Regent Honeyeater has shown that the species can undertake large-scale nomadic movements in the order of hundreds of kilometres. However, the exact nature of these movements is still poorly understood. It is likely that movements are dependent on spatial and temporal flowering and other resource patterns. To successfully manage the recovery of this species a full understanding of the habitats used in the non-breeding season is critical (NSW OEH BioNet, 2018).

Site activities planned to assist the species

The preferred habitat and tree species (Box – Ironbark) is unsuited to establishment on the floodplain. However retention and expansion of vegetation on and around the Quarry Site may facilitate the transit of the species to Grey Box (*E. microcarpa*) areas on the hillslopes to the north.

Swift Parrot (*Lathamus discolour*)

Abundance

The Swift Parrot has not been recorded within 10 km of the Quarry Site.

Impact

Any impacts on the species and even individuals from the specific quarry activities would be insignificant since the species is not reliant on the specific area for food sources and potential habitat surrounding the Quarry Site will be retained, extended and protected.

Movement

The birds breed in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes.

Site activities planned to assist the species

The preferred habitat and tree species (Box – Ironbark) is unsuited to establishment on the floodplain. However retention and expansion of vegetation on and around the Quarry Site may facilitate the transit of the species to used lerp infested Grey Box (*E. microcarpa*) areas on the hillslopes to the north.

Square-tailed Kite (*Lophoictinia isura*)

Abundance

Square-tailed Kites are found in a variety of timbered habitats including dry woodlands and open forests. They show a particular preference for timbered watercourses.

Impact

Any impacts on the species and even individuals from the specific quarry activities would be insignificant, given the low level of habitat disturbance and extensive areas available for hunting.

Movement

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

Activities to assist the species

Potential nesting and foraging habitat will be retained, protected and extended with revegetation and retention of remnant Red gums. In the event that any nesting activity were to occur close to the activity site, prescriptions will be put in place to ensure adequate protection for the species and the surrounding habitat.

Brush-tailed Phascogale (*Phascogale tapoatafa*) (Vulnerable)

Abundance

The species has not been recorded within 10 km of the Quarry Site. The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide.

Impact

Any impacts on the species and even individuals from the specific quarry activities would be insignificant, given the low level of habitat disturbance and extensive corridor areas available for foraging and potentially nesting.

Movement

The species prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. They also inhabit heath, swamps, rainforest and wet sclerophyll forest. Brush-tailed Phascogales are reported to be agile climbers foraging preferentially in rough barked trees of 25 cm DBH or greater. Females have exclusive territories of approximately 200 ha, while males have overlapping territories often greater than 100 ha.

Site activities planned to assist the species

Retaining, protecting and extending nesting and foraging habitat with revegetation and retention of remnant Red gums will enhance any species establishment in the area. In the event that any nesting activity were to occur close to the activity site, prescriptions will be put in place to ensure adequate protection for the species and the surrounding habitat.

Austral Pillwort (Pilularia novae-hollandiae)

Abundance

Austral Pillwort *Pilularia novae-hollandiae*) has been not been identified as being present at the Quarry Site, but it is possible that some populations could be in, or develop in the area with the variation that can occur in seasons and hydrology together with land and water management from irrigation and/or flood control (e.g. Hume dam overflows). **Figure 26** presents the known records of the species in the local area.

Threats to Austral Pillwort include:

- Drainage of swamps;
- Roadside populations may be threatened by roadworks;
- Rye grass and other grasses out-competing the species.

Impacts

A flood levee will be constructed to limit potential flood incursion and also retain runoff within the Quarry Site. The Quarry Site, in its current state, is not considered to be suitable Austral Pillwort habitat and therefore the development will have no impact on the species.

Site activities planned to assist the species

The quarry development and resulting rehabilitation program has the opportunity to encourage the growth of the species by extending the area of wetlands across the site.

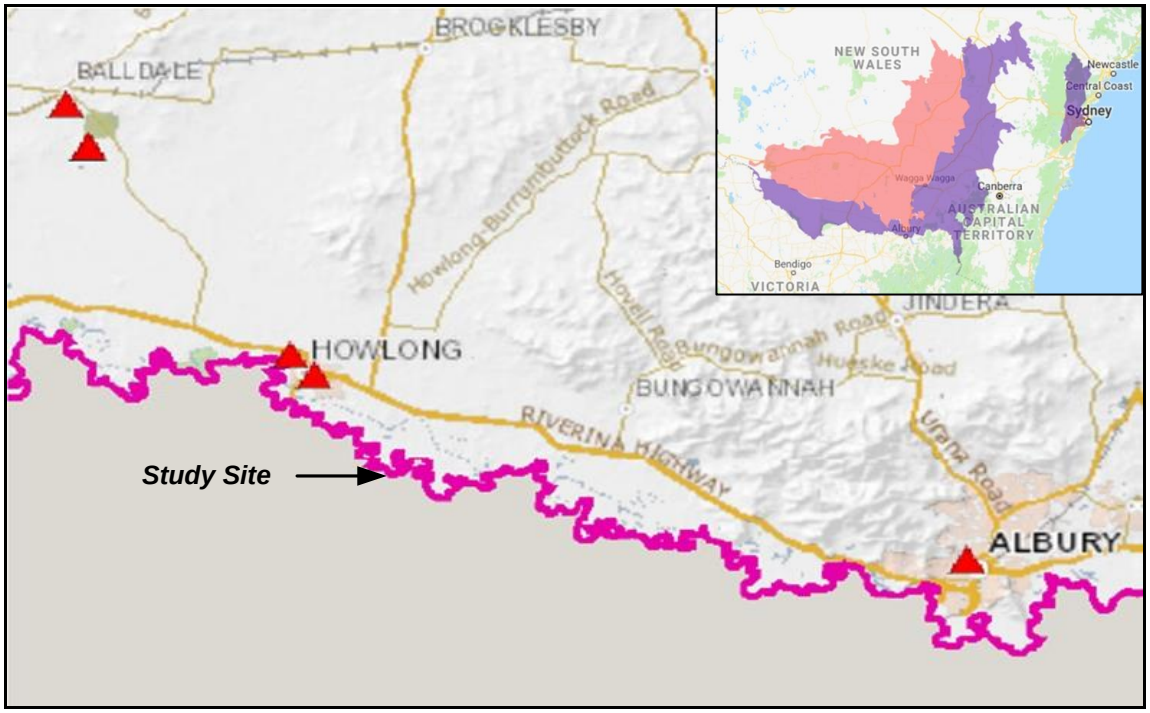


Figure 26 Austral Pillwort records in the Howlong – Albury district (NSW Inset map Red – known, Purple –predicted)

Small Scurf Pea (*Cullen parvum*)

Although not recorded in the Howlong local area the species was nonetheless included in the threatened species search list because of the potential for suitable habitat and presence in some wetter seasons.

Abundance

The Small Scurf-pea has not been recorded within 10 km of the Quarry Site and is known in NSW from only two herbarium collections; one from Wagga Wagga in 1884 and the other from Jindera (near Albury) in 1967. A small population was recently reported from near Jerilderie (although it has not been relocated). In recent years, two populations have been recorded in travelling stock reserves south-west of Wagga Wagga, and a population reputedly exists on a roadside near Galong. Another population has recently been discovered on private land near Young. Large populations have been recorded in grassy gaps in the Red Gum Woodlands of Barmah State Park, just across the border in Victoria. Extensive suitable habitat probably occurs in NSW (NSW OEH BioNet, 2018).

Impact

There is the possibility the Small Scurf Pea could occur in areas surrounding the Quarry Site (e.g. PCT 5), but those area are not subject to quarry related activities.

Site activities planned to assist the species

If found in future surveys, a management plan will be developed for its protection.

4.4 Impacts on Threatened Species Habitat

There are no activities that will impact threatened species within the Quarry Site. The reasons for this are that there is very little vegetation clearing proposed and the activity is predominantly a daytime operation. Threatened bird and mammal species (if present) such as Little Eagle, Sea Eagles and Spotted Tailed Quoll may use the quarry lakes or surrounds for opportunistic foraging for mammals and fish while the Dusky Wood Swallow and Bent Wing Bat may seek out insects across the area. The quarry footprint and ground cover adjacent the haul road do not constitute a suitable feeding ground for the Superb Parrot, although they may transit the area.

The Project would involve progressive rehabilitation and revegetation works within the Stage 1 extraction area and adjacent to the Quarry Site. The section of the Stage 1 extraction area that is within 100 m of the Murray River will have soil reinstated. Revegetation will complement the existing young cohorts and the few older Red Gum trees located between the existing pit area and the river.

4.5 Additional Potential Biodiversity Impacts

4.5.1 Koala Habitat Protection

The proposed development is located within Federation Council as listed under Schedule 1 of the SEPP (Koala Habitat Protection) 2019, and is therefore considered to be within the known distribution of the Koala (*Phascolarctos cinereus*) within New South Wales. Although the decision making role of Council is altered in the case of a State Significant Development, it is nonetheless important to take the planning requirement into consideration. Furthermore, before granting development consent, a Council is required to consider information prepared by a suitably qualified and experienced person regarding the presence of feed tree species listed under Schedule 2 of SEPP (Koala Habitat Protection) 2019 or the presence of core koala habitat within the subject land.

The proposed development activity area (and surrounds) does not support “core Koala habitat” (i.e. an area of land with a resident population of Koalas, evidenced by attributes such as breeding females and recent sightings of and historical records of a Koala population).

On the adjacent river areas (that is, outside the Quarry disturbance areas) there are patches of vegetation containing River red gums in the overstory that meet the requirements for potential Koala habitat and are listed in Schedule 2 of the SEPP (Koala Habitat Protection) 2019. Areas identified as potential Koala habitat are outside the proposed area to be disturbed for Quarry activities.

Despite several searches conducted over several months no sightings of Koala were recorded for the proposed development activity area or surrounding forested areas. The NSW Bionet Atlas records the closest sighting to be~25 km to the north-west of Howlong (**Figure 27**). More commonly, sightings occur in the Moira and Milawa State Forest, ~100 km to the west of the proposed activity site.

It is therefore considered unlikely that the Project would impact Koala habitat.

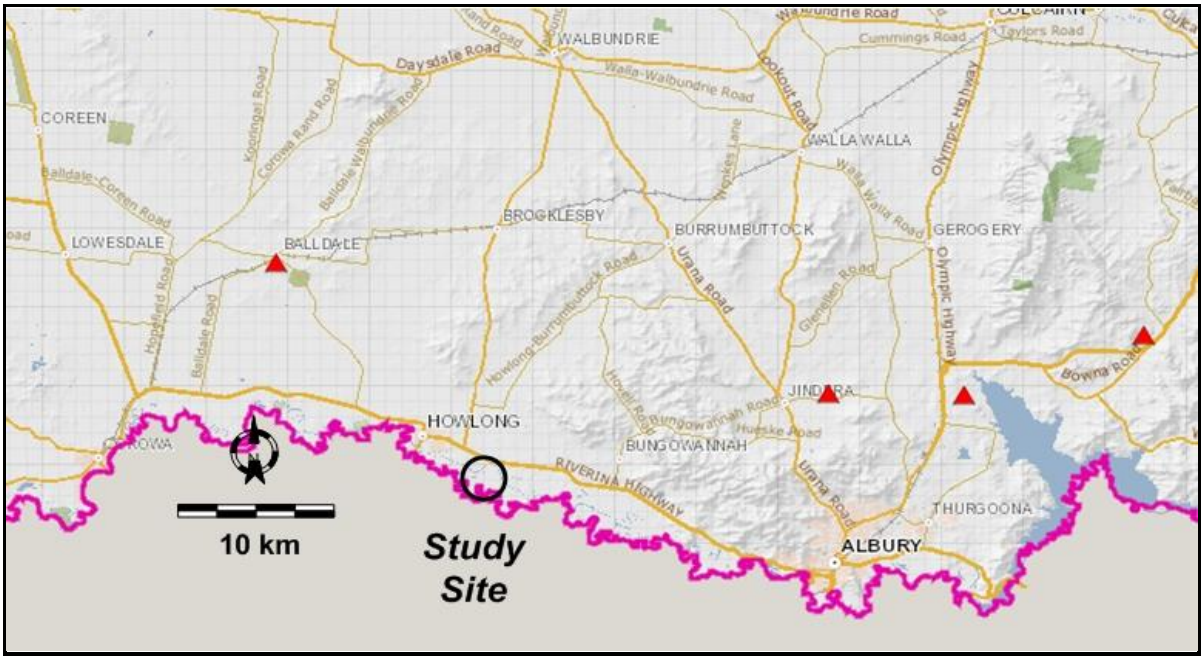


Figure 27 Koala sightings in the Howlong – Albury district

4.5.2 Flight Path Integrity

Flight path integrity is the degree to which the flight paths of protected animals over a particular site are free from interference. Truck movements within the Quarry Site are likely to cause the most significant impacts in relation to flight path integrity.

There are likely to be a maximum of 80 truck movements in and out of the site per day and very occasionally this could include truck movements up until about 10:00pm at night. The daily number of truck movements per day equates to about 6 trucks per hour entering and leaving the site. Trucks travelling on the haul road are limited to 40 km /hr. The probability of road kills of threatened species from the development activity can be considered negligible. Kills from raptors and feral animals is likely to dominate losses of any small bird populations.

4.5.3 Man-made Structures

Waterbodies

Existing operations have created two waterbodies within which rainfall, runoff and groundwater inflow collects in the pits creating two man-made lakes. These lakes may provide a habitat opportunity for Murray Cod (*Maccullochella peeliipeelii*) and other aquatic species such as Yabbies (*Cherax destructor*) and Murray Crayfish (*Euastacus armatus*) that make up the Lower Murray River Endangered Ecological Community. It should be noted that this endangered ecological community includes all native fish and aquatic invertebrates within all "natural" creeks, rivers, and associated lagoons. As such, it might be argued that since the lakes are not natural they do not make up part of the lower Murray River Endangered Ecological Community.

Buildings

A hay shed and pump shed may provide some habitat for threatened species, such as bats. Eastern Bentwing Bats (*Miniopterus schreibersii oceanensis*) and Southern Myotis (*Myotis macropus*) use caves as their primary roosting habitat, they also use derelict mines, storm-water tunnels, buildings and other man-made structures. Neither species was recorded during field surveys within the Study Area.

4.5.4 Water Sustainability

Water sustainability is the degree to which water quality, water bodies and hydrological processes sustain threatened species and threatened ecological communities.

Due to their fine clay texture the surface soils (~1 m depth) may contribute dispersed clay particles to high energy channel and surface flows. During high intensity rainfall events or floods some fine clay particles are suspended and transported. During the majority of rainfall events any overland flow is usually either caught in detention storage amongst vegetation or deposited where water velocity is low. There are no table drains to concentrate water beside the new section of haul road. Runoff from the crowned surface will be absorbed into nearby vegetation cover in the majority of rainfall events.

No additional substantial negative impact on surface and river water quality or water bodies is expected from the proposed activity because any runoff on the Quarry Site (the pits) is contained by levees that prevent surface flow across the wider landscape and to the Murray River.

In relation to levees, these are to be constructed to prevent the pits, including the loading area, from flooding during a 1% AEP flood event (1:100 year flood). Hydrologic modelling indicates the implementation of an adequate levee, when compared to existing levee conditions, could result in a minor increase in water levels up to 4 km upstream of the site.

Water quality around and within the site would be monitored during the life of the Project. In addition, rehabilitation and revegetation works in areas adjacent to the Quarry would serve to reduce channel erosion and turbidity at a localised level.

5. Offset Calculations

Table 18 has been derived from the Biodiversity Assessment Model in which the clearing input was for two Red Gum (E. camaldulensis) trees. It should be noted that a check was made with OE&H species mapping and the area is not within the areas assessed as being of importance (i.e. Serious and Irreversible Impact - SAII) to the Regent Honeyeater and the Swift Parrot.

Table 18 Paddock Tree Offset calculation

Class of Paddock Tree to be cleared	Paddock Trees – No hollows	Total Credits required
Class 3	2	2

6. Mitigating and Managing Impacts and Improving Biodiversity Values

The removal of two trees (less than 0.1 ha of PCT5 vegetation) trees will require the calculation of offset requirements. A total of 2 ecosystem credits will be required to offset the loss of two Red Gums (*E. camaldulensis*).

Detailed information relating to revegetation and improvement of biodiversity values has been provided in the rehabilitation section of the EIS.

The flora and fauna characteristics of the site have been addressed in other sections of this document. The proposed rehabilitation plan is primarily based on the recommendations of Stelling (1998) which detail the vegetation profile for Major's Creek that runs through the site and crosses the Riverina Highway.

The revegetation process will take into account the key elements of the revegetation guide for the area (Stelling, 1998). In particular, achievement of gains in extent and quality of native vegetation are expected through site rehabilitation and revegetation with indigenous species.

6.1 Indigenous Vegetation

The re-instatement of wetlands and revegetation (~40.80 ha, see **Figure 7**) of areas adjacent to the Quarry Site and currently under agricultural land use will assist in enhancing the biodiversity and connectivity of the floodplain. Further consultation will be undertaken with landcare groups and threatened species experts to design appropriate landforms and derive the best possible outcomes for fauna in the area.

Key revegetation activities would include:

- Reinstatement of indigenous vegetation, including wetlands, wherever possible;
- Revegetation of nearby sites that will enhance habitat for threatened species and farm shelter values;
- Conservation, protection and regeneration around old remnants trees;
- Establishing corridors between the Black Swan Anabranch and the Murray River to the north of the site.

Implementation of these measures will achieve multiple rehabilitation objectives in conformity with the NSW vegetation management policy to avoid, minimise and offset any vegetation and fauna impacts.

6.2 Revegetation Species Selection

The plant species sown should be decided in consultation with the Local Land Services and local Landcare groups, but principally follow the recommendations of Stelling (1998) for the Major's Creek area. These revegetation works could be utilised to demonstrate to other landholders in the district the potential to improve the productivity of structurally degraded agricultural land.

Various treatments can be established in the different environments of the site. Some of these could involve:

- Seed treatment: (e.g. smoke, insecticide, lime coating);
- Vegetation removal and replacement procedures;
- The use of fire as a regeneration mechanism;
- The use of soil ameliorants for direct seeding.

Collection operations will need to be carefully timed to coincide with seed availability. Seed material will be securely stored until required for propagation or direct seeding.

As noted previously, the Project will require removal of small patches of largely introduced species of ground cover vegetation and two isolated trees (no hollows) that have been identified as derived PCT 5 or as non-native trees that have been planted on the property. The total vegetation clearing area is estimated to be 1.1ha.

The potential for significant impact to threatened species is limited and no threatened species have been identified within the Quarry Site following comprehensive survey. Nonetheless, the vegetation that would be removed may be used as habitat for a variety of native species. The following measures are recommended to reduce the potential for impact to native flora and fauna and to manage impacts such that any residual impact is limited. The lease site operator is responsible for enforcement of the following mitigation measures.

- Where possible, large habitat trees should be retained in the landform and along the banks of extraction ponds.
- All coarse woody debris should be retained for application in areas under rehabilitation;
- All machinery is to be maintained as per manufacturers specifications;
- Vehicle speed limits are to be strictly adhered to;
- Roads are to be kept moist to avoid dust impacts;
- Any earth moving machinery is to be thoroughly cleaned of seeds and soil before entering of leaving the site;

In addition, food waste generated in staff amenity areas should be carefully managed with sealed containers so as not to encourage pest species to frequent the Quarry Site.

Staff training and induction should also include awareness and procedures relevant to managing the risk of chemical or fuel spills and the risks of bushfire in the local area.

Progress and planning for the reinstatement of a 100m buffer to the Murray River as well as revegetation activities should be recorded and reported annually. A Biodiversity and Rehabilitation Management Plan should be prepared that establishes performance and completion criteria for both revegetation within the Quarry, the proposed revegetation plans adjacent to the Quarry and management of areas within the Quarry that are under rehabilitation. Progress in these areas should be reported annually.

7. Impact Summary

As a result of removing two red gums without hollows and clearing of approximately 1.1 ha of predominantly introduced ground cover, the net impact on PCT 5 River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina will be negligible. Similarly, in relation to threatened species, were they to be present at any time, will also be negligible.

The re-establishment of approximately 60 ha of PCT 5 River Red Gum herbaceous-grassy very tall open forest wetland vegetation, as described in this report and in the EIS Rehabilitation Report, will result in a substantial improvement in biodiversity and create and enhance opportunities for threatened species, such as Sloane's Froglet, to re-establish their presence across the site.

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OEH Website (2018) Austral Pillwort: http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10628

OEH Website (2018) Superb Parrot: http://www.environment.nsw.gov.au/threatenedspeciesapp/profileData.aspx?id=10645&cmaName=Cobar+Peneplain

OEH Website (2018) Spotted Tailed Quoll: http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10207

OEH Website (2018) White Bellied Sea Eagle http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20322

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Appendix 1 Information Resources Used for the BDAR

Australian bird distribution maps - Birds in Backyards 2018.

Office of Environment and Heritage – Biobanking Credit Calculator.

Office of Environment and Heritage - Biodiversity Assessment Method Calculator.

Office of Environment and Heritage - Field Survey Methods.

Office of Environment and Heritage NSW Guide to Surveying Threatened Plants (2016) and related “Field Survey Methods” guidance notes.

Office of Environment and Heritage Biodiversity Assessment Model (BAM) (2017).

Office of Environment and Heritage - NSW BioNet Atlas 2018.

Office of Environment and Heritage – Threatened Species Profile Database.

Appendix 2 Plant Community Type Profile Reports

River Red Gum herbaceous-grassy very tall open forest wetland (PCT 5)

From: Bionet Vegetation Classification (2018)

PCT Common Name: **River Red Gum herbaceous-grassy very tall open forest wetland** on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.

PCT Common Usage Name: PCT 5 - River Red Gum herbaceous-grassy very tall open forest wetland

PCT Scientific Name: Eucalyptus camaldulensis subsp. camaldulensis / Acacia dealbata / Bothriochloa macra, Carex tereticaulis, Lachnagrostis filiformis, Hemarthria uncinata var. uncinata

Data Entry Date: 31/12/2005

Last Modified Date: 15/10/2014

Vegetation Description: Very tall open forest dominated by River Red Gum (Eucalyptus camaldulensis subsp. camaldulensis) with trees averaging about 25 m high and a canopy cover of about 40%. The shrub layer is sparse or absent with Mountain Cedar Wattle (Acacia dealbata) sometimes present. The ground cover may be mid-dense or dense and is dominated by grass species such as snow grass *Poa labillardieri*, Blown Grass (*Lachnagrostis filiformis*) and Mat Grass (*Hemarthria uncinata var. uncinata*) along with sedges such as Carex tereticaulis, Carex inversa and Carex appressa and rushes such as *Juncus amablis* and *Juncus subsecundus. Forb* species include Ranunculus spp., *Persicaria prostrata, Wahlenbergia fluminalis, Pratea concolor* and *Centipeda cunninghamii*.

Weed species may be common and include Bromus hordeaceus, Cirsium vulgare, Vulpia bromoides, Verbena officinalis, Hypochaeris radicata, Lolium perenne, Lolium rigidum and Cyperus eragrostis. Occurs on silty-sandy loam-clay soils on levees or other raised landform elements adjacent to rivers and wetlands. Mainly distributed along the Murray and Murrumbidgee Rivers with small areas on the Lachlan River in the temperate (hot summer) and semi-arid (warm) climate regions of south-western NSW and Victoria. Most common east of Deniliquin and replaced by other River Red Gum floristic types to the west of there. The main threats are dieback from extended drought and lack of flooding regimes due to reduced water flows and flooding, weed

invasion and over-logging. Tree dieback from drought has increased since 2000.

Rainfall: Not Assessed

Elevation: Not Assessed

Emergent species: None

Upper Stratum Species: Eucalyptus camaldulensis subsp. camaldulensis;

Mid Stratum Species: Acacia dealbata; Exocarpos strictus; Amyema miquelii;

Ground Stratum Species: Bothriochloa macra; Lachnagrostis filiformis; Hemarthria uncinata var. uncinata; Carex tereticaulis;

Juncus amabilis; Juncus flavidus; Cynodon dactylon; Carex appressa; Carex inversa; Eleocharis acuta; Eleocharis pusilla;

Persicaria prostrata; Wahlenbergia fluminalis; Centipeda cunninghamii; Pratia concolor; Ranunculus undosus; Juncus subsecundus;

Epilobium billardiereanum subsp. cinereum; Oxalis perennans; Verbena hispida; Austrodanthonia racemosa var. racemosa; Chamaecytisus palmensis; Elymus scaber var. scaber; Elymus scaber var. scaber; Alternanthera denticulata; Pseudoraphis spinescens; Eleocharis acuta; Austrodanthonia caespitosa; Paspalid

Diagnostic Species: Not Assessed

Height Class (Walker & Hopkins 1990): 8 - Range:20.01-35.00m (Very tall)

Vegetation Formation: Forested Wetlands;

Vegetation Class: Inland Riverine Forests;

NSW Landscape Name: Not Assessed

Classification source: Includes communities 3 and 4 with species listed from Table 1.2 in the floristic plot survey along the Murray River by Smith & Smith (1990). Mapped along the Murray River as part of map unit 1 (Red Gum Forest) in Margules & Partners (1990) and possibly site quality 2 in state forest typing of the Murray River Red Gum forests. Note: that forest typing is about stand quality for forestry and does not necessarily strongly correlate particular floristic assemblages. Similar to community C2.1 in Bos & Lockwood (1996). Probably the River Red Gum forest in Wagga Shire in Priday (2004). On higher ground adjacent to river in the eastern sections of the Murray, Murrumbidgee and perhaps Lachlan Rivers. Extra species noted in Benson

(1999-2009). Note: as of 2005, in NSW, only the Murray River and the Great Cumbung Swamp had been adequately plot sampled to detect floristic variation in River Red Gum communities. Future survey and mapping should attempt to map out or model RRG floristic communities.

Authority: VCA 1.1 - archive

Pre-European Mapped Or Modelled: Mapped or modelled as part of a broader complex

Current Extent Mapped Or Modelled: Mapped as part of a broader complex

Adequacy of plot sampling: Adequate Number of Plots: 0

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IBRA Bioregion: Riverina (30-70%); NSW South Western Slopes (30-70%); Cobar Peneplain (Not known); Murray Darling Depression (Not known);

IBRA Sub-Region: Murrumbidgee (1-30%); Lower Slopes (1-30%); Lachlan Plains (1-30%); Murray Fans (>70%); Darling Depression (Not known); Inland Slopes (Not known);

LGA: Murray (30-70%); Wakool (1-30%); Albury (1-30%); Carrathool (1-30%); Bland (1-30%); Corowa (1-30%); Lockhart (1-30%); Berrigan (1-30%); Murrumbidgee (1-30%); Greater Hume (1-30%); Wagga Wagga (1-30%); Narrandera (1-30%);

Lithology: Alluvial loams and clays , Silt

Landform Pattern: Covered plain, Flood plain

Landform Element: Bank (streambank), Flood-out, Levee

Pre-European Extent: 15000 ha ?50%. Expert estimate not based on any mapped vegetation

Pre-European Extent Accuracy: 50

Pre-European Comments: Estimated from landscape position in relation to current extent.

Current Extent: Not Assessed

Current Extent Accuracy: 50

Current Extent Comments: Estimated that about 7500 ha occurs along the Murray River in NSW. This has been estimated by attributing 50% of section 1, 45% of section 2, 5% of section 3 and 5% of section 4 of the structural map unit Red Gum Forest as mapped in Margules & Partners (1990) and by correlating the sampling plot frequency along the River of floristic communities 3 and 4 described in Smith & Smith (1990). Additional areas for the Murrumbidgee River have been estimated. Miles (2001) estimates that 60% of Riverine vegetation along the Murray River remains. Some areas have been cleared on private land for cropping and grazing. Tree dieback becoming more common due to reduced rainfall and flooding.

PCT Percent Cleared: 40.00 % accuracy (of PCT % cleared estimate): +/-80

Variation and Natural Disturbance: The ecology of River Red Gum regeneration is discussed on pp33-34 in Forestry Commission of NSW (1985) and Stefana (2002). After seed fall seedlings can establish where sufficient moisture is retained the soil after rain or floods. If flooding is reduced due to river regulation drought-like conditions will prevent tree recruitment. Extended flooding for over four months may kill small seedlings while taller ones may survive. Abundance of associate species varies depending on wetness of the site and the season. This community probably requires less regular flooding than ID2. Roots of

River Red Gum seedlings must penetrate below a poorly aerated gley layer to an aerated clay layer in the soil profile to ensure their successful establishment (Pressey et al. 1984).

Fire Regime: Rarely subject to fire due to flooding and low ground biomass. Crown fires are rare due to the height of the trees and a lack of shrubs. Intense or even medium-intense fires may kill River Red Gum trees by burning to the tree's cambium at the base of the trees. These fires will also kill seedlings. River Red Gum cannot recover by sprouting from lignotubers. Fires in River Red Gum forests of the Murray River region have been recorded in summers after a lack of winter floods. It is possible that Aborigines lightly patch burnt the forest floor prior to European settlement.

Citations: (Priday S., 2004 ; Benson J., 1999-2009 ; NPWS, 1978a ; Miles C., 2001 ; Margules & Partners, 1990; Smith P & Smith J, 1990 ; Bos D. & Lockwood M., 1996 ; Cuningham S. et al., 2007 ; Pressey R. et al., 1984 ; Stefano J., 2002 ; FCNSW, 1985 ; FCNSW, 1989a)

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PCT % Benchmark values

Vegetation Class Inland Riverine Forests

Benchmark values (PCT 5)

Tree richness	2
Tree cover	16
Shrub richness	2
Shrub cover	0
Grass & grass-like richness	6
Grass & grass-like cover	26
Forb richness	11
Forb cover	9
Fern richness	1
Fern cover	0
Other richness	0
Other cover	0
Total length of fallen logs	100
Litter cover	80
No. of large trees (per 0.1ha)	4
Large Tree Threshold Size	50

Western Grey Box tall grassy woodland (PCT 76)

PCT Common Name: Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions

PCT Scientific Name: Eucalyptus microcarpa / Dodonaea viscosa subsp. cuneata , Acacia buxifolia subsp. buxifolia/ Austrodanthonia caespitosa , Austrostipa scabra subsp. falcata , Chloris truncata , Sida corrugata

Vegetation Description: Tall woodland to 25 m high dominated by Western Grey Box (Eucalyptus microcarpa) often as the only tree species often occupying 90% of the canopy cover but other trees may include Yellow Box (Eucalyptus melliodora), White Cypress Pine (Callitris glaucophylla) and minor Buloke. The shrub layer is absent or sparse and includes Dodonaea viscosa subsp. cuneata, Acacia buxifolia, Acacia acinacea, Acacia hakeoides, Bursaria spinosa. Grazing has eliminated shrubs these in many places. A mid-dense or dense grass ground cover is present composed of Austrodanthonia caespitosa, Austrodanthonia setacea, Austrostipa scabra subsp. falcata, Paspalidium constrictum, Themeda australis, Austrostipa aristiglumis, Aristida behriana and Elymus scaber var.

scaber along with introduced grass species such as Bromus spp., Vulpia spp. and Hordeum leporinum. The small scrambler Einadia nutans subsp. nutans is usually present. Native forbs include Sida corrugata, Wahlenbergia gracilis, Vittadinia gracilis, Dianella porracea, Oxalis perennans and Chamaesyce drummondii. Occurs on texture contrast red or brown earths or grey clay soils (that may be gilgaied) on undulating alluvial plains in the predominantly winter rainfall belt of south-central western NSW with an average annual rainfall between 550 and 450 mm. Mainly restricted to the eastern section of the Riverina Bioregion and the western section of the NSW South-western Slopes Bioregion. Distributed from north of Forbes in the north to near Albury in the south extending into north-central Victoria. It has lost its original shrub layer in many locations where grazing has been intense. Grades into the more shrubby Western Grey Box-White Cypress Pine - Buloke community (ID80) on loamy-sand soils and grades into White Box (Eucalyptus albens) on podzolic soils to the east on the western slopes. Grades into a riverine Western Grey Box community ID237 along the floodplains of the Murrumbidgee and Murray Rivers. Due to its occurrence on arable soils, this community has largely been cleared. Much of its remaining extent is threatened by grazing and weed invasion. It is a critically endangered community.

Rain fall: Not Assessed *Elevation:* Not Assessed

Emergent species: None

Upper Stratum Species: Eucalyptus microcarpa; Callitris glaucophylla; Allocasuarina luehmannii;

Mid Stratum Species: Dodonaea viscosa subsp. cuneata; Acacia buxifolia subsp. buxifolia; Bursaria spinosa subsp. spinosa; Acacia oswaldii; Acacia pycnantha; Acacia hakeoides; Acacia brachybotrya; Santalum acuminatum; Acacia homalophylla; Templetonia stenophylla; Exocarpos aphyllus;

Ground Stratum Species: Austrodanthonia caespitosa; Chloris truncata; Sida corrugata; Austrostipa scabra subsp. falcata; Wahlenbergia gracilis; Einadia nutans subsp. nutans; Paspalidium constrictum; Themeda australis; Austrostipa aristiglumis; Aristida behriana; Elymus scaber var. scaber; Austrodanthonia setacea; Carex inversa; Poa sieberiana; Vittadinia gracilis; Dianella porracea; Salsola tragus subsp. tragus; Oxalis perennans; Atriplex semibaccata; Chamaesyce drummondii; Lomandra filiformis subsp. coriacea; Asperula conferta; Convolvulus erubescens; Rhodanthe corymbiflora; Austrostipa bigeniculata; Enchylaena tomentosa; Leiocarpa panaetioides; Podolepis jaceoides; Atriplex semibaccata;

Diagnostic Species: Not Assessed

Height Class (Walker & Hopkins 1990): 8 - Range:20.01-35.00m (Very tall),7 - Range:12.01-20.00m (Tall)

Vegetation Formation: Grassy Woodlands; *Vegetation Class:* Floodplain Transition Woodlands; *NSW Landscape Name:* Not assessed

Classification source: A broadly classified community where Western Grey Box is a very dominant canopy species on clay to loam soils. Beadle (1981) separates Western Grey Box communities from the north to the south based on rainfall regimes. Moore (1953a) lists four associations of "Eucalyptus woollsiana" woodland on south-western NSW. This community equates to his "Eucalyptus woollsiana association" on red-earth and clay soils. Part of the broad Grassy Box Woodland map unit in Miles (2001) for the Murray Catchment. Includes community C3.1 in Bos & Lockwood (1996) is grouped under major vegetation unit 9 in Draft Western Riverina RVM Plan (WRRVC 2001). May include a small part of community 24 mapped in Porteners (1993) on the southern Hay Plain, equivalent to part of Western Grey Box community in the Mid-Lachlan area (Mid-Lachlan RVC 1999), probably includes community 12 in Austin et al. (2000) for central Lachlan area. May overlap with part of map units P3 and P4 in Sivertsen & Metcalfe (1995). It is equivalent to plant associations 2.4.1 (Eucalyptus microcarpa) and 2.4.2 in Brickhill (1984).

Includes Biolandscape SouA25e and part of Biolandscapes SouA255a, SouA25c, SouA25d and UlaV25a in Priday (2006). modelled and surveyed in Priday (2004) for Wagga Wagga region. Recorded along roadsides in the Corowa Shire (Mulham 1994). Some similarities to the shrubbier Western Grey Box woodland (ID80) that occurs on sandier soils over a similar distribution and the riverine Western Grey Box woodland (ID237) that occurs along rivers.

Authority: VCA 1.1 - archive

Pre-European Mapped Or Modelled: Mapped or modelled as part of a broader complex

Current Extent Mapped Or Modelled: Mapped as part of a broader complex

Adequacy of plot sampling: Inadequate *Number of Plots:* 0

IBRA Bioregion: NSW South Western Slopes (30-70%); Riverina (1-30%); Cobar Peneplain (Not known); South Eastern Highlands (Not known);

IBRA Sub-Region: Lower Slopes (30-70%); Murray Fans (1-30%); Murrumbidgee (1-30%); Lachlan Plains (Not known); Inland Slopes (Not known); Lachlan (Not known); Bondo (Not known);

LGA: Coolamon (1-30%); Leeton (1-30%); Greater Hume (1-30%); Murray (1-30%); Griffith (1-30%); Corowa (1-30%);

Lithology: Shale , Alluvial loams and clays *Landform Pattern:* Alluvial plain Flood plain *Landform Element:* Levee , Plain , Valley flat

Pre-European Extent: 500000 ha ?30%. Estimated from extant vegetation maps: part range

Pre-European Extent Accuracy: 30

Pre-European Comments: An extensive community on the South Western Plains and western part of the South Western Slopes Botanical Divisions. Over 500000 ha Western

Grey Box probably was modelled as existing prior to European settlement in the Western Riverina area (WRRVC 2001) but this covers several communities. Only small remnants remain and most of these have been heavily altered by grazing by stock and rabbits. Austin et al. (2000) model a pre-European extent of 155,200 ha for the central Lachlan region.

Current Extent: Not Assessed

Current Extent Accuracy: 30

Current Extent Comments: The Western Riverina draft RVM Plan pre-European mapping indicates only 2.7% of its broad Western Grey Box type remains (14700 ha from an original 544500 ha) for that planning region. Miles (2001) indicates 8% of a grassy box woodland type remains in the Murray Catchment but this includes a number of box woodland communities. This community has been mainly cleared throughout its range. Austin et al. (2000) predict that only 3% (4600 ha) remain in the central Lachlan region.

PCT Percent Cleared: 92.00*% accuracy (of PCT % cleared estimate):* +/-60

Variation and Natural Disturbance: Varies with soil type and drainage. Areas on heaver clays contain less shrubs and a rich forb/grass cover. Areas on lighter loam soils may contain White Cypress Pine and Yellow Box. Little is known about natural succession due to gross changes of understorey due to weed invasion. Fire may have played a significant role in grass/shrub dynamics.

Fire Regime: Unknown, highly fragmented so most patches are rarely burnt.

Table 19 PCT 76 Benchmark values

Vegetation Class	**Floodplain Transition Woodlands**
IBRA	Riverina
Benchmark Calculation Level	Class/IBRA
Tree Richness	2
Shrub Richness	3
Grass and Grass Like Richness	5
Forb Richness	7
Fern Richness	0
Other Richness	0
Tree Cover	9.0
Shrub Cover	4.0
Grass and Grass Like Cover	17.0
Forb Cover	7.0
Fern Cover	0.0
Other Cover	0.0
Total length of fallen logs	35
Litter Cover	60
Number of Large Trees	3.0
Large Tree Threshold Size	50

PCT associated with TEC: Yes

Associated TEC Names: Listed TSC Act, E: Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (Part) ; Listed EPBC Act, E: Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (Part);

Derived corkscrew grass grassland/forbland (PCT 165)

PCT Common Name: Derived corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) climate zone

PCT Scientific Name: Austrostipa scabra subsp. scabra, Austrostipa nodosa, Austrostipa nitida / Sclerolaena divaricata, Salsola tragus subsp. tragus / Bromus rubens, Hordeum leporinum

Vegetation Description: Mid-high open chenopod shrubland and/or very open woodland dominated by species of copperburr including several varieties of Black Roly Poly (Sclerolaena muricata), Sclerolaena bicornis and Galvanised Burr (Sclerolaena birchii). Other species include Buckbush (Salsola kali), Maireana microphylla, Atriplex leptocarpa, Black Bluebush (Maireana pyramidata). Scattered woodland trees may be present including Western Rosewood (Alectryon oleifolius), Poplar Box (Eucalyptus populnea subsp. bimbil), Black Box (Eucalyptus largiflorens) and Coolabah (Eucalyptus coolabah). The ground cover is dominated by grasses and forbs including Sporobolus mitchellii, Enteropogon acicularis, Boerhavia dominii, Chloris truncata, Panicum decompostum, Sporobolus caroli, Marsilea drummondii, Goodenia fascicularis and Solanum esuriale. Weeds are common and include Cucumis myriocarpus subsp. leptodermis, Xanthium spinosum and Rapistrum rugosum. Occurs on slight rises with yellow-brown clay-loam soils or red-brown or grey cracking clays on periodically flooded sections of floodplains of rivers mainly in the Darling Riverine Plain Bioregion in the semi-arid (hot) and temperate (hot summer) climatic zones. Common in the northern wheatbelt of NSW. While this community has probably been derived from previous shrublands or woodlands its derived extent has been extensively cleared for crops. Remaining areas are generally in poor condition but are important as native vegetation linkages between woodland remnants in fragmented landscapes.

Rainfall: Not Assessed Elevation: Not Assessed Emergent species: None

Upper Stratum Species: Casuarina pauper; Myoporum platycarpum subsp. platycarpum;

Mid Stratum Species: Maireana pyramidata; Maireana sedifolia;

Ground Stratum Species: Austrostipa scabra subsp. scabra; Austrostipa nodosa; Austrostipa nitida; Chloris truncata; Dissocarpus paradoxus; Sclerolaena divaricata; Salsola tragus subsp. tragus; Sclerolaena obliquicuspis; Sclerolaena muricata; Aristida contorta; Einadia nutans subsp. nutans; Rhodanthe pygmaea; Erodium crinitum; Atriplex stipitata; Cheilanthes sieberi subsp. sieberi;

Diagnostic Species: Not Assessed

Height Class (Walker & Hopkins 1990): 1 - Range:0.01-0.25m (Low),2 - Range:0.26-0.50m (Mid-high)

Vegetation Formation: Arid Shrublands (Chenopod sub-formation);

Vegetation Class: Riverine Chenopod Shrublands;

NSW Landscape Name: Not Assessed

Classification source: Equivalent to the CS (Chenopod Shrubland) map unit in Steenbeeke (1996) and Steenbeeke & Witts (1995) for the lower Macquarie River floodplain. Apparently a major proportion of map unit P9 in series 2 and 3 northern wheatbelt mapping of Sivertsen & Metcalfe (2001) but P9 appears to include several communities. This is similarly reflected in map unit BVT 12 in Kerr et al. (2003). Includes community 1 in McGann & Earl (1999). Part of BVT 34 in DEC (2006). A derived community in semi-cleared landscapes which varies in composition across a large distribution.

Authority: VCA 1.1 - archive

Pre-European Mapped Or Modelled: Mapped or modelled as part of a broader complex

Current Extent Mapped Or Modelled: Mapped as part of a broader complex

Adequacy of plot sampling: Inadequate Number of Plots: 0

IBRA Bioregion: Cobar Peneplain (1-30%); Riverina (1-30%); Murray Darling Depression (>70%); Brigalow Belt South (Not known); Darling Riverine Plains (Not known); Mulga Lands (Not known);

IBRA Sub-Region: South Olary Plain (30-70%); Darling Depression (1-30%); Nymagee (1-30%); Lachlan Plains (1-30%); Moonie-Barwon Interfluve (Not known); Narrandool (Not known); Boorindal Plains (Not known); Barnato Downs (Not known); Canbelego Downs (Not known); Culgoa-Bokhara (Not known); Warrambool-Moonie (Not known); Castlereagh-Barwon (Not known); Bogan-Macquarie (Not known); Louth Plains (Not known); Wilcannia Plains (Not known); Menindee (Not known); Nebine Plains (Not known); Paroo-Darling Sands (Not known);

Lithology: Eolian sand or loam *Landform Pattern:* Dunefield , Sand plain *Landform Element:* Drainage depression, Plain, Swale

Pre-European Extent: 50,000 ha ? 50%. Estimated from extant vegetation maps: part range

Pre-European Comments: Probably a derived community. The original vegetation composition may have been quite different in species composition than the Roly Poly dominated shrubland today - it may have been dominated by more palatable grasses and chenopods.

Current Extent: Not Assessed

Current Extent Comments: Probably occupies about 40% of 260000 ha mapped as map unit P9 in Sivertsen & Metcalfe 2001 (L. Metcalfe pers. comm.) i.e. about 100000 ha. Some areas occur outside this mapping area. Most of the community is in poor condition and is probably derived from saltbush shrubland or grassland types. About 50% has been cleared. Forms an important function as native ground cover matrix.

PCT Percent Cleared: 3.00*% accuracy (of PCT % cleared estimate):* Not Assessed

Variation and Natural Disturbance: Periodically flooded and this affects species composition in community. It is likely that this community has been derived from one dominated by either saltbushes or perennial native grasses that have been grazed out.

Fire Regime: Rarely burns. *PCT associated with TEC:* No

Table 20 PCT 165 Benchmarks

IBRA	**Riverina**
Benchmark Calculation Level	**Class/IBRA**
Tree Richness	0
Shrub Richness	8
Grass and Grass Like Richness	3
Forb Richness	8
Fern Richness	0
Other Richness	0
Tree Cover	0.0
Shrub Cover	24.0
Grass and Grass Like Cover	4.0
Forb Cover	7.0
Fern Cover	0.0
Other Cover	0.0

Appendix 3 Flora and fauna recorded for the Howlong Study Area

The following table lists of species for the Howlong locality (within 10 km of the study site) recorded on the BioNet database. Species recorded in or close (1.5 km) of the Study Area are highlighted in yellow. Threatened species are highlighted in light green.

Fauna

Class	Family	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Record
Amphibia	Myobatrachidae	*Crinia parinsignifera*		Eastern Sign-bearing Froglet	P		7
Amphibia	Myobatrachidae	*Limnodynastes peronii*		Brown-striped Frog	P		1
Amphibia	Myobatrachidae	*Limnodynastes tasmaniensis*		Spotted Grass Frog	P		4
Aves	Anatidae	*Anas superciliosa*		Pacific Black Duck	P		3
Aves	Anatidae	*Chenonetta jubata*		Australian Wood Duck	P		4
Aves	Podicipedidae	*Tachybaptus novaehollandiae*		Australasian Grebe	P		1
Aves	Columbidae	*Ocyphaps lophotes*		Crested Pigeon	P		2
Aves	Phalacrocoracidae	*Phalacrocorax varius*		Pied Cormorant	P		1
Aves	Ardeidae	*Ardea modesta*		Eastern Great Egret	P		1
Aves	Ardeidae	*Ardea pacifica*		White-necked Heron	P		1
Aves	Ardeidae	*Egretta novaehollandiae*		White-faced Heron	P		3
Aves	Ardeidae	*Ixobrychus dubius*		Australian Little Bittern	P		1
Aves	Ardeidae	*Nycticorax caledonicus*		Nankeen Night Heron	P		1
Aves	Threskiornithidae	*Platalea flavipes*		Yellow-billed Spoonbill	P		1
Aves	Threskiornithidae	*Threskiornis molucca*		Australian White Ibis	P		2
Aves	Accipitridae	*Elanus axillaris*		Black-shouldered Kite	P		2
Aves	Accipitridae	*Haliaeetus leucogaster*		White-bellied Sea-Eagle	V,P	C	1
Aves	Accipitridae	*Haliastur sphenurus*		Whistling Kite	P		2
Aves	Accipitridae	*Milvus migrans*		Black Kite	P		1
Aves	Falconidae	*Falco cenchroides*		Nankeen Kestrel	P		2
Aves	Rallidae	*Gallinula tenebrosa*		Dusky Moorhen	P		1
Aves	Rallidae	*Porphyrio*		Purple Swamphen	P		1
Aves	Charadriidae	*Vanellus miles*		Masked Lapwing	P		2
Aves	Cacatuidae	*Cacatua galerita*		Sulphur-crested Cockatoo	P		2
Aves	Cacatuidae	*Cacatua sanguinea*		Little Corella	P		1
Aves	Cacatuidae	*Eolophus roseicapillus*		Galah	P		2
Aves	Psittacidae	*Platycercus elegans flaveolus*		[Yellow Rosella]	P		2

Class	Family	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Record
Aves	Psittacidae	*Platycercus eximius*		Eastern Rosella	P		2
Aves	Psittacidae	*^^Polytelis swainsonii*		Superb Parrot	V,P,3	V	5
Aves	Psittacidae	*Psephotus haematonotus*		Red-rumped Parrot	P		1
Aves	Strigidae	*Ninox novaeseelandiae*		Southern Boobook	P		1
Aves	Tytonidae	*Tyto javanica*		Eastern Barn Owl	P		1
Aves	Alcedinidae	*Dacelo novaeguineae*		Laughing Kookaburra	P		2
Aves	Alcedinidae	*Todiramphus sanctus*		Sacred Kingfisher	P		1
Aves	Coraciidae	*Eurystomus orientalis*		Dollarbird	P		1
Aves	Maluridae	*Malurus cyaneus*		Superb Fairy-wren	P		2
Aves	Acanthizidae	*Acanthiza chrysorrhoa*		Yellow-rumped Thornbill	P		2
Aves	Acanthizidae	*Acanthiza lineata*		Striated Thornbill	P		1
Aves	Acanthizidae	*Acanthiza nana*		Yellow Thornbill	P		1
Aves	Acanthizidae	*Acanthiza pusilla*		Brown Thornbill	P		1
Aves	Pardalotidae	*Pardalotus punctatus*		Spotted Pardalote	P		1
Aves	Pardalotidae	*Pardalotus striatus*		Striated Pardalote	P		2
Aves	Meliphagidae	*Anthochaera carunculata*		Red Wattlebird	P		2
Aves	Meliphagidae	*Entomyzon cyanotis*		Blue-faced Honeyeater	P		1
Aves	Meliphagidae	*Manorina melanocephala*		Noisy Miner	P		2
Aves	Meliphagidae	*Philemon citreogularis*		Little Friarbird	P		1
Aves	Meliphagidae	*Philemon corniculatus*		Noisy Friarbird	P		1
Aves	Meliphagidae	*Ptilotula penicillatus*		White-plumed Honeyeater	P		2
Aves	Campephagidae	*Coracina novaehollandiae*		Black-faced Cuckoo-shrike	P		2
Aves	Pachycephalidae	*Colluricincla harmonica*		Grey Shrike-thrush	P		1
Aves	Pachycephalidae	*Pachycephala rufiventris*		Rufous Whistler	P		1
Aves	Artamidae	*Cracticus tibicen*		Australian Magpie	P		2
Aves	Artamidae	*Cracticus torquatus*		Grey Butcherbird	P		1
Aves	Rhipiduridae	*Rhipidura leucophrys*		Willie Wagtail	P		2
Aves	Corvidae	*Corvus coronoides*		Australian Raven	P		2
Aves	Monarchidae	*Grallina cyanoleuca*		Magpie-lark	P		2
Aves	Monarchidae	*Myiagra inquieta*		Restless Flycatcher	P		1
Aves	Corcoracidae	*Corcorax melanorhamphos*		White-winged Chough	P		1
Aves	Timaliidae	*Zosterops lateralis*		Silvereye	P		1
Aves	Hirundinidae	*Hirundo neoxena*		Welcome Swallow	P		3
Aves	Hirundinidae	*Petrochelidon ariel*		Fairy Martin	P		1
Aves	Hirundinidae	*Petrochelidon nigricans*		Tree Martin	P		1
Aves	Turdidae	*Turdus merula*	*	Eurasian Blackbird			1
Aves	Sturnidae	*Sturnus tristis*	*	Common Myna			1
Aves	Sturnidae	*Sturnus vulgaris*	*	Common Starling			2
Aves	Passeridae	*Passer domesticus*	*	House Sparrow			2
Aves	Motacillidae	*Anthus novaeseelandiae*		Australian Pipit	P		1

Class	Family	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Record
Aves	Fringillidae	*Carduelis*	*	European Goldfinch			1
Mammalia	Tachyglossidae	*Tachyglossus aculeatus*		Short-beaked Echidna	P		1
Mammalia	Dasyuridae	*Dasyurus maculatus*		Spotted-tailed Quoll	V,P	E	1
Mammalia	Pseudocheiridae	*Pseudocheirus peregrinus*		Common Ringtail Possum	P		1
Mammalia	Phalangeridae	*Trichosurus vulpecula*		Common Brushtail Possum	P		2
Mammalia	Molossidae	*Austronomus australis*		White-striped Freetail-bat	P		1
Mammalia	Molossidae	*Mormopterus planiceps*		Little Mastiff-bat	P		1
Mammalia	Molossidae	*Mormopterus ridei*		Eastern Free-tailed Bat	P		1
Mammalia	Vespertilionidae	*Chalinolobus gouldii*		Gould's Wattled Bat	P		2
Mammalia	Vespertilionidae	*Chalinolobus morio*		Chocolate Wattled Bat	P		1
Mammalia	Vespertilionidae	*Miniopterus schreibersii oceanensis*		Eastern Bentwing-bat	V,P		1
Mammalia	Vespertilionidae	*Nyctophilus geoffroyi*		Lesser Long-eared Bat	P		1
Mammalia	Vespertilionidae	*Scotorepens balstoni*		Inland Broad-nosed Bat	P		1
Mammalia	Vespertilionidae	*Vespadelus darlingtoni*		Large Forest Bat	P		1
Mammalia	Vespertilionidae	*Vespadelus vulturnus*		Little Forest Bat	P		1
Mammalia	Canidae	*Vulpes*	*	Fox			1
Mammalia	Felidae	*Felis catus*	*	Cat			1
Mammalia	Cervidae	*Cervus sp.*	*	Unidentified Deer			1

Flora

Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Amaranthaceae	6478	*Alternanthera denticulata*		Lesser Joyweed			3
Amaranthaceae	1064	*Amaranthus viridis*	*	Green Amaranth			1
Anthericaceae	CAES	*Caesia spp.*					1
Anthericaceae	7355	*Tricoryne elatior*		Yellow Autumn-lily			1
Apiaceae	10681	*Eryngium ovinum*		Blue Devil			2
Asteraceae	1273	*Arctotheca calendula*	*	Capeweed			2
Asteraceae	1280	*Aster subulatus*	*	Wild Aster			1
Asteraceae	10409	*Brachyscome perpusilla var. tenella*		Tiny Daisy			1
Asteraceae	1348	*Calotis scapigera*		Tufted Burr-daisy			2
Asteraceae	1384	*Centipeda cunninghamii*		Common Sneezeweed			2
Asteraceae	14360	*Centipeda minima subsp. minima*		spreading sneezeweed			1
Asteraceae	1400	*Cirsium vulgare*	*	Spear Thistle			5
Asteraceae	1404	*Conyza bonariensis*	*	Flaxleaf Fleabane			1
Asteraceae	8788	*Hypochaeris radicata*	*	Catsear			8
Asteraceae	1550	*Lactuca serriola*	*	Prickly Lettuce			1

Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Asteraceae	7780	*Pseudognaphalium luteoalbum*		Jersey Cudweed			1
Asteraceae	8911	*Pycnosorus globosus*		Drumsticks	P		1
Asteraceae	1675	*Senecio quadridentatus*		Cotton Fireweed			1
Asteraceae	1684	*Silybum marianum*	*	Variegated Thistle			1
Asteraceae	1689	*Sonchus asper*	*	Prickly Sowthistle			2
Asteraceae	1690	*Sonchus oleraceus*	*	Common Sowthistle			3
Asteraceae	1729	*Xanthium spinosum*	*	Bathurst Burr			2
Azollaceae	9260	*Azolla filiculoides*		Pacific Azolla			1
Boraginaceae	1749	*Cynoglossum suaveolens*		Sweet Hound's-tongue			1
Boraginaceae	1751	*Echium plantagineum*	*	Patterson's Curse			4
Boraginaceae	1761	*Heliotropium europaeum*	*	Potato Weed			2
Brassicaceae	7382	*Rorippa palustris*	*	Yellow Cress			1
Campanulaceae	1931	*Wahlenbergia fluminalis*		River Bluebell			2
Campanulaceae	1933	*Wahlenbergia gracilenta*		Annual Bluebell			1
Campanulaceae	7314	*Wahlenbergia luteola*		Bluebell			1
Caryophyllaceae	2006	*Stellaria media*	*	Common Chickweed			1
Casuarinaceae	2018	*Allocasuarina verticillata*		Drooping Sheoak			1
Casuarinaceae	9006	*Casuarina cunninghamiana subsp. cunninghamiana*		River Oak	P		1
Chenopodiaceae	14529	*Dysphania pumilio*		Small Crumbweed			1
Convolvulaceae	2287	*Cuscuta campestris*	*	Golden Dodder			1
Convolvulaceae	2222	*Dichondra repens*		Kidney Weed			2
Crassulaceae	7745	*Crassula decumbens var. decumbens*		Spreading Stonecrop			2
Crassulaceae	6820	*Crassula peduncularis*		Purple Stonecrop			2
Cucurbitaceae	11072	*Cucumis myriocarpus subsp. leptodermis*	*	Paddy Melon			1
Cupressaceae	6379	*Callitris glaucophylla*		White Cypress Pine			1
Cyperaceae	2327	*Carex inversa*		Knob Sedge			1
Cyperaceae	CARE	*Carex spp.*					1
Cyperaceae	2337	*Carex tereticaulis*					1
Cyperaceae	2364	*Cyperus eragrostis*	*	Umbrella Sedge			1
Cyperaceae	2408	*Eleocharis acuta*					1
Cyperaceae	2425	*Fimbristylis aestivalis*					2
Cyperaceae	6742	*Lipocarpha microcephala*		Button Rush			1
Euphorbiaceae	8560	*Chamaesyce drummondii*		Caustic Weed			1
Fabaceae (Faboideae)	2922	*Medicago polymorpha*	*	Burr Medic			1
Fabaceae (Faboideae)	3074	*Trifolium campestre*	*	Hop Clover			1
Fabaceae (Faboideae)	3076	*Trifolium dubium*	*	Yellow Suckling Clover			2
Fabaceae (Faboideae)	3079	*Trifolium glomeratum*	*	Clustered Clover			2
Fabaceae (Faboideae)	3085	*Trifolium repens*	*	White Clover			1
Fabaceae (Faboideae)	TRIF	*Trifolium spp.*	*	A Clover			2

Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Fabaceae (Faboideae)	3088	*Trifolium striatum*	*	Knotted Clover			2
Fabaceae (Faboideae)	3089	*Trifolium subterraneum*	*	Subterranean Clover			4
Fabaceae (Faboideae)	3091	*Trifolium tomentosum*	*	Woolly Clover			1
Geraniaceae	3142	*Erodium crinitum*		Blue Crowfoot			1
Geraniaceae	3154	*Geranium retrorsum*		Cranesbill Geranium			2
Geraniaceae	3156	*Geranium solanderi*		Native Geranium			2
Haloragaceae	3252	*Haloragis heterophylla*		Variable Raspwort			1
Haloragaceae	6546	*Myriophyllum verrucosum*		Red Water-milfoil			1
Hypoxidaceae	7493	*Hypoxis glabella var. glabella*		Tiny Star			1
Iridaceae	3304	*Romulea minutiflora*	*	Small-flowered Onion Grass			1
Iridaceae	7477	*Romulea rosea var. australis*	*	Onion Grass			4
Juncaceae	3313	*Juncus amabilis*					1
Juncaceae	3330	*Juncus flavidus*					5
Juncaceae	3335	*Juncus ingens*		Giant Rush			1
Juncaceae	JUNC	*Juncus spp.*		A Rush			1
Juncaceae	3350	*Juncus usitatus*					1
Juncaceae	3351	*Juncus vaginatus*					1
Juncaginaceae	3368	*Triglochin procera*		Water Ribbons			1
Lamiaceae	3381	*Marrubium vulgare*	*	White Horehound			2
Lamiaceae	3446	*Salvia verbenaca*	*	Vervain			1
Lobeliaceae	1922	*Pratia concolor*		Poison Pratia			2
Lomandraceae	6302	*Lomandra filiformis*		Wattle Matt-rush			1
Lomandraceae	6511	*Lomandra filiformis subsp. coriacea*		Wattle Matt-rush			1
Lythraceae	3623	*Lythrum hyssopifolia*		Hyssop Loosestrife			2
Malvaceae	3657	*Malva parviflora*	*	Small-flowered Mallow			2
Malvaceae	3664	*Sida corrugata*		Corrugated Sida			2
Marsileaceae	8803	*Marsilea drummondii*		Common Nardoo			6
Marsileaceae	8138	*Marsilea hirsuta*		Short-fruited Nardoo			1
Not found in search Marsileaceae	8140	*Pilularia novae-hollandiae*		Austral Pillwort	E1,P,3		2
Myrtaceae	4039	*Eucalyptus albens*		White Box			4
Myrtaceae	4057	*Eucalyptus blakelyi*		Blakely's Red Gum			1
Myrtaceae	6360	*Eucalyptus camaldulensis*		River Red Gum			9
Myrtaceae	4125	*Eucalyptus melliodora*		Yellow Box			4
Myrtaceae	4127	*Eucalyptus microcarpa*		Western Grey Box			3
Oleaceae	4324	*Olea europaea*	*	Common Olive			1
Onagraceae	4326	*Epilobium billardierianum*					1
Onagraceae	4330	*Epilobium hirtigerum*					1
Onagraceae	7375	*Ludwigia peploides subsp. montevidensis*		Water Primrose			1
Oxalidaceae	4615	*Oxalis exilis*					2
Oxalidaceae	4621	*Oxalis perennans*					4
Oxalidaceae	OXAL	*Oxalis spp.*					1

Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Plantaginaceae	4699	*Plantago lanceolata*	*	Lamb's Tongues			1
Plantaginaceae	13395	*Veronica derwentiana subsp. derwentiana*					1
Plantaginaceae	6007	*Veronica peregrina*	*	Wandering Speedwell			1
Plantaginaceae	13400	*Veronica peregrina subsp. xalapensis*	*				1
Poaceae	4721	*Agrostis capillaris*	*	Browntop Bent			1
Poaceae	4770	*Aristida ramosa*		Purple Wiregrass			1
Poaceae	10386	*Austrostipa bigeniculata*		Yanganbil			1
Poaceae	10382	*Austrostipa setacea*		Corkscrew Grass			1
Poaceae	AUSO	*Austrostipa spp.*		A Speargrass			2
Poaceae	4780	*Avena fatua*	*	Wild Oats			1
Poaceae	AVEN	*Avena spp.*	*	Oats			3
Poaceae	4790	*Bothriochloa macra*		Red Grass			2
Poaceae	4801	*Briza minor*	*	Shivery Grass			1
Poaceae	7813	*Bromus catharticus*	*	Praire Grass			1
Poaceae	4806	*Bromus diandrus*	*	Great Brome			4
Poaceae	4807	*Bromus hordeaceus*	*	Soft Brome			5
Poaceae	6540	*Cynodon dactylon*		Common Couch			7
Poaceae	4846	*Dactylis glomerata*	*	Cocksfoot			3
Poaceae	8796	*Elymus scaber*		Common Wheatgrass			1
Poaceae	6387	*Eragrostis cilianensis*	*	Stinkgrass			1
Poaceae	4955	*Eragrostis elongata*		Clustered Lovegrass			1
Poaceae	5001	*Hemarthria uncinata*		Matgrass			3
Poaceae	7871	*Hemarthria uncinata var. uncinata*					1
Poaceae	5005	*Holcus lanatus*	*	Yorkshire Fog			1
Poaceae	5011	*Hordeum hystrix*	*	Mediterranean Barley Grass			2
Poaceae	5012	*Hordeum leporinum*	*	Barley Grass			1
Poaceae	5013	*Hordeum marinum*	*	Sea Barley Grass			3
Poaceae	HORD	*Hordeum spp.*	*	A Barley Grass			2
Poaceae	5017	*Isachne globosa*		Swamp Millet			1
Poaceae	11388	*Lachnagrostis filiformis*					1
Poaceae	5031	*Lolium multiflorum*	*	Italian Ryegrass			1
Poaceae	5033	*Lolium rigidum*	*	Wimmera Ryegrass			3
Poaceae	5054	*Panicum coloratum*	*	Coolah Grass			1
Poaceae	5086	*Paspalum dilatatum*	*	Paspalum			9
Poaceae	5087	*Paspalum distichum*		Water Couch			1
Poaceae	5106	*Phalaris aquatica*	*	Phalaris			1
Poaceae	5110	*Phalaris minor*	*	Lesser Canary Grass			1
Poaceae	5121	*Poa annua*	*	Winter Grass			1
Poaceae	5122	*Poa bulbosa*	*	Bulbous Poa			2
Poaceae	5141	*Poa sieberiana*		Snowgrass			1
Poaceae	7878	*Rostraria cristata*	*	Annual Cat's Tail			1
Poaceae	14305	*Rytidosperma caespitosum*		Ringed Wallaby Grass			12
Poaceae	14307	*Rytidosperma duttonianum*		Brown-back Wallaby Grass			1
Poaceae	14317	*Rytidosperma racemosum*		Wallaby Grass			1
Poaceae	14322	*Rytidosperma setaceum*		Small-flowered Wallaby-grass			1

Family	Species Code	Scientific Name	Exotic	Common Name	NSW status	Comm. status	Records
Poaceae	RYTI	*Rytidosperma spp.*					1
Poaceae	5239	*Vulpia bromoides*	*	Squirrel Tail Fesque			4
Poaceae	5242	*Vulpia myuros*	*	Rat's Tail Fescue			3
Poaceae	VULP	*Vulpia spp.*	*	Rat's-Tail Fescue			1
Poaceae	13475	*Walwhalleya proluta*					1
Polygonaceae	5265	*Acetosella vulgaris*	*	Sheep Sorrel			1
Polygonaceae	5281	*Persicaria hydropiper*		Water Pepper			1
Polygonaceae	5285	*Persicaria prostrata*		Creeping Knotweed			3
Polygonaceae	5288	*Polygonum aviculare*	*	Wireweed			4
Polygonaceae	5291	*Polygonum plebeium*		Small Knotweed			1
Polygonaceae	5296	*Rumex brownii*		Swamp Dock			5
Polygonaceae	5298	*Rumex crispus*	*	Curled Dock			3
Polygonaceae	5299	*Rumex crystallinus*		Shiny Dock			1
Polygonaceae	5303	*Rumex pulcher*	*	Fiddle Dock			1
Polygonaceae	RUME	*Rumex spp.*	*	Dock			1
Portulacaceae	5324	*Portulaca oleracea*		Pigweed			1
Pteridaceae	10439	*Cheilanthes sieberi*		Rock Fern			1
Ranunculaceae	8810	*Ranunculus pumilio var. pumilio*					2
Ranunculaceae	9640	*Ranunculus sessiliflorus var. pilulifer*		Common Buttercup			1
Rosaceae	5609	*Aphanes australiana*		Australian Pert			1
Rosaceae	5646	*Rubus ulmifolius*	*	Blackberry			1
Rubiaceae	5679	*Galium aparine*	*	Goosegrass			1
Rubiaceae	GALI	*Galium spp.*	*				1
Scrophulariaceae	5969	*Kickxia elatine*	*	Pointed Toadflax			1
Solanaceae	6091	*Solanum nigrum*	*	Black-berry Nightshade			2
Urticaceae	6238	*Urtica urens*	*	Small Nettle			1
Verbenaceae	6256	*Verbena bonariensis*	*	Purpletop			1

Appendix 4 BAM Candidate Species Report

BAM Candidate Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00013223/BAAS18107/18/00013224	Howlong Sand and Gravel EIS	07/11/2018
Assessor Name	**Report Created**	**BAM Data version ***
Peter F Clinnick	15/11/2018	4
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS18107		

List of Species Requiring Survey

Name	Presence	Survey Months
Crinia sloanei Sloane's Froglet	Yes (assumed present)	Jul, Aug
Cullen parvum Small Scurf-pea	Yes (assumed present)	Jan, Feb, Dec
Lathamus discolor Swift Parrot	Yes (assumed present)	May, Jun, Jul, Aug
Myotis macropus Southern Myotis	Yes (assumed present)	Jan, Feb, Mar, Nov, Dec
Petaurus norfolcensis Squirrel Glider	Yes (assumed present)	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Phascogale tapoatafa Brush-tailed Phascogale	Yes (assumed present)	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Phascolarctos cinereus Koala	Yes (assumed present)	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

Page 1 of 2

BAM Candidate Species Report

Polytelis swainsonii Superb Parrot	Yes (assumed present)	Jan Feb Mar Apr May Jun Jul Aug **Sep** **Oct** **Nov** Dec
Anthochaera phrygia Regent Honeyeater	Yes (assumed present)	Jan Feb Mar Apr May Jun Jul Aug **Sep** **Oct** **Nov** **Dec**
Haliaeetus leucogaster White-bellied Sea-Eagle	Yes (assumed present)	Jan Feb Mar Apr May Jun **Jul** **Aug** **Sep** **Oct** **Nov** **Dec**
Lophoictinia isura Square-tailed Kite	Yes (expert report)	**Jan** Feb Mar Apr May Jun Jul Aug **Sep** **Oct** **Nov** **Dec**
Ninox strenua Powerful Owl	Yes (assumed present)	Jan Feb Mar Apr **May** **Jun** **Jul** **Aug** Sep Oct Nov Dec
Hieraaetus morphnoides Little Eagle	Yes (assumed present)	Jan Feb Mar Apr May Jun Jul **Aug** **Sep** **Oct** Nov Dec

List of Species Not On Site

Name
Burhinus grallarius Bush Stone-curlew

Appendix 5 Commonwealth EPBC Report and Response

Australian Government
Department of the Environment and Energy

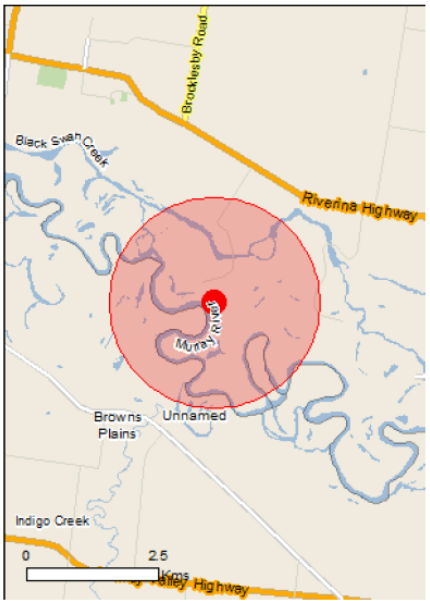
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

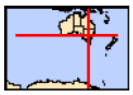
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 13/11/19 09:51:01



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 2.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	7
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	25
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	1
Invasive Species:	30
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Banrock station wetland complex	600 - 700km upstream
Barmah forest	100 - 150km upstream
Gunbower forest	150 - 200km upstream
Hattah-kulkyne lakes	400 - 500km upstream
Nsw central murray state forests	100 - 150km upstream
Riverland	500 - 600km upstream
The coorong, and lakes alexandrina and albert wetland	600 - 700km upstream

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Natural Grasslands of the Murray Valley Plains	Critically Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat likely to occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
Galaxias rostratus Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat likely to occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Frogs		
Crinia sloanei Sloane's Froglet [59151]	Endangered	Species or species habitat likely to occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tensa Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat likely to occur within area
Prasophyllum validum Sturdy Leek-orchid [10268]	Vulnerable	Species or species habitat may occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Reptiles		

Name	Status	Type of Presence
Aprasia parapulchella		
Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area
Delma impar		
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
River Murray Reserve	VIC

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
North East Victoria RFA	Victoria

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Carduelis chloris European Greenfinch [404]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Ulex europaeus Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-36.0134 146.66028

Appendix 6 Correspondence from the Department of the Environment and Energy – dated 4 June 2018

Australian Government
Department of the Environment and Energy

Peter Clinnick
Managing Director
Advanced Environmental Systems
Suite 2/75 Hume St
ECHUCA VIC 3564

Dear Mr Clinnick,

Re: Howlong Sand and Gravel Quarry

Thank you for your letter on behalf of Fraser Earthmoving Construction Pty Ltd, regarding its proposal to expand the existing sand and gravel quarry at Howlong, NSW.

The Department of the Environment and Energy notes that Advanced Environmental Systems (AES) undertook an assessment of impacts on matters of national environmental significance (MNES) and concluded that, due to the scope of works and existing land use, the proposed action is not considered likely to result in significant impacts to MNES. I understand that, as a result, you do not intend to refer the proposed action for consideration under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

I note that Fraser Earthmoving Construction has considered its obligations under the EPBC Act. Based on the information provided, including on proposed mitigation measures, the Department will not request (under section 70 of the EPBC Act) that the proposed action be referred.

If you have any further questions about the application of the EPBC Act to the proposed action, please contact Lauren Ooi, Southern NSW and ACT Assessments Section by email lauren.ooi@environment.gov.au or phone 02 6274 1535.

Yours sincerely

Mike Smith
Director
Southern NSW & ACT Assessments
4 June 2018

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Appendix 7 BAM Plot Photos and Data

BAM Plot

Surrogate vegetation plot (20x50 m) in river buffer area (Datum point - view east)

Vegetation plot (20x50 m) in buffer area (View west)

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BAM Site – Field Survey Form

Site Sheet no: 1 of 2

Survey Name	Zone ID	Recorders
HOWLONG EIS	REMNANT 1	P. CLINNICK

Date	17-4-18	Plot ID	BUFFER 1	Plot dimensions	20 x 50
Zone 54	Datum PEG			Photo #	
Easting 1010008	Northing 5999795	IBRA region	EASTERN RIVERINA	Midline bearing from 0 m	90° Magnetic?
Vegetation Class	INLAND RIVERINE FOREST				Confidence: H (M) L
Plant Community Type	PCT 5 – RIVER RED GUM – GRASSY			EEC: —	Confidence: H (M) L

Record easting and northing at 0 m on midline. Dimensions (Shape) of 0.04 ha base plot.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	5
	Forbs	0
	Ferns	0
	Other	1
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	29
	Forbs	0
	Ferns	0
	Other	10
High Threat Weed cover		3

BAM Attribute (1000 m² plot)		
DBH	# Tree Stems Count	# Stems with Hollows
80 + cm	—	0
50 – 79 cm	—	
30 – 49 cm	4	TOTAL TREES = 35
20 – 29 cm	8	CANOPY COVER ~ 35%
10 – 19 cm	15	
5 – 9 cm	8	
< 5 cm	7	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	13 Tally space	

Counts apply when the **number of tree stems** within a size class is ≤ 10. Estimates can be used when > 10 (eg. 10, 20, 30..., 100, 200, 300...). For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate. **Tree stems must be living.**

For **hollows**, count only the presence of a stem containing hollows. For a **multi-stemmed tree**, only the largest stem is included in the count/estimate. **Stems may be dead and may be shrubs.**

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	96	50	98	99	99	3	20	2	1	1	0	30	0	0	0	1	1	0	0	0
Average of the 5 subplots	88					5					6					1				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots centred at 5, 15, 25, 35, 45 m along the plot midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Assessors may also record the cover of rock, bare ground and cryptogams.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	FLOOD PLAIN	Landform Element	MID TERRACE	Landform Pattern	PLANAR	Microrelief	1 m
Lithology	Qtr ALLUVIUM	Soil Surface Texture	SANDY LOAM	Soil Colour	YELLOW/BRN	Soil Depth	3 m
Slope	1%	Aspect	—	Site Drainage	MODERATE	Distance to nearest water and type	30 LAKE

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	2	O	STUMPS, COPPICE REGROWTH
Cultivation (inc. pasture)			
Soil erosion	1	R	PEDICULES
Firewood / CWD removal	3	R	
Grazing (identify native/stock)	1	R	COW PADS DEER OBSERVED
Fire damage			
Storm damage			
Weediness	1	R	PRESENT OBSERVED
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

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400 m² plot: Sheet 2 of 2

Survey Name	Plot Identifier	Recorders
HOWLONG EIS	BUFFER 1	R CUNNICK

Date: 17-4-18

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	% Cover	Abund	stratum	voucher
G	1 Chloris truncata (Windmill grass)	E	10	100	Ground	
G	2 Hordeum glaucum (Barley grass)	E	3	40		
O	3 Cryptogams	N	<1	Many		
G	4 Poa labillardieri (Tussock grass)	N	5	200		
F	5 Taraxacum officinale (Dandelion)	E	3	50		
G	6 Cynodon dactylon (Couch grass)	E	5	40		
G	7 Rytidosperma caespitosum (Wallaby Grass)	N	20	300		
G	8 Paspalum dilatatum (Paspalum)	HTE	3	25		
F	9 Rumex acetosa (Sorrel)	E	1	10		
G	10 Phalaris aquatica (Phalaris)	E	3	20		
F	11 Helminthotheca echioides (Ox tongue)	E	2	20		
R	12 Juncus usitatus (Common rush)	N	10	25		
G	13 Tripogon loliiformis (Rye beetle grass)	N	1	5		
F	14 Plantago lanceolata (Plantain)	E	1	10		
V	15 Cyperus involucratis (Nut grass)	E	4	25		
F	16 Cirsium vulgare (Spear Thistle)	E	1	1		
G	17 Bromus hordeaceus (Soft brome)	E	1	3	↓	
	18 Red gums absent in 20x20 plot				Mid/ Upper	
	19					
	20					
	21					
	22 Composition 26.3					
	23					
	24 Structure 51.1 Integrity Score	39.4				
	25					
	26 Function 45.6					
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.

Cover: 0.1, 0.2, 0.3, …, 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); ***Note:*** *0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, …, 10, 20, 30, … 100, 200, …, 1000, …

Appendix 8 Amphibian Search Call Records

Frog Search and recordings confirmed by the Australian Museum (AM)

Site	Capture date	Species name	Common name	AM ID
4	28/09/2018 06:28 pm	Limnodynastes tasmaniensis, Crinia parinsignifera	Common Eastern Froglet Eastern Sign-bearing Froglet	33351
4	28/09/2018 06:26 pm	Litoria verreauxii, Limnodynastes tasmaniensis, Crinia parinsignifera	Whistling Tree Frog Common Eastern Froglet Eastern Sign-bearing Froglet	33348
4	28/09/2018 06:25 pm	Limnodynastes tasmaniensis, Crinia parinsignifera	Common Eastern Froglet Eastern Sign-bearing Froglet	33347
3	28/09/2018 06:20 pm	Crinia parinsignifera	Eastern Sign-bearing Froglet	33340
3	28/09/2018 06:02 pm	Limnodynastes peronii	Brown-striped Frog	33334
2	17/04/2018 06:31 pm	Validated - Not A Frog *Insect*	Crickets	21253
1	06/03/2018 09:43 pm	Validated - Not A Frog *Insect*	Crickets	18509

Frog calls heard at other times

Site	Capture date	Species	Common name
6		Limnodynastes tasmaniensis	Spotted Grass Frog
5	26/07/2017 Cod Creek	Limnodynastes tasmaniensis	Spotted Grass Frog
3	28/09/2018	Limnodynastes dumerilii	Eastern Banjo Frog

Appendix 9 Microbat Call Identification Report

Microbat Call Identification Report

Prepared for (“Client”):	Advanced Environmental Systems
Survey location/project name:	Howlong Quarry, NSW
Survey dates:	1-6 March 2018
Client project reference:	
Job no.:	AES-1801
Report date:	22 March 2018

Methods

Data received

Balance! Environmental received almost 18,000 zero-crossing bat-call sequence files (ZC files), recorded over six consecutive nights (1-6 March 2018) using an Anabat Swift detector (Titley Scientific, Brisbane). Position data from the detector's on-board GPS shows that the same site was sampled for all six nights (36.0163° S, 146.6635° E).

Due to budgetary constraints, the client requested analysis only for a three-night sub-sample of the data set. Accordingly, data were analysed for the nights of March 1st (2833 ZC files), 3rd (3376 ZC files) and 6th (2761 ZC files).

Call identification

All sequence files for the three chosen nights were scanned manually in *AnalookW* (Corben 2017) and a subset of 551 calls, representative of all call types recorded, were extracted for detailed analysis.

Species identification was achieved manually by comparing the *AnalookW* spectrograms of the selected calls with those of regionally relevant reference calls and/or with reference to published call descriptions (e.g. Reinhold *et al.* 2001; Pennay *et al*. 2004). Identification was also guided by considering probability of occurrence based on general distribution information (Churchill 2008; van Dyck *et al.* 2013) and/or *Atlas of Living Australia* on-line database records (http://www.ala.org.au).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Jackson & Groves (2015). This treatment of Australian mammal taxonomy elevates the sub-genus names proposed by Reardon *et al.* (2014) for the *Mormopterus* free-tailed bats to genus level; hence the use herein of *Ozimops planiceps* (formerly *M. planiceps* or 'species 4') and *O. ridei* (formerly *M. ridei* or *M.* 'species 2'). The Jackson & Groves (2015) nomenclature also uses alternative species and sub-species names for the *Miniopterus schreibersii* complex, so *M. s. oceanensis* is listed herein as *M. orianae oceanensis*.

Results & Discussion

At least 10 and up to 15 species were recorded during the Howlong Quarry bat survey. Positively-identified calls represented the following nine species:

- *Austronomus australis* (White-striped Free-tailed Bat)
- *Ozimops planiceps* (Southern Free-tailed Bat)
- *Ozimops ridei* (Ride's Free-tailed Bat)
- *Chalinolobus gouldii* (Gould's Wattled Bat)
- *Chalinolobus morio* (Chocolate Wattled Bat)
- *Scotorepens balstoni* (Inland Broad-nosed Bat)
- *Scotorepens greyii* (Little Broad-nosed Bat)
- Vespadelus darlingtoni (Large Forest Bat)
- Vespadelus vulturnus (Little Forest Bat)

Additional species that may have been present, but which could not be reliably identified include:

- *Myotis macropus* (Large-footed Myotis) or *Nyctophilus* species (unidentified Long-eared Bat)
    - Calls are very similar and difficult to differentiate
    - Relatively few calls recorded, and all could be from any member of the group

- Two *Nyctophilus* species probably occur in the Study Area - *N. geoffroyi* (Lesser Long- eared Bat) and *N. gouldi* (Gould's Long-eared Bat)
- *M. macropus* is known to occur along the Murray River and it may forage over farm dams such as those nearby to the detector location

- *Ozimops petersi* (Inland Free-tailed Bat)
  - Survey area is probably outside the south-eastern limit of this species' range but its calls are similar to and overlap the frequency ranges of both the above-listed *Ozimops* species
- *Vespadelus regulus* (Southern Forest Bat)
  - Call frequency and pulse-shape characteristics are like those of *C. morio*
  - *C. morio* positively identified from calls with distinct down-sweeping tails and characteristic frequency (Fc) in the range 50-53 kHz
  - A few calls with similar pulse shapes but Fc above 54 kHz could have been from either *C. morio* or *V. regulus* (some of these calls looked like those of *Miniopterus australis* (Little Bent-winged Bat), but that species is not known to occur south of about Sydney)
- Miniopterus orianae oceanensis (Eastern Bent-winged Bat)
  - Fc~43-47 kHz, which overlaps with that of both *V. darlingtoni* and *V. vulturnus* and makes it very difficult to differentiate *M. o. oceanensis* from those species
  - *V. vulturnus* positively identified from calls with relatively short-duration pulses that had distinctly hooked bodies with up-sweeping tails and Fc~45-47 kHz
  - *V. darlingtoni* identified from calls with longer duration pulses with flat or diagonal bodies at Fc~40-44 kHz and either no tail or up-sweeping tail
  - *M. o. oceanensis* calls are most like those of *V. darlingtoni*, but often have shorter initial frequency sweep (narrower 'band-width') and down-sweeping tails, plus more erratic (*cf.* uniform in *Vespadelus* spp.) pulse characteristics of Fc, slope and duration
  - Many calls bear a strong resemblance to *M. o. oceanensis*, but were not allocated positively to that species because those with clear feeding-buzz sequences exhibited buzz characteristics more typical of vespertilionid bats (Corben 2010). No feeding buzzes of the type Corben (2010) described for *Miniopterus* spp. were observed.
  - The Atlas of Living Australia contains a single historic record of *M. o. oceanensis* from near Howlong, but this record is based on an acoustic recording, so may be unreliable due to the difficulties in call identification described above

Threatened Species

Two of the above-listed unconfirmed species – *M. o. oceanensis* and *M. macropus* – are listed as Vulnerable under the NSW *Biodiversity Conservation Act 2016*.

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Churchill, S. (2008). *Australian Bats*. Jacana Books, Allen & Unwin; Sydney. Corben, C. (2010). Feeding Buzzes. *Australasian Bat Society Newsletter* **35**, 40-44.

Corben, C. (2017). AnalookW for bat call analysis using ZCA. Version 4.2n, 16 March 2017.

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Pennay, M., Law, B. and Reinhold, L. (2004). *Bat Calls of New South Wales*. Department of Environment and Conservation, Hurstville.

Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

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Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

van Dyck, S., Gynther, I. and Baker, A. (ed.) (2013). *Field Companion to the Mammals of Australia*. New Holland; Sydney.

Glossary

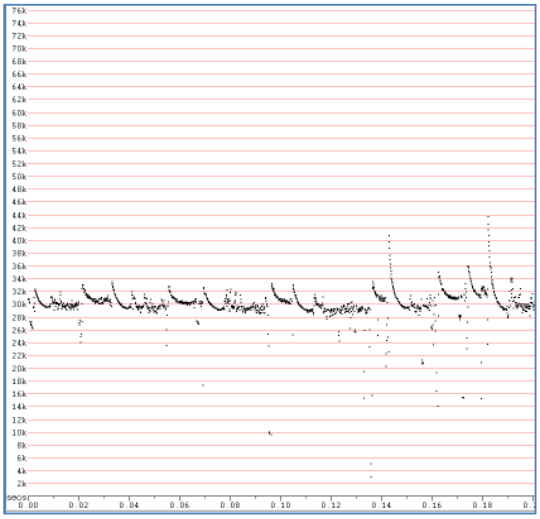
Technical terms used in this report are described in the following table.

Approach-phase	The part of a bat *call* emitted as the bat starts to home in on a detected prey item; a transitional series of *pulses* between the *search phase* and *feeding buzz*, that become progressively steeper and shorter in duration.
Call	Refers to a single bat call, made up of a series of individual sound pulses in one or more phases (search, approach, feeding buzz).
CF (=Constant Frequency)	A type of *pulse* in which the dominant component consists of a more-or-less 'pure tone' of sound at a Constant Frequency; with *shape* appearing flat on the sonogram. Often also contains a brief *FM* component at the beginning and/or end of the CF component (*viz.* FM-CF-FM).
Characteristic frequency (Fc)	The frequency of the flattest part of a *pulse*; usually the lowest frequency reached in the *qCF* component of a pulse. This is often the primary diagnostic feature for species identification.
Duration	The time period from the beginning of a *pulse* to the end of the pulse.
Feeding-buzz	The terminal part of a *call*, following the *approach phase*, emitted as the bat catches a prey item; a distinctive, rapid series of very steep, very short-duration pulses.
FM (=Frequency Modulated)	A type of *pulse* in which there is substantial change in frequency from beginning to end; *shape* ranges from almost vertical and linear through varying degrees of curvature.
FC range	Refers to the range of frequencies occupied by the *characteristic frequency* section of *pulses* within a call or set of calls.
Frequency sweep or "band-width"	The range of frequencies through which a *pulse* sweeps from beginning to end; Maximum frequency (Fmax) – minimum frequency (Fmin).
Knee	The transitional part of a *pulse* between the initial (usually steeper) frequency sweep and the *characteristic frequency* section (usually flatter); time to knee (Tk) and frequency of knee (Fk) can be diagnostic for some species.
Pulse	An individual pulse of sound within a bat *call*; the *shape*, *duration* and *characteristic frequency* of a pulse are the key diagnostic features used to differentiate species.

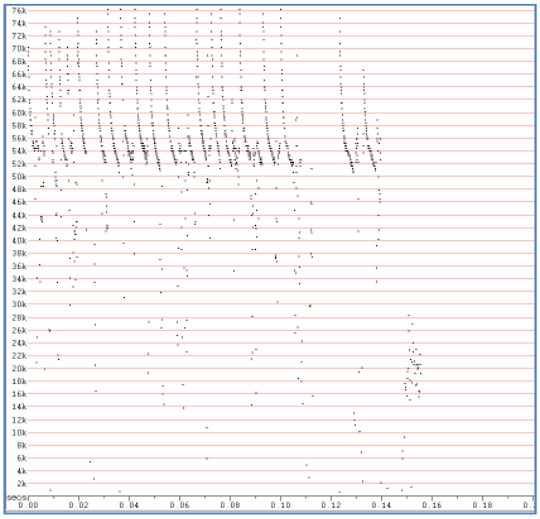
Pulse body	The part of the *pulse* between the *knee* and *tail* and containing the characteristic frequency section.
Pulse shape	The general appearance of a *pulse* on the sonogram, described using relative terms related to features such as slope and degree of curvature. See also *CF, qCF* and *FM*.
qCF (=quasi Constant Frequency)	A type of *pulse* in which there is very little change in frequency from beginning to end; *shape* appears to be almost flat. Some pulses also contain an *FM* component at the beginning and/or end of the qCF component (*viz.* FM-qCF).
Search phase	The part of a bat *call* generally required for reliable species diagnosis. A consistent series of *pulses* emitted by a bat that is searching for prey or and/or navigating through its habitat. Search phase pulses generally have longer duration, flatter slope and more consistent shape than *approach phase* and *feeding buzz* pulses.
Sequence	Literally, a sequence of *pulses* that may be from one or more bats; but generally refers to a *call* or part (e.g. *phase*) of a call.
Tail	The final component of a *pulse*, following the *characteristic frequency* section; may consist of a short or long sweep of frequencies either upward or downward from the Fc; or may be absent.

Appendix 10 Representative call sequences from the Howlong survey, March 2018

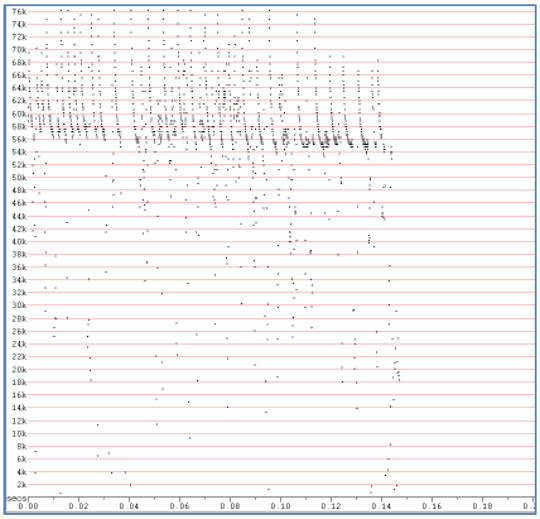
(*AnalookW* spectrograms; time between pulses removed; *x*-axis scale = 10ms per tick)



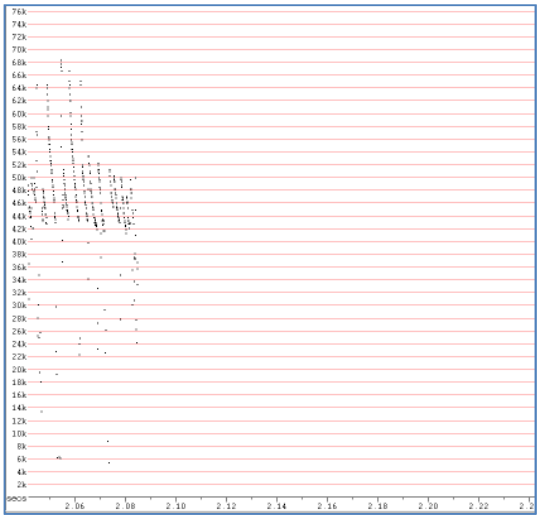
Chalinolobus gouldii



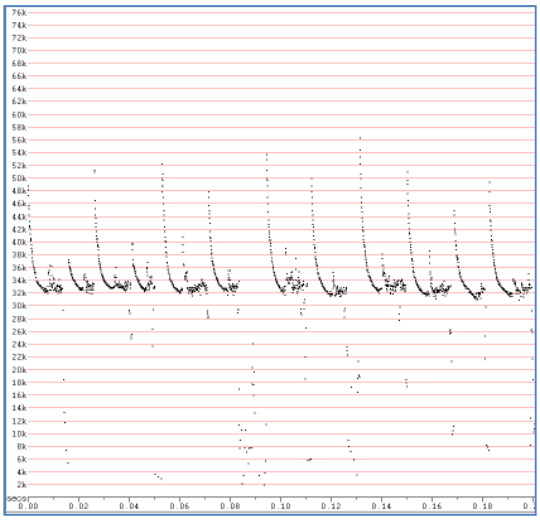
Chalinolobus morio



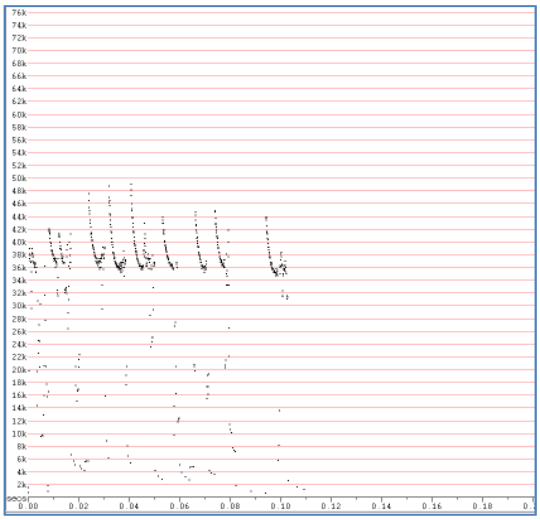
Chalinolobus morio / Vespadelus regulus



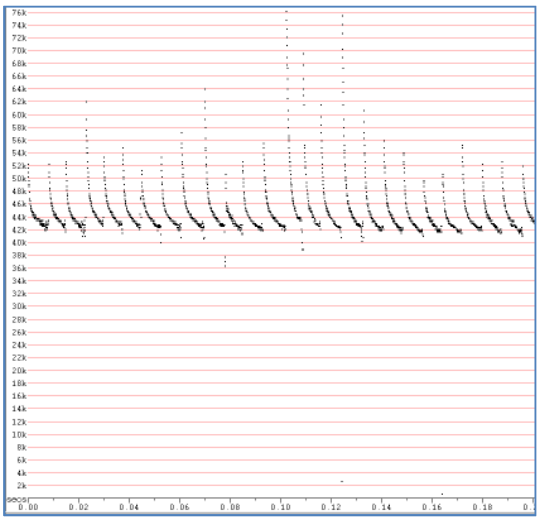
Myotis macropus / Nyctophilus sp.



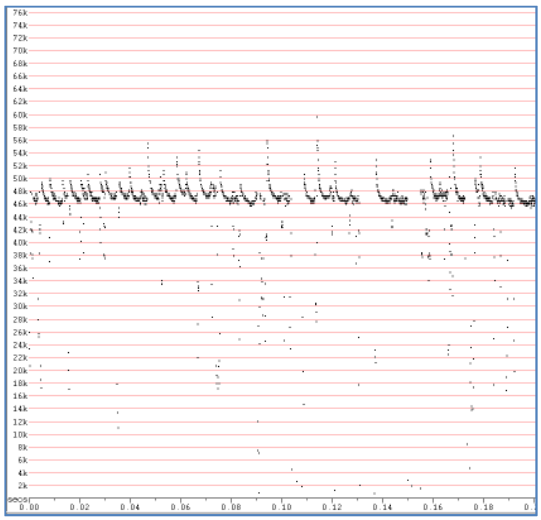
Scotorepens balstoni



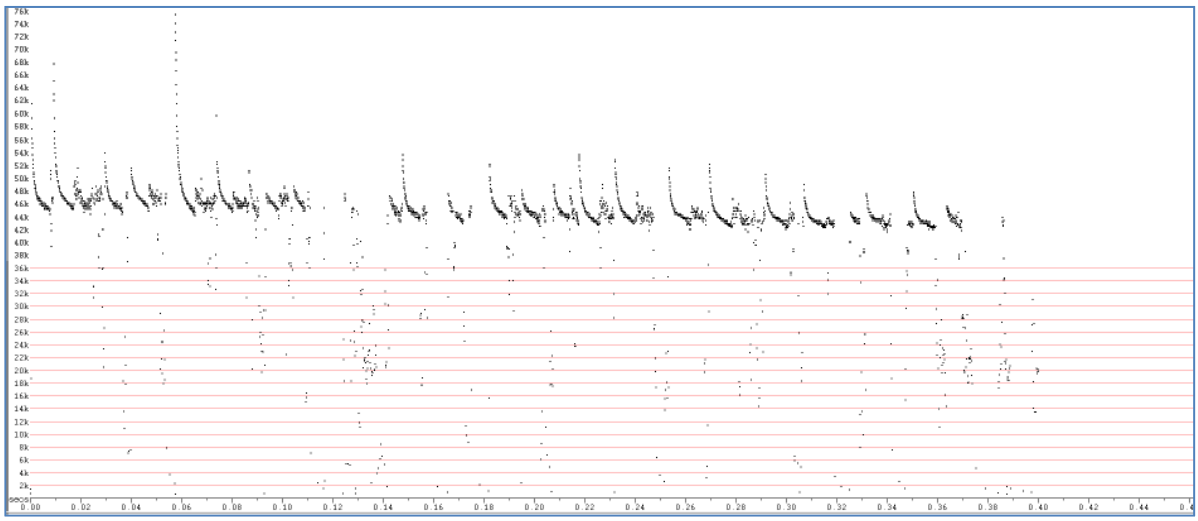
Scotorepens greyii



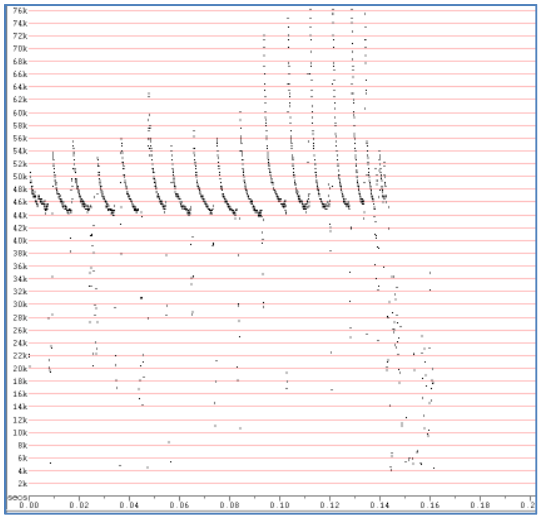
Vespadelus darlingtoni

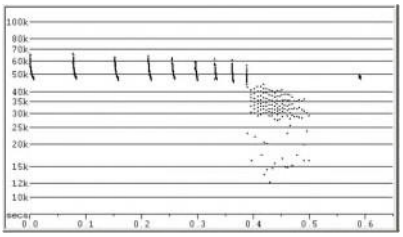


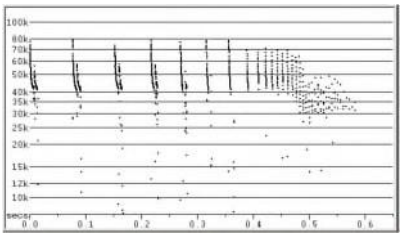
Vespadelus vulturnus



V. darlingtoni / Miniopterus o. oceanensis – note short down-swept tail on some pulses

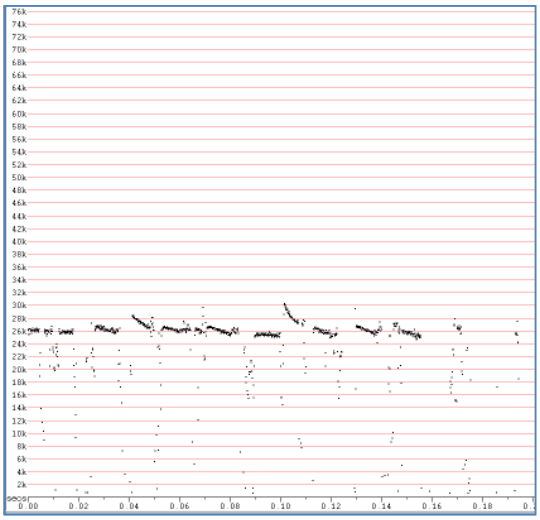




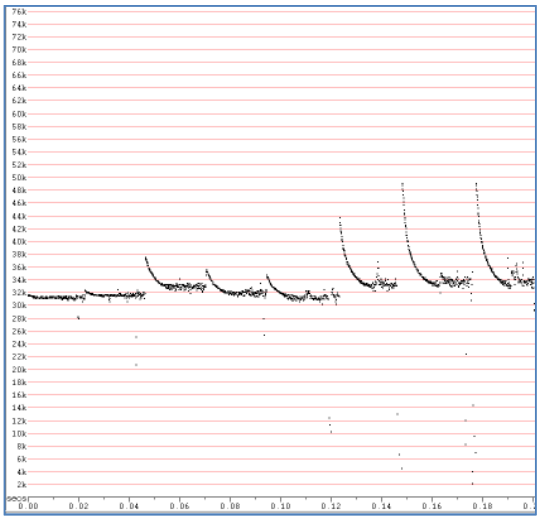


V. darlingtoni – similar to above call, but note partial feeding buzz

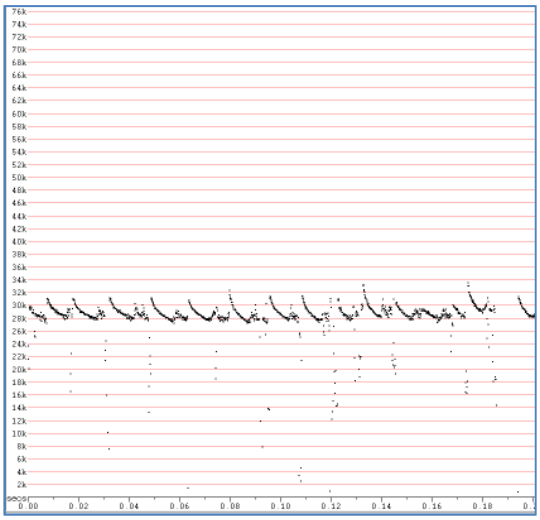
"Typical" buzzes shown for *Miniopterus* (top right) and *Vespadelus* (bottom right) (after Corben 2010)



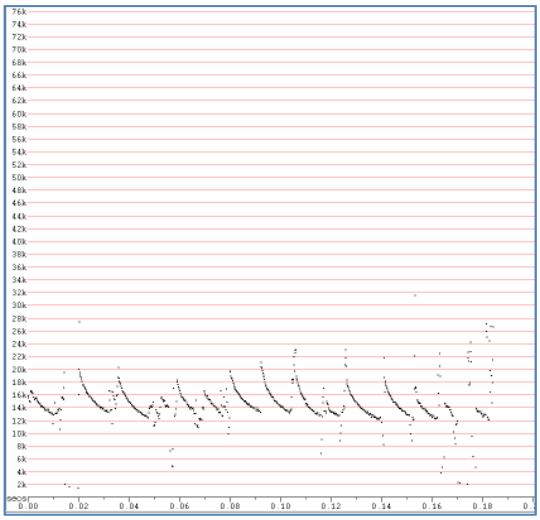
Ozimops planiceps



Ozimops ridei



Ozimops ridei / O. petersi



Austronomus australis

Appendix 11 Species and trees size assessment on the subject land

Table A11.1 Subject site tree group assessment results

Group/Tree number	Species * Planted	Height/Spread (m)	Diam (DBH)	Paddock tree class	Notes
1.1	*Eucalyptus camaldulensis*	13/ 1-8	16-60	1, 3	Planted 12 stems Age 2-15 1 x 60cm DBH Class 3, No hollows
1.2	*E. camaldulensis*	14/ 12	80	3	
1.3	*E. camaldulensis Acacia dealbata*	14, 4-6/ 10	60	3	Planted / Regen
1.4	*E. camaldulensis*	4 – 6/ 1-2	5-10	1	No hollows, Planted and introduced eucalypts
1.5	**E. machroryncha*	14/ -	75	NA	
1.6	**E. machroryncha*	6/-	56	NA	
1.7	**E. nicholii*	4/-	55	NA	
2.1	*E. camaldulensis*	13/ 12	75	3	No hollows, 20 young trees in Group 2.4
2.2	*E. camaldulensis*	12/ 9	42	2	
2.3	*E. camaldulensis*	13/14	60	3	
2.4	*E. camaldulensis*	5 – 7/ 1to2	5 - 15	1	No hollows
2.5	*E. camaldulensis*	10/ 7	35	2	
2.6	*E. camaldulensis*	6/ 5	22	2	
3.1	*E. camaldulensis*	13/ 11	80	3	No hollows
3.2	*E. camaldulensis*	14/ 10	68	3	
3.3	*E. camaldulensis*	15/10	65	3	
3.4	*E. camaldulensis*	15/ 7	32	2	
3.5	*A. dealbata*	<15/ -	<5	NA	Acacia regen ~10 trees
3.6	**E. porosa*	3 to 7 /-	<30	NA	~10 trees inc Willows, palm tree and introduced eucalypts
4.1	*E. camaldulensis*	9/ 7	50	3	
4.2	**E. porosa,* **E. polyanthemos*			NA	Willows, poplars, silky oak and introduced eucalypts
4.3	*E. camaldulensis*	12/ 10	45	2	No hollows
5.1	*E. camaldulensis*	11/ 16	70	3	No hollows
5.2	*Non indigenous species			NA	Large willows
6.1	*E. camaldulensis*	15/ 15	62	3	
6.2	*E. camaldulensis*	5/ 1 to3	10-20	1	15 regen trees
7.1	*E. camaldulensis*	15/ 12	58	3	No hollows
7.2	*E. camaldulensis*	<5/ 1to 2	10-15	1	11 regen trees
8.1	*E. camaldulensis*	6-12/ 1to10	<50	2	~10 trees ingle and multistem 10-20 years old
9.1	*E. camaldulensis*	20+/ 15	195	3	Large tree developing hollows
10.1	*E. camaldulensis*	5-14/ 1to12	15-60	3	22 trees age15-18 No hollows
10.2	*E. camaldulensis*	5-15/ 1to10	10-50	3	41 trees age15-18 No hollows
11.1	*E. camaldulensis*	11/ 12	60	3	No hollows
11.2	*E. camaldulensis*	10/ 11	50	3	No hollows
10.3	*E. camaldulensis*	11/ 9	35	2	No hollows

Results of the vegetation survey within the subject site are listed in **Table A 11.1** and their location is indicated in **Figure A11.1**.

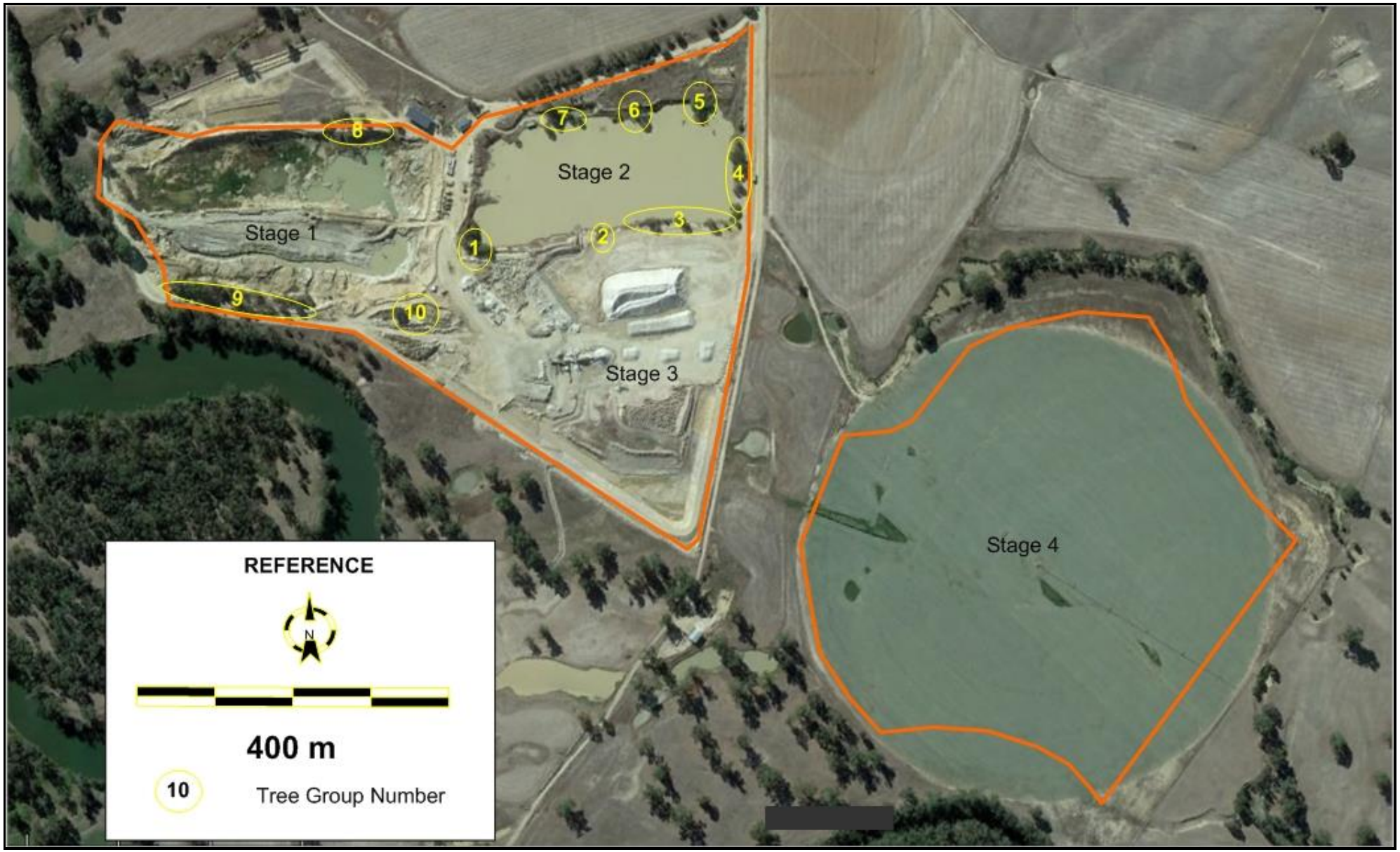


Figure A11.1 Subject site vegetation survey groups

Table A11.2 Old and new and common to both - Haul road large tree assessment

New haul road								
Tree No	**Diam (cm)**	**Height**	**Hollows (10-20 cm)**	**Canopy (diam (m)**	**Distance to new road (m)**	**Tree Protection Zone***	**Structural Root Zone***	**TPZ Encroachment* (%)**
1	150	18	Yes	15	10.0	15.0	4.0	Nil
2	198	18	Yes	12	12.0	15.0	4.5	5
4	220	22	Yes	20	50.0	15.0	4.7	Nil
5	230	18	Yes	19	25.0	15.0	4.8	Nil
6	190	19	Yes	21	21.0	15.0	4.4	Nil
7	135	18	Yes	21	21.0	15.0	4.0	Nil
8	130	22	Yes	20	26.0	15.0	4.0	Nil
9	120	20	Yes	25	12.0	15.0	3.7	4
11	235	19	Yes	22	20	15.0	5.0	Nil
12	205	20	Yes	10	17.0	15.0	4.7	Nil
Averages	**167**	**19**		**19**	**19.5**	**15**	**4**	
Old haul road								
Tree No	**Diam (cm)**	**Height**	**Hollows (10-20 cm)**	**Canopy (diam (m)**	**Distance to new road (m)**	**Tree Protection Zone***	**Structural Root Zone***	**TPZ Encroachment* (%)**
13	135	14	Yes	10	11.0	15.0	4.0	8
14	125	14	Yes	14	12.0	14.4	3.8	4
15	135	14	Yes	14	11.0	15.0	4.0	8
16	130	16	Yes	15	11.0	15.0	4.0	8
17	110	15	Yes	12	11.0	13.2	3.7	4
18	100	14	No	3	11.0	12.0	3.6	1
19	130	24	Yes	15	12.0	15.0	4.0	5
20	150	24	Yes	20	12.0	15.0	4.0	5
21	150	23	Yes	10	13.0	15.0	4.0	3
22	140	13	Yes	6	12.0	15.0	4.0	5
23	40	13	No	8	9.0	4.8	2.5	Nil
24	45	13	No	6	9.0	5.4	2.5	Nil
25	60	15	No	1	10.0	7.2	2.9	Nil
26	30	14	No	2	7.0	3.6	2.0	Nil
27	35	14	No	2	7.0	4.2	2.3	Nil
Averages	**88**	**16**		**7**	**10.3**	**10**	**3**	
Common to old and new road								
Tree No	**Diam (cm)**	**Height**	**Hollows (10-20 cm)**	**Canopy (diam (m)**	**Distance to new road (m)**	**Tree Protection Zone***	**Structural Root Zone***	**TPZ Encroachment* (%)**
3	155	19	Yes	18	22.0	15.0	4.0	Nil
10	160	21	Yes	21	9.0	14.4	4.2	11
Averages	**186**	**20**		**17**	**11.4**	**15**	**4**	

*TPZ, SRZ and Encroachment calculations refer and Tree Tec calculator (http://www.treetec.net.au/TPZ_SRZ_DBH_calculator.php)

The realignment of the haul road results in only two remnant trees (T2, T9) having very minor encroachment into their tree protection zone. This compares with ten trees is included) having minor encroachment and two trees, if T11 (5m to road) is included, that would have major encroachment on the old alignment. The new alignment changes the average distance between the road and large remnant trees from 10.3 m on the old road to 19.5 m on the new road

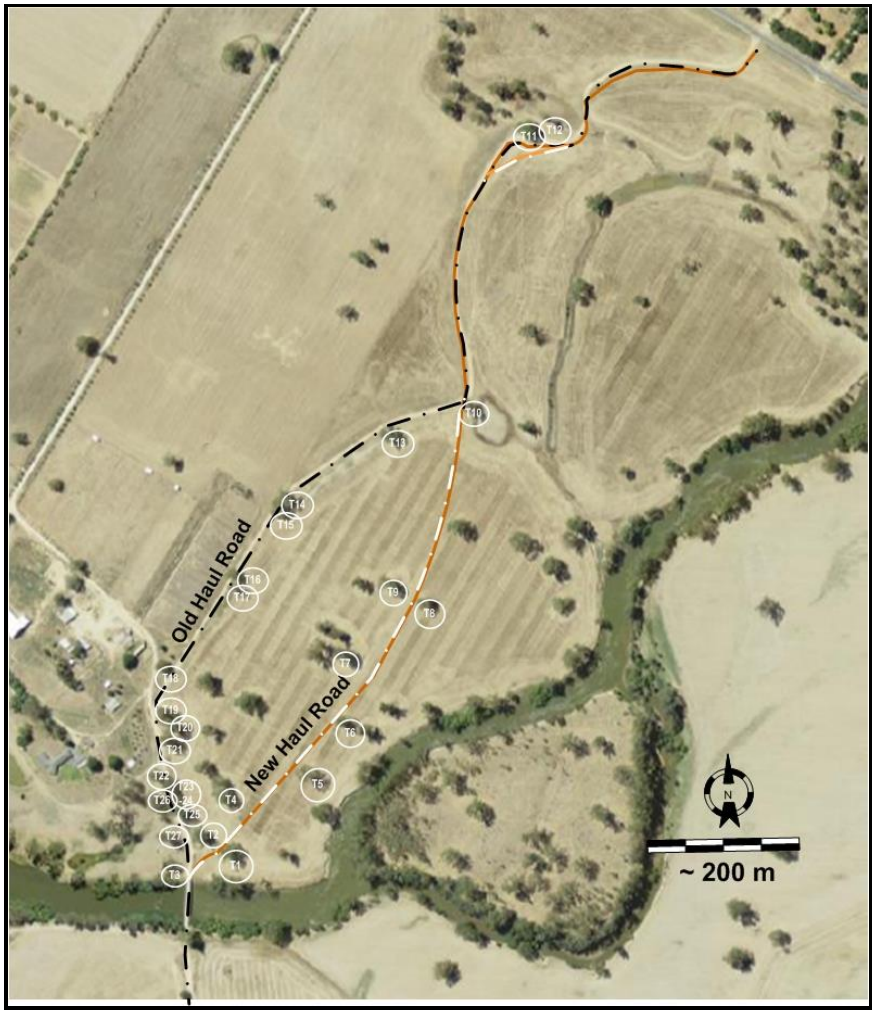
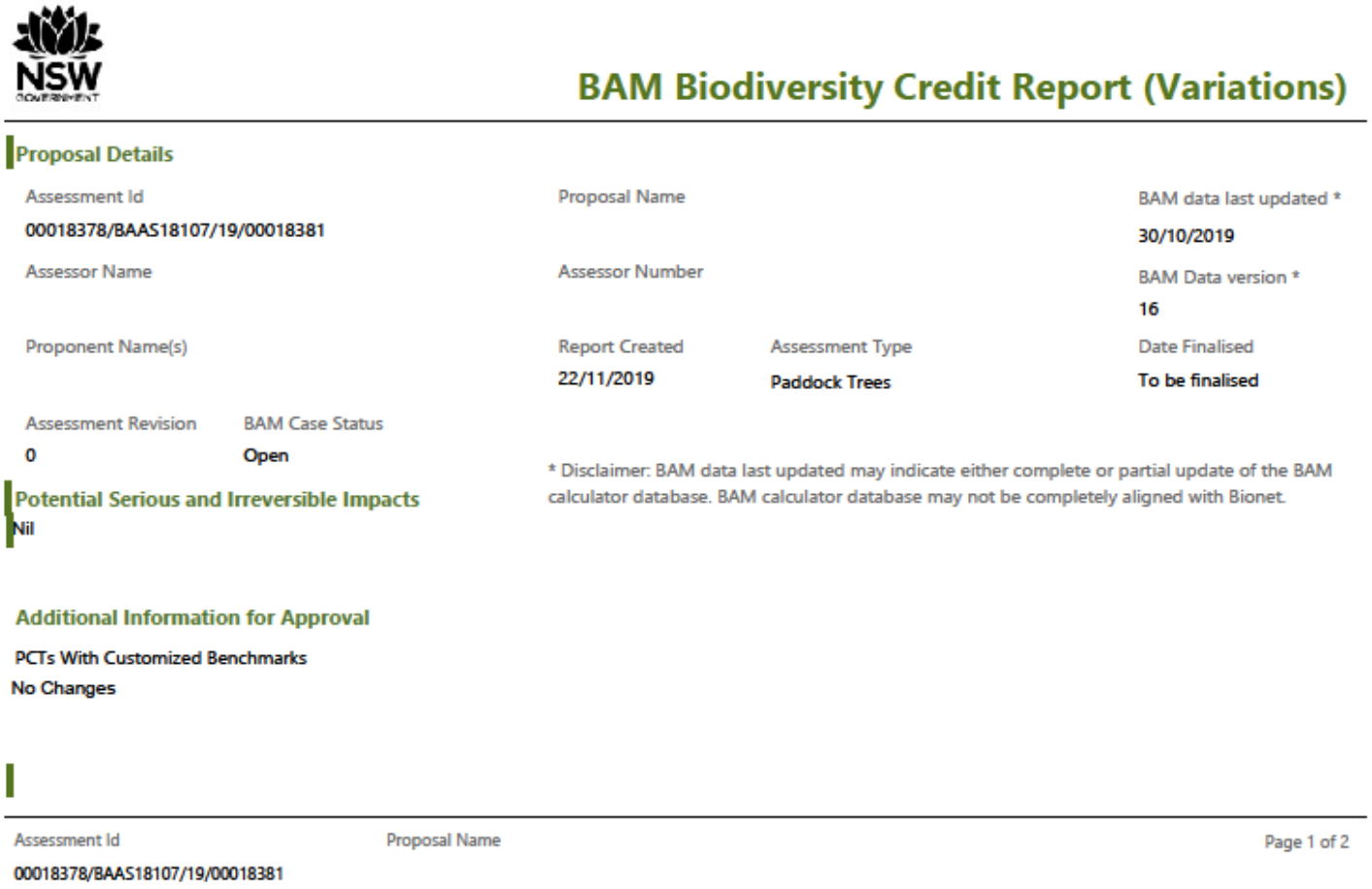


Figure A11.2. Haul Road and remnant Red gums

Appendix 12 BAM Calculator Reports



NSW GOVERNMENT

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00018378/BAAS18107/19/00018381

Proposal Name

BAM data last updated *
30/10/2019

Assessor Name

Assessor Number

BAM Data version *
16

Proponent Name(s)

Report Created
22/11/2019

Assessment Type
Paddock Trees

Date Finalised
To be finalised

Assessment Revision
0

BAM Case Status
Open

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

Potential Serious and Irreversible Impacts

Nil

Additional Information for Approval

PCTs With Customized Benchmarks
No Changes

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id **00018378/BAAS18107/19/00018381**	Proposal Name	BAM data last updated * **30/10/2019**
Assessor Name	Assessor Number	BAM Data version * **16**
Proponent Names	Report Created **22/11/2019**	Date Finalised **To be finalised**
Assessment Revision **0**	Assessment Type **Paddock Trees**	BAM Case Status **Open**

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

Potential Serious and Irreversible Impacts

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00018378/BAAS18107/19/00018381

Proposal Name

BAM data last updated *
30/10/2019

Assessor Name

Assessor Number

BAM Data version *
16

Proponent Name(s)

Report Created
22/11/2019

Assessment Type
Paddock Trees

Date Finalised
To be finalised

Assessment Revision
0

BAM Case Status
Open

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

Potential Serious and Irreversible Impacts

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

BAM Credit Summary Report

Proposal Details

Assessment Id 00018378/BAAS18107/19/00018381	Proposal Name	BAM data last updated * 30/10/2019
Assessor Name	Report Created 22/11/2019	BAM Data version * 16
Assessor Number	BAM Case Status Open	Date Finalised To be finalised
Assessment Revision 0	Assessment Type Paddock Trees	

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

Paddock Trees Credit Requirement

Class	Contains hollows	Number of trees	Ecosystem credits
5-River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.			
3	False	2.0	2
			2
			2

Paddock Tree Report

Proposal Details

Assessment Id 00018378/BAAS18107/19/00018381	Assessment name	BAM data last updated * 30/10/2019
Assessor Name	Report Created 22/11/2019	BAM Data version * 16
Assessor Number	BAM Case Status Open	Date Finalised To be finalised
Assessment Revision 0	Assessment Type Paddock Trees	

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

Paddock Trees

PCT code	PCT name	No. of trees	Species	DBHOB Category	Contain hollows	Class	Assessment required
5	River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.	2	Eucalyptus camaldulensis	> 50cm	False	3	Visual assessment for hollows, presence of important habitat features and habitat suitability for threatened species

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00018378/BAAS18107/19/00018381		30/10/2019
Assessor Name	Report Created	BAM Data version *
	22/11/2019	16
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
0	Paddock Trees	

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

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name
Barking Owl	Ninox connivens
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis
Dusky Woodswallow	Artamus cyanopterus cyanopterus
Flame Robin	Petroica phoenicea
Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata
Koala	Phascolarctos cinereus
Little Eagle	Hieraaetus morphnoides
Little Lorikeet	Glossopsitta pusilla
Little Pied Bat	Chalinolobus picatus
Painted Honeyeater	Grantiella picta
Purple-crowned Lorikeet	Glossopsitta porphyrocephala
Scarlet Robin	Petroica boodang
Spotted Harrier	Circus assimilis
Superb Parrot	Polytelis swainsonii
Swift Parrot	Lathamus discolor
Varied Sittella	Daphoenositta chrysoptera
White-bellied Sea-Eagle	Haliaeetus leucogaster
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris

Appendix 13 Requirements for a Biodiversity Development Assessment Report – streamlined assessment modules

THE FOLLOWING HIGHLIGHTED SECTIONS HAVE BEEN INCORPORATED IN THE BDAR

Table 28: Minimum information requirements for the Biodiversity Development Assessment Report – streamlined assessment modules

Report section	Information	Maps & data	BAM reference
Introduction	Introduction to the biodiversity assessment including: • identification of development/ footprint, including the operational footprint • general description of development • sources of information used in the assessment, including reports and spatial data (optional).	• Site Map (as described in Section 4.2) • Location Map (as described in Section 4.2) • Digital shape files for all maps and spatial data	
Landscape features	Identification of landscape features at the development site including: • IBRA bioregions and subregions • any landscape feature • site context components, including percent native vegetation cover in the buffer area.	• IBRA bioregions and subregions (as described in Paragraphs 4.2.1.3–4.2.1.4)	Sections 4.2 and 4.3, Appendix 3
Native vegetation	Identify the PCTs within the development site, including: • vegetation class • vegetation type • area (ha) for each PCT • information used to identify a PCT being field assessment or best available native vegetation map (as outlined in Paragraph 5.2.1.12) • Identify each TEC and area (as outlined in Paragraphs 5.2.1.14–5.2.1.15) • patch size (development site and biodiversity stewardship site) • table showing the vegetation integrity score for each vegetation zone.	• Map of PCTs within the development /biodiversity stewardship site • Map of EECs (Described) • Table of plot data for each attribute • Patch size of intact native vegetation (as described in Subsection 5.3.2) • Table of current vegetation integrity scores for each vegetation zone	Chapter 5

Report section	Information	Maps & data	BAM reference
Threatened species	Identify ecosystem credit species associated with PCTs on both the development site and biodiversity stewardship site as outlined in Section 6.2, including: • list of species derived • justification for exclusion of any ecosystem credit species predicted above. Non excluded Where required, identify species credit species on both the development site and the biodiversity stewardship site as outlined in Sections 6.3 to 6.5, including: • list of candidate species assessed • justification for inclusions and exclusions based on habitat features • indication of presence based on targeted survey or expert report • details of targeted survey (Separate Report) • species polygons • biodiversity risk weighting for the species • threatened species survey. Table detailing species and habitat feature/component associated with species and its abundance on site (as described in Paragraph 6.4.1.34 Species habitat and abundance described in Section 4.3	• Table of habitats or habitat components and their sensitivity classes for each species • Species credit species polygons (as described in Paragraph 6.4.1.33) • Species credit species not found so no polygons presented	Chapter 6
Avoid and minimise impacts	Demonstration of efforts to avoid and minimise impact on biodiversity values in accordance with Section 8. Assessment of direct and indirect impacts unable to be avoided at the development site in accordance with Sections 9.1 and 9.2.	• Table of measures to be implemented before, during and after construction to avoid and minimise the impacts of the project, including action, outcome, timing and responsibility Addressed in detail in EIS Rehabilitation Report	Chapter 8

Report section	Information	Maps & data	BAM reference
Impact summary	Description of the impact on PCTs/TECs Description of the impact on threatened species Table showing for each PCT/TEC for each vegetation zone at the development site: • current vegetation integrity score	• Table of PCTs requiring offset and the number of ecosystem credits required	Subsections 11.2.3 and 11.2.4
	• future vegetation integrity score (Equations 17 and 18 in Appendix 6) • change in vegetation integrity score (Subsection 9.1.3) • biodiversity risk weighting • BC Act listing status • number of required ecosystem credits for each PCT (Subsection 11.2.3) No ecosystem credits required name of each species assessed for species credits and the number of credits required for species (Subsection 11.2.4).	• Table of threatened species requiring offset and the number of species credits required	
Biodiversity credit report	Credit classes for ecosystem credits and species credits at the development site.	• Produced by the BAM Credit Calculator	Section 11.3

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