

Detailed Flora and Vegetation Assessment

Carrabungup Road, Nirimba

Project No: EP20-102(01)

**Prepared for Shire of Murray
February 2021**



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Executive Summary

The Shire of Murray engaged Emerge Associates (Emerge) to undertake a detailed flora and vegetation survey along section of Carrabungup Road in Nirimba (referred to herein as the 'site'). Emerge were engaged to conduct a detailed assessment to provide information on the flora and vegetation values to inform a clearing permit application.

As part of the assessment a desktop review of relevant background information was completed and a field survey was undertaken in September and December 2020. During the field survey an assessment was made on the type, condition and values of vegetation across the site.

Outcomes of the survey include the following:

- The site contains approximately 0.48 ha of native vegetation (plant communities **CcCo** and **ErM**) present in predominately 'degraded' condition.
- The remainder of the site comprises unsealed road, bare ground or 'completely degraded' non-native vegetation (3.31 ha/87%).
- One threatened flora species, *Diuris drummondii* (tall donkey orchid), was recorded during the survey. A total of 307 individuals were recorded of which 47 provisionally occur within the site.
- No other threatened or priority species were recorded or are considered to occur due to a lack of suitable habitat or because they were not recorded during the field survey.
- No threatened or priority ecological communities occur within the site.
- Native eucalypts within site have potential to provide a relatively minor foraging resource for threatened species of black cockatoo along with other ecological services.
- Grass and herb weed cover was high across the site. Two declared pests were recorded, **Moraea flaccida* (one leaf cape tulip) and **Zantedeschia aethiopica* (arum lily), which are listed in the exempt keeping category under the *Biosecurity and Agriculture Management Act 2007* for which no permit or conditions are required.

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Conservation Significant Communities and Likelihood of Occurrence Assessment

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Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
EPA	Environmental Protection Authority
DBCA	Department of Biodiversity, Conservation and Attractions
DoW	Department of Water (now DWER)
DWER	Department of Water and Environmental Regulation
DPaW	Department of Parks and Wildlife (now DBCA)
WALGA	Western Australia Local Government Association

Table A2: Abbreviations – General terms

General terms	
CCW	Conservation category wetland
ESA	Environmentally sensitive area
FCT	Floristic community type
IBRA	Interim Biogeographic Regionalisation of Australia
MUW	Multiple use wetland
NVIS	National Vegetation Inventory System (ESCAVI 2003)
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
P5	Priority 5
PEC	Priority ecological community
REW	Resource enhancement wetland
T	Threatened
TEC	Threatened ecological community
UFI	Unique feature identifier

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Table A3: Abbreviations –Legislation

Legislation	
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
EP Act	<i>Environmental Protection Act 1986</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
BC Act	<i>Biodiversity Conservation Act 2016</i>
BC Regs	<i>Biodiversity Conservation Regulations 2018</i>

Table A4: Abbreviations – planning

Planning terms	
MRS	Metropolitan region scheme
PRS	Peel Region Scheme
TPS	Town planning scheme

Table A5: Abbreviations – units of measurement

Units of measurement	
cm	Centimetre
ha	Hectare
m	Metre
m AHD	m in relation to the Australian height datum
mm	Millimetre

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1 Introduction

1.1 Project background

The Shire of Murray (the Shire) intends to widen a section of Carrabungup Road in Nirimba. The relevant portions of this road and the associated road reserve is referred to herein as the 'site'.

The site is located approximately 80 kilometres (km) south west of the Perth Central Business District within the Shire of Murray and is zoned 'rural' under the *Peel Region Scheme* (PRS) and 'rural' under the Shire of Murray *Local Planning Scheme* (LPS) No. 4.

The site is approximately 3.80 hectares (ha) in size and is bound by the remainder of Carrabungup Road to the north west, Greenlands Road and Lake Meelup Road to the south east and rural land to all other sides. The location and extent of the site is shown in **Figure 1**.

1.2 Purpose and scope of work

Emerge Associates (Emerge) were engaged by the Shire to conduct a flora and vegetation survey of the site to inform a clearing permit application and road design and construction. The purpose of this survey is to provide sufficient information on the flora and vegetation values within the site to inform these processes.

The scope of work was specifically to undertake a flora and vegetation assessment to the standard required of a 'detailed' survey in accordance with the Environmental Protection Authority's (EPA's) technical guidance (EPA 2016).

As part of this scope of work, the following tasks were undertaken:

- Desktop review of relevant background information pertaining to the site and surrounds, including database searches for threatened flora species and ecological communities.
- Compilation of a comprehensive list of flora species recorded as part of the field survey.
- Mapping of plant communities, vegetation condition and conservation significant flora and vegetation.
- Identification of potential habitat for conservation significant flora and vegetation and an assessment of likelihood of occurrence.
- Documentation of the desktop assessment, survey methodology and results into a report.

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2 Environmental Context

2.1 Climate

Climate has a strong influence on the types of vegetation that grow in a region and the life cycles of the flora present. It is therefore critical for a flora and vegetation survey to respond appropriately to climatic conditions to ensure that surveys are conducted during times when flora species are easiest to detect and identify.

The south west of Western Australia experiences a Mediterranean climate of hot dry summers and cool wet winters. In Mediterranean type climates some flora species will typically spend part of their lifecycle as either underground storage organs or as seed. This is an adaptation to unfavourable environmental conditions such as excessive heat and drought that occur over the summer period. These species, known as 'geophytes' or 'annuals', tend to re-emerge during winter when favourable conditions return and are most visible during spring, which is the flowering period for a majority of plant species. Therefore, spring is the optimal time to complete flora and vegetation surveys in the south west of WA.

An average of 680.6 millimetres (mm) of rainfall is recorded annually from the Pinjarra South weather station, which is the closest weather station, located approximately 11 km east of the site. The majority of this rainfall is received between the months of May and September.

Mean maximum temperatures at the Halls Head weather station, which is the nearest temperature recording station approximately 13.5 km north west of the site, range from 17.3°C in July to 29.6°C in February. Mean minimum temperatures at the Halls Head weather station, which is the nearest temperature recording station approximately 15 km north west of the site, range from 10.7°C in July to 19.4°C in February (BoM 2021).

A total of 353.6 mm of rain was recorded from May to August 2020 prior to the survey, which is approximately 79% of the mean of 447.2 mm for this period (BOM 2021). Although slightly lower than the annual mean, the amount of rainfall was considered to have been sufficient to promote the flowering and emergence of native flora based on species inventory recorded (refer **Section 0**).

2.2 Geomorphology and soils

Landform and soils influence vegetation types at regional and local scales. The site occurs on the Swan Coastal Plain, which is the geomorphic unit that characterises much of the Perth metropolitan area.

The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly the Swan Coastal Plain consists of two sedimentary belts of different origin. On its eastern side is the Pinjarra Plain which has formed from the deposition of alluvial material washed down from the Darling Scarp. The western side is comprised of three dune systems referred to as the Quindalup, Spearwood and Bassendean associations that run roughly parallel to the Indian Ocean coastline: the (Kendrick *et al.* 1991; Seddon 2004).

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The site lies within the Bassendean dune association (Gozzard 2011). Examination of broad scale soil mapping places the majority of the site within the Southern River association (Churchward and McArthur 1980). The Southern River association is located in the transitional zone between the Bassendean dune system and the Pinjarra Plain, where sands from the Bassendean dunes overlay the alluvial soils of the Pinjarra Plain. The northern portion of the site lies within the Vasse association, which comprises poorly drained plains with variable undifferentiated estuarine and marine deposits (Churchward and McArthur 1980).

The site is not known to contain any restricted landforms or unique geological features.

2.3 Topography

The elevation of the site ranges from 2 m in relation to the Australian height datum (mAHD) to 3 m AHD (DoW 2008), as shown in **Figure 1**.

2.4 Hydrology and wetlands

Wetlands include “areas of seasonally, intermittently or permanently waterlogged soils or inundated land, whether natural or otherwise, fresh and saline, e.g. waterlogged soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries” (Wetlands Advisory Committee 1977). Wetlands can further be recognised by the presence of vegetation associated with waterlogging or the presence of hydric soils such as peat, peaty sand or carbonate mud (Hill *et al.* 1996).

Wetlands of national or international significance may be afforded special protection under Commonwealth or international agreements. The following lists of important wetlands were checked as part of this assessment:

- *Ramsar List of Wetlands of International Importance* (DBCA 2017b)
- *A Directory of Important Wetlands in Australia* (DBCA 2018).

No Ramsar or important wetlands are mapped as occurring within the site. The Peel-Yalgorup system Ramsar wetland, which is also mapped as the Peel-Harvey estuary important wetland, is located approximately 500 m north of the site.

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2018) shows no hydrological features within the site. Two drains (‘drain – major’) are identified close to the east of the site and two wetlands (‘swamp – perennial’) are identified near the south east corner of the site.

On the Swan Coastal Plain DBCA (2017a) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period). The Department of Biodiversity, Conservation and Attractions (DBCA) maintains the *Geomorphic Wetlands of the Swan Coastal Plain* dataset (DBCA 2020), which further categorises geomorphic wetland features into specific management categories to guide land use and conservation. Note that as this dataset was drafted at a regional scale the boundaries of mapped wetland features are often inconsistent with physical wetland boundaries.

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A review of the *Geomorphic Wetlands, Swan Coastal Plain* dataset (DBCA 2020) indicated that nearly all of the site lies within a 'multiple use' category wetland feature (UFI 15227). Multiple other features occur in the wide local area. UFI 15227 is classified as a palusplain wetland and extends to the east and south west of the site.

The locations of the hydrological and wetland features in the site and local area are shown in **Figure 2**.

2.5 Regional vegetation

Native vegetation is described and mapped at different scales in order to illustrate patterns in its distribution. At a continental scale the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides the Swan Coastal Plain into two floristic subregions (Environment Australia 2000). The site is contained within the 'SWA02' or Perth subregion, which is characterised as mainly containing *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; and woodland of *Eucalyptus gomphocephala* (tuart), *E. marginata* (jarrah) and *Corymbia calophylla* (marri) on less leached soils (Beard 1990). This subregion is recognised as a biodiversity hotspot and contains a wide variety of endemic flora and vegetation types.

Variations in native vegetation within the site can be further classified based on regional vegetation complexes. Heddlé *et al.* (1980) mapping shows the northern portion of the site lies within the 'Vasse' complex, which is described as a 'mixture of the closed scrub of *Melaleuca* spp. fringing woodland of *Eucalyptus rudis* - *Melaleuca* spp. and open forest of *Eucalyptus gomphocephala* - *Eucalyptus marginata* - *Corymbia calophylla*'. The central and southern portions of the site are mapped as comprising the 'Southern River' complex, which is described as 'open woodland of *Corymbia calophylla* - *Eucalyptus marginata* - *Banksia* spp. with fringing woodland of *Eucalyptus rudis* - *Melaleuca raphiophylla* along creek beds'.

The 'Vasse' complex was determined to have 31.40% remaining in 2018, of which 13.45% is under formal protection (Government of Western Australia 2019). The 'Southern River' complex was determined to have 318.43% remaining in 2018, of which 1.37% is under formal protection (Government of Western Australia 2019).

More recent Beard *et al.* (2013) mapping shows the site comprises vegetation association 'Pinjarra_968'. This association is described as 'medium woodland; jarrah, marri & wandoo' (Beard *et al.* 2013). 'Pinjarra_968' association has 6.6% of its pre-European extent remaining on the Swan Coastal Plain with 1.18% protected for conservation purposes (Government of Western Australia 2018).

Studies have indicated that the loss of biodiversity caused by habitat fragmentation is significantly greater once a habitat type falls below 30% of its original extent (Miles 2001). The national objectives and targets for biodiversity conservation established an objective of retaining 30% of the original extent of each vegetation complex (Environment Australia 2001). However, a lower objective of 10% is applied in 'constrained urban areas' such as the Swan Coastal Plain (Ministry for Planning 1995). The percentage protected for conservation of the above three complexes fall below the 30% retention objective and the 'Southern River' and 'Pinjarra_968' complexes fall below the 10% retention objective.

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2.6 Historic land use

Review of historical images available shows that part of the site had been cleared of native vegetation as a road and associated rural landuse prior to 1979 (WALIA 2020).

2.7 Significant flora and vegetation

2.7.1 Threatened and priority flora

Certain flora taxa that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, flora taxa may be listed as 'threatened' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened flora species listed under the EPBC Act are assigned a conservation status according to attributes such as population size and geographic distribution. Any action likely to have a significant impact on a taxon listed under the EPBC Act requires Ministerial approval.

In Western Australia flora species may also be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act). Similarly, it is an offence to 'take' or 'disturb' threatened flora listed under the BC Act without Ministerial approval.

Flora species that do not currently meet the criteria for listing as threatened but are potentially rare or threatened may be added to the DBCA's *Priority Flora List*. These species are classified into 'priority' levels based on threat. Whilst priority species are not under direct statutory protection, they are considered during State approval processes. Further information on threatened and priority species and their categories is provided in **Appendix A**.

2.7.2 Threatened and priority ecological communities

An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. An ecological community's structure, composition and distribution are influenced by environmental factors such as soil type, position in the landscape, altitude, climate and water availability (DAWE 2020). 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

Selected TECs are afforded statutory protection at a Commonwealth level under the EPBC Act. Similar to flora species, TECs listed under the EPBC Act are assigned a conservation status. Any action likely to have a significant impact on a community listed under the EPBC Act requires Ministerial approval.

TECs are also listed within Western Australia under the BC Act and the BC Regulations. Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

A plant community that is under consideration for listing as a TEC in Western Australia, but does not yet meet survey criteria or has not been adequately defined, may be listed as a 'priority ecological

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community' (PEC). Listing as a PEC is similarly considered during State approval processes. Further information on categories of TECs and PECs is provided in **Appendix A**.

2.7.3 Local and regional significance

Flora species and ecological communities may be significant for a number of reasons irrespective of whether they have special protection under policy or legislation.

A key reason that vegetation within the site may be significant is that it has value as habitat for threatened species including, in particular, Carnaby's black cockatoo, Baudin's black cockatoo and the forest red-tailed black cockatoo, which are listed under the EPBC Act and BC Act.

2.7.4 Weeds

The term 'weed' can refer to any plant that requires some form of action to reduce its effect on the economy, the environment, human health and amenity. Many non-native flora species and some native species are considered to be weeds.

A particularly invasive or detrimental weed species may be listed as a 'declared pest' pursuant to Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act), indicating that it warrants special management to limit its spread. At a National level, the Australian government has compiled a list of 32 *Weeds of National Significance* (WoNS) (DAWE 2020c). Whilst the WoNS list is non-statutory, many WoNS are also listed under the BAM Act. Further information on categories of declared pests is provided in **Appendix A**.

Due to historical disturbance weed species are expected to be present at the site.

2.8 Environmentally sensitive areas

'Environmentally sensitive areas' (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding values such as significant wetlands, threatened flora, threatened communities and *Bush Forever* sites. Within an ESA none of the exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* apply. However, exemptions under Schedule 6 of the EP Act still apply, which includes any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the EP Act).

Part of one ESA occurs within the south western portion of the site. This ESA appears to be associated with wetland features. Other ESAs also occur outside of the site in the local area. The location of the ESAs in the site and local area are shown in **Figure 3**.

2.9 Regional natural areas

Environmental Protection Bulletin no. 12 *Swan Bioplan – Peel Regionally Significant Natural Areas* (EPB 12) (EPA 2013) is used to inform strategic land use planning in the Peel Region by identifying 'Peel regionally significant natural areas' (Peel RSNAs). Peel RSNAs are natural areas which have significant flora, vegetation and landform values that represent the original landscape of the Peel Region. Development proposals which may potentially impact upon a Peel RSNA require detailed

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flora, vegetation and fauna investigations to be undertaken. Based on the outcomes of these investigations, development proposals should firstly aim to avoid, and then minimise, potential impacts on identified natural areas.

No Peel RSNAs occur within the site. Multiple Peel RSNAs occur to the north and west of the site in association with the Peel-Harvey estuary, as shown in **Figure 3**.

2.10 Ecological linkages

Ecological linkages are linear landscape elements that allow the movement of fauna, flora and genetic material between areas of remnant habitat. This exchange of genetic material between vegetation remnants improves the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth Metropolitan Region (WALGA and PBP 2004). This study was extended beyond the Perth Metropolitan Region through the South West Biodiversity Project, resulting in the identification and mapping of the South West regional ecological linkages (Molloy *et al.* 2009).

One mapped ecological linkage occurs within and adjacent to the site (no. 27). This linkage extends to the north and south of the site and connects to other mapped linkages. The location of the linkage within the site is shown in **Figure 3**.

2.11 Previous surveys

No previous surveys of the site are known to have been completed.

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3 Methods

3.1 Desktop assessment

A search was conducted for threatened and priority flora that may occur or have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DAWE 2020a), *NatureMap* (DBCA 2020) and DBCA's threatened and priority flora database (reference no. 24-0920FL).

A search was also conducted for TECs and PECs that may occur or have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DAWE 2020a), the *weed and native flora dataset* (Keighery *et al.* 2012) and DBCA's threatened and priority ecological communities' databases (reference no. 61-102EC).

Prior to undertaking the field survey, information on the habitat preferences of threatened and priority flora species and communities identified from database searches was reviewed. This was compared to existing environmental information available for the site, such as geomorphology, soils, regional vegetation and historic land use, to identify species and communities for which habitat may occur in the site.

3.2 Field survey

Botanists from Emerge visited the site on 22 September and 12 December 2020 to conduct the flora and vegetation field survey. The majority of the flora and vegetation sampling was undertaken during the September field survey and a targeted flora survey was undertaken during the December survey.

3.2.1 Flora and vegetation

The site was traversed on foot and the composition and condition of vegetation was recorded.

No formal sampling was conducted as most native vegetation within the site had been cleared historically and showed signs of disturbance. Instead, plant taxa were recorded systematically across the site. Photographs were taken throughout the field visit to show particular site conditions.

The suitability of habitat within the site for conservation significant species identified in the desktop assessment was assessed (refer **Section 3.1**). Where identified, areas of suitable habitat were traversed to search for conservation significant species.

All plant specimens collected during the field survey were dried, pressed and then named in accordance with requirements of the Western Australian Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Flora species not native to Western Australia are denoted by an asterisk ('*') in text and raw data.

Vegetation condition was assigned at each sample and changes in vegetation condition were also noted and mapped across the site. The condition of the vegetation was assessed using methods from Keighery (1994).

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Table 1: Vegetation condition scale applied during the field assessment

Condition category	Definition (Keighery 1994)
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

3.2.2 Weeds

Weed cover was assigned by weed suites determined based on the dominant weed types present including grasses, herbaceous weeds and bulbous weeds. Flora species listed as 'declared pests' and/or weeds of national significance (WoNS) were located and mapped separately as points.

3.3 Mapping and data analysis

3.3.1 Conservation significant flora and vegetation

Based on the information recorded during the field survey, an assessment of the likelihood of occurrence of threatened and priority flora species and communities within the site was undertaken using the categories outlined in **Table 2**.

Table 2: Likelihood of occurrence assessment categories and definitions

Likelihood	Definition
Recorded	The species was recorded during the current field survey.
Likely	The site contains suitable habitat for the species and it is likely the species may occur based on presence of a recent historical record within or close to the site.
Possible	The site contains suitable habitat for the species but there is no other information to suggest that the species may occur within or close to the site.
Unlikely	The site does not contain suitable habitat for the species <u>or</u> the site contains suitable habitat for the species within which thorough targeted searches were completed and conclusion has been made that the species is unlikely to be present.

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3.3.2 Plant community identification and description

The local plant communities within the site were identified from the sample data collected during the field survey. The vegetation was described according to the dominant species present using the structural formation descriptions of the *National Vegetation Inventory System* (NVIS) (ESCAVI 2003). The identified plant communities were mapped on aerial photography from the sample locations and boundaries were interpreted from aerial photography and notes taken in the field. Vegetation condition was mapped on aerial photography based on the locations and notes recorded during the field survey to define areas with differing condition.

3.3.3 Floristic community type assignment

No floristic analysis was conducted as most native vegetation within the site had been cleared historically.

3.3.4 Threatened and priority ecological communities

If relevant, areas of native vegetation potentially representing a TEC were assessed against key diagnostic characteristics and, if available, size and/or vegetation condition thresholds.

3.3.5 Species accumulation curve

Species accumulation was not assessed as no formal samples were collected.

3.3.6 Weeds

Weed suites were mapped on aerial photography based on the locations and notes on weed cover recorded during the field survey.

3.4 Survey limitations

It is important to note the specific constraints imposed on surveys and the degree to which these may have limited survey outcomes. An evaluation of the survey methodology against standard constraints outlined in the EPA document *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) is provided in **Table 3**.

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Table 3: Evaluation of survey methodology against standard constraints outlined in EPA (2016)

Constraint	Degree of limitation	Details
Availability of contextual information	No limitation	The broad scale contextual information described in Section 2 was adequate to place the site and vegetation in context.
Experience level of personnel	No limitation	This flora and vegetation assessment was conducted by team of experienced ecologists including a senior and a principal environmental consultant with nine- and 18-years' experience in environmental science in Western Australia respectively.
Sampling intensity	No limitation	No sampling was completed and instead flora taxa were recorded comprehensively. As most native vegetation had been cleared from the site historically it was not considered necessary to record samples in order to appropriately characterise vegetation the vegetation present.
Suitability of timing	No limitation	The survey was conducted in spring and early summer and thus within the main flowering season. Adequate rainfall was recorded from May to October 2020 in the months preceding the site visit. Therefore, it is likely that many plant species would have been in flower and/or visible at the time of survey. The survey timing was considered adequate to allow the detection of species for which seasonal timing is critical.
Temporal coverage	No limitation	Comprehensive flora and vegetation assessments can require multiple visits, at different times of year, and over a period of a number of years, to enable observation of all species present. The site was visited in September and December 2020. Both visits provided an insight into the composition and condition vegetation and according to the EPA guidelines this survey is considered to meet the requirements of a 'detailed' survey.
Spatial coverage and access	No limitation	Site coverage was comprehensive (track logged).
	No limitation	All parts of the site could be accessed as required.
Influence of disturbance	Minor limitation	Time since fire is greater than 40 years as interpreted from historical aerial imagery and therefore short-lived species more common after fire may not have been visible.
	No limitation	Historical ground disturbance and modification as part of road construction was evident in parts of the site and some native vegetation in the site is likely regrowth. The disturbance history of the site was considered when undertaking field sampling.
Adequacy of resources	No limitation	All resources required to perform the survey were available.

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4 Results

4.1 General site conditions

The site is generally flat and includes unsealed gravel road with shallow road side swales along the western and eastern boundaries. Soils include the gravel road base and sandy to clayey earths that while sandy at surface, are essentially heavy and tending to poorly drained. The majority of the vegetation within the site, particularly the understorey, is non-native. Scattered native trees and plants occur on the margins of the site.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of 13 threatened and 35 priority flora species as having been recorded within a 10 km radius of the site. Information on these species including their habitat preferences and flowering period is provided in **Appendix B**.

Two DBCA records of one threatened species, *Diuris drummondii*, occur in one location within the south western portion of the site. One record states that approximately 200 individuals were present and the other record does not include a count.

Based on background information and site conditions available for the site, it was considered possible that six threatened flora species and 15 priority flora species could possibly occur within the site as shown in **Table 4**.

Table 4: Conservation significant flora species considered possible to occur in the site

Species name	Level of significance		Life strategy	Habitat	Flowering period
	BC Act	EPBC Act			
<i>Synaphea</i> sp. Pinjarra Plain (A.S. George 17182)	EN	CR	P	White grey clayey sand on edges of seasonally inundated low lying areas.	Sep-Oct
<i>Synaphea</i> sp. Serpentine (G.R. Brand 103)	CR	CR	P	Seasonally damp areas, loam - sand.	Sep-Oct
<i>Diuris micrantha</i>	VU	V	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep- early Oct
<i>Diuris drummondii</i>	VU	V	PG	In low-lying depressions in peaty and sandy clay swamps.	Nov-Jan
<i>Caladenia huegelii</i>	CR	E	PG	Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels.	Sep-early Nov

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Table 4: Conservation significant flora species considered possible to occur in the site (continued)

Species name	Level of significance		Life strategy	Habitat	Flowering period
	BC Act	EPBC Act			
<i>Diuris purdiei</i>	EN	E	PG	Sand to sandy clay soils in areas subject to winter inundation.	Sep-mid-Oct, only after a summer/early autumn fire
<i>Grevillea bipinnatifida</i> subsp. <i>pagna</i>	P1	-	P	Grey sandy clay and loam, ironstone. Seasonal wetlands, swamps, roadsides.	Aug or Oct-Nov
<i>Caladenia swartziorum</i>	P2	-	PG	Winter-wet creeklines and plains (limited information)	Oct
<i>Cardamine paucijuga</i>	P2	-	A	Winter wet areas, sand or clay	Sep-Oct
<i>Eryngium pinnatifidum</i> subsp. <i>Umbraphilum</i> (G.J. Keighery 13967)	P2	-	A/P	Winter wet, clay, sand or limestone soils.	Oct-Nov
<i>Trithuria australis</i>	P2	-	A	Seasonally wet areas. Edge of wetlands. Grey clay, clay over sand. Sand over laterite.	Oct-Nov
<i>Chamaescilla gibsonii</i>	P3	-	P	Clay to sandy clay in winter-wet flats, shallow water-filled claypans.	Sep
<i>Dillwynia dillwynioides</i>	P3	-	P	Winter wet depressions on sandy soils	Aug - Dec
<i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i> (G.J. Keighery 13459)	P3	-	P	Grey brown sand or clay in winter wet flats.	Sep-Nov
<i>Hemigenia microphylla</i>	P3	-	P	Sandy clay, peaty clay, granite. Winter-wet depressions.	Sep-Dec
<i>Jacksonia gracillima</i>	P3	-	P	Sand, often adjacent to winter wet areas	Sep-Dec
<i>Schoenus</i> sp. <i>Waroona</i> (G.J. Keighery 12235)	P3	-	A	Clay or sandy clay. Winter-wet flats.	Oct-Nov
<i>Acacia semitrullata</i>	P4	-	P	White/grey sand, sometimes over laterite, clay sometimes in sandplains, swampy areas.	May-Oct
<i>Rumex drummondii</i>	P4	-	P	Winter-wet disturbed areas.	Aug-Nov
<i>Tripterococcus</i> sp. <i>Brachylobus</i> (A.S. George 14234)	P4	-	P	Winter-wet areas on grey sand.	Oct-Feb
<i>Caladenia speciosa</i>	P4	-	PG	White, grey or black sand.	Sep-Oct

CR=critically endangered, E=endangered, V=vulnerable, P1-P4=Priority 1-Priority 4, P=perennial, PG=perennial geophyte.

4.2.2 Species inventory

A total of 16 native and 31 non-native (weed or planted) species were recorded within the site during the field survey, representing 16 families and 37 genera. The dominant families containing native taxa were Cyperaceae (five native taxa) and Myrtaceae (five native non-planted taxa). The families

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containing the most taxa were Myrtaceae (five native, five planted taxa) and Poaceae (ten non-native taxa).

A complete species list is provided in **Appendix D** and a species list by plant community matrix is provided in **Appendix E**.

4.2.3 Threatened and priority flora

One threatened flora species, *Diuris drummondii*, was recorded within and adjacent to the site. A total of 307 *D. drummondii* individuals were recorded. Due to spatial error of the GPS used to record the *D. drummondii* individuals, it is not possible to accurately determine the number of individuals within the site. However, based on the spatial location of the records collected, 48 individuals lie within the site and the remaining 257 are located outside of the site (as detailed in **Section 5.1**). The locations of the *D. drummondii* individuals within and adjacent to the site are shown in **Figure 4**.

No other threatened flora species or priority flora species were recorded within the site.

The remaining threatened and priority flora species identified in the desktop assessment are not considered to occur in the site, as shown in **Appendix B**.

4.3 Vegetation

4.3.1 Desktop assessment

The database search results identified 6 TECs and 4 PECs occurring or potentially occurring within a 10 km radius of the site. Information on these communities is provided in **Appendix C**.

Based geomorphology, soils and regional vegetation patterns, the following five TECs were considered to have potential to occur in the site:

- 'SCP10a - Shrublands on dry clay flats' TEC which is listed as 'critically endangered' under EPBC Act and 'endangered' in Western Australia.
- 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' TEC/PEC which is listed as 'critically endangered' under EPBC Act and 'priority 3' in Western Australia.
- 'SCP07 - Herb rich saline shrublands in clay pans' TEC which is listed as 'critically endangered' under EPBC Act and 'vulnerable' in Western Australia.
- 'SCP15 - Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain' TEC which is listed as 'vulnerable' in Western Australia.
- 'SCP25 - Southern *Eucalyptus gomphocephala*-*Agonis flexuosa* woodlands' PEC which is listed as 'priority 3' in Western Australia.

4.3.2 Plant communities

Two native plant communities and an area containing predominantly non-native species or bare ground were identified within the site. Due to the small size of the site plant community mapping is provided at a relatively fine scale such that individual native species rather than communities of native plants are identified.

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Plant community **CcCo** occurs across the north of the site and extends over 0.23 ha. Plant community **ErM** occurs across the south west side of the site and extends over 0.25 ha. The remainder of the site is cleared and contains non-native vegetation with bare soil, weeds or gravel road (3.31 ha).

A description and the area of each plant community is provided in **Table 5** and representative photographs of each are provided in **Plate 1** to **Plate 3**. The location of each plant community is shown in **Figure 5**. A matrix of species recorded within each plant community is provided in **Appendix E**.

Table 5: Description and extent of plant communities identified within the site

Plant community	Description	Area (ha)
CcCo	Low open woodland of <i>Corymbia calophylla</i> or <i>Casuarina obesa</i> over occasional <i>Xanthorrhoea preissii</i> over sedgeland of <i>Baumea juncea</i> and <i>Lepidosperma longitudinale</i> over forbland <i>*Watsonia meriana</i> , <i>*Asphodelus fistulosus</i> , <i>*Stachys arvensis</i> and <i>*Lythrum hyssopifolia</i> over grassland of <i>*Ehrharta</i> spp., <i>*Eragrostis curvula</i> , <i>*Lolium</i> sp. and <i>*Paspalum dilatatum</i> or bare ground (Plate 1).	0.23
ErM	Low open woodland to forest of <i>Eucalyptus rudis</i> , <i>Melaleuca raphiophylla</i> , <i>M. preissiana</i> over occasional <i>M. teretifolia</i> over sedgeland of <i>Typha</i> sp. and <i>Bolboschoenus caldwellii</i> over forbland <i>*Watsonia meriana</i> , <i>*Zantedeschia aethiopica</i> , <i>*Oxalis pes-caprae</i> , <i>*Lotus subbiflorus</i> and <i>*Lythrum hyssopifolia</i> over grassland of <i>*Cynodon dactylon</i> and <i>*Paspalum dilatatum</i> or bare ground (Plate 2).	0.25
Predominantly non-native species or bare ground	Heavily disturbed areas comprising gravel road, non-native trees over weeds or bare ground (Plate 3).	3.31



Plate 1: Plant community **CcCo** in 'degraded' condition

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Plate 2: Plant community *ErM* in 'degraded' condition



Plate 3: *Predominantly non-native species or bare ground* in 'completely degraded' condition

4.3.3 Vegetation condition

The most intact native vegetation in the site occurs within the patches of plant communities **CcCo** and **ErM** that supported native canopy species over native understory sedges such as *Baumea*

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juncea, *Lepidosperma longitudinale* and/or *Typha* sp. These areas were mapped as being in 'good' condition as they showed signs of disturbance, are very small and isolated and surrounded by high cover of non-native species such as grasses.

The remainder of plant communities **CcCo** and **ErM** were mapped as being in 'degraded' condition as they comprise scattered native canopy species over a non-native understorey.

The **predominantly non-native species or bare ground** areas in the site were mapped as being in 'completely degraded' condition as they comprise non-native species.

The extent of vegetation by condition category is detailed in **Table 6** and shown in **Figure 6**.

Table 6: Extent of vegetation condition categories within the site

Condition category (Keighery 1994)	Size (ha)
Pristine	0
Excellent	0
Very good	0
Good	0.01
Degraded	0.48
Completely degraded	3.31

4.3.4 Floristic community types

The vegetation within the site is too degraded to be assigned to any FCT.

4.3.5 Threatened and priority ecological communities

No TECs or PECs occur within the site (refer **Section 4.3.1** and **Appendix C**).

4.3.6 Locally and regionally significant vegetation

Some of the trees within the site have a potential to provide foraging habitat for threatened species of black cockatoos, along with other ecological services. While not specifically assessed none of the trees observed were particularly large or considered likely to be considered black cockatoo habitat trees or bear hollows suitable for use by black cockatoos.

4.4 Weeds

4.4.1 Weed cover

The dominant weeds in the site were grasses and herbs. Dominant grasses include **Bromus* sp., **Paspalum dilatatum*, **Cynodon dactylon*, **Ehrharta longiflora*, **Eragrostis curvula* and **Lolium* sp. Dominant herbs include **Lotus subbiflorus*, **Lythrum hyssopifolia*, **Oxalis pes caprae* and **Stachys arvensis*. Bulbous species occurred in isolated locations including **Moraea flaccida* and **Watsonia meriana*, **Zantedeschia aethiopica*. Both weed suites were present at 6-75% cover within the

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mapped areas. The general location of grasses and herbs weed suite and bulbous weed suite within the site is shown in **Figure 7**.

4.4.2 Declared pests

Two species listed as a declared pest (S-22) pursuant to the BAM Act were recorded within the site including **Moraea flaccida* (one leaf cape tulip) and **Zantedeschia aethiopica* (arum lily). No weeds of national significance (WoNS) were recorded within the site.

The location of declared pests is shown on **Figure 7**.

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5 Discussion

The site has been subject to significant past disturbance and modification. Approximately 87% of the site was mapped as being in 'completely degraded' condition with approximately 0.2% in 'good – degraded' condition and 13% in 'degraded' condition.

5.1 Threatened and priority flora

The timing of the survey was optimal for detecting the threatened or priority flora with potential to occur in the site. Two visits were conducted and the site was traversed comprehensively.

Generally, wetland habitats are present in the site that could provide habitat for a variety of threatened and priority flora with preferences for poorly drained, sandy clay or loamy soiled habitats (refer **Section 4.2.1**). However, the degree of disturbance reduces the likelihood that any such species would occur. Nevertheless, *Diuris drummondii* was recorded in particularly disturbed area growing out of a dense patch of **Cynodon dactylon* (couch) and *Watsonia ?meriana* (bulbil watsonia). *D. drummondii* prefers moist locations often emerging from standing water (Department of the Environment 2008). The level of weed cover amongst the *D. drummondii* individuals does not appear to have a negative impact on the plants as they appeared healthy and in full flower.

Given there is historical records of *D. drummondii* in the site it seems likely that this population is relative stable in this location. A total of 307 individuals were recorded, compared to approximately 200 in the historic record in the same location. Records for the species were collected inside and outside of the site. Due to spatial error associated with GPS points the number of *D. drummondii* individuals within the site cannot be reported precisely. Nevertheless, the species was only recorded in one part of the site and is not considered to currently occur elsewhere in the site based on habitat preferences and outcomes of the current survey.

5.2 Vegetation condition

Classifying the condition of vegetation within the site was relatively straight forward. Most of the patches of plant communities **CcCo** and **ErM** have been severely modified by historic disturbances. Due to the presence of native overstorey in most patches these plant communities were still recognisable as 'woodland' and so were classed as being in 'degraded' condition. Due to the high weed cover these patches are considered to be at the lower end of the 'degraded' category.

At a fine scale small patches of plant communities **CcCo** and **ErM** with native sedges were classified as being in 'good' condition. Small patches are difficult to characterise because as the scale of mapping reduces the vegetation condition improves as plants are mapped in isolation. However, single plants do not represent a vegetation community and so at some point there is little gained in terms of values by focussing on small patches. The small patches in 'good' condition in the site were mapped but are not considered to have significant value as remnants of native vegetation.

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5.3 Weeds

Weed cover within the site was high which is a result of the history of disturbance.

The two declared pests recorded, one leaf cape tulip and arum lily, are currently listed by the DPIRD in an 'exempt' keeping category (s-22) and so there is no requirement to take action to manage these weeds under the BAM Act.

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6 Conclusions

Native and non-native plants occur on the margins of the site but the majority comprises non-vegetated unsealed road.

One threatened flora species, *Diuris drummondii* (tall donkey orchid), was recorded during the survey. A total of 307 individuals were recorded of which 47 provisionally occur within the site. No other threatened or priority species were recorded or are considered to occur due to a lack of suitable habitat or because they were not recorded during the field survey.

The site contains approximately 0.48 ha of native vegetation (plant communities **CcCo** and **ErM**) present in predominately 'degraded' condition. The remainder of the site comprises unsealed road, bare ground or 'completely degraded' non-native vegetation (3.31 ha/87%).

Native eucalypts within site have potential to provide a relatively minor foraging resource for threatened species of black cockatoo along with other ecological services.

Grass and herb weed cover was high across the site. Two declared pests were recorded, **Moraea flaccida* (one leaf cape tulip) and **Zantedeschia aethiopica* (arum lily), which are listed in the exempt keeping category under the BAM Act for which no permit or conditions are required.

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7 References

7.1 General references

Alan Tingay and Associates 1998, *A Strategic Plan for Perth's Greenways - Final Report*. December 1998.

Beard, J. S. 1990, *Plant Life of Western Australia*, Kangaroo Press Pty Ltd., Kenthurst, N.S.W.

Beard, J. S., Beeston, G. R., Harvey, J. M., Hopkins, A. J. M. and Shepherd, D. P. 2013, *The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir. Second edition.*, Conservation Science Western Australia, 9: 1-152.

Churchward, H. M. and McArthur, W. M. 1980, 'Landforms and Soils of the Darling System, Western Australia', in Department of Conservation and Environment (ed.), *Atlas of Natural Resources Darling System Western Australia*, Department of Conservation and Environment.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017a, *A methodology for the evaluation of wetlands on the Swan Coastal Plain*, draft prepared by the Wetlands Section of the Department of Biodiversity, Conservation and Attractions and the Urban Water Branch of the Department of Water and Environmental Regulation, Perth.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017b, *Ramsar Sites (DBCA-010)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018, *Directory of Important Wetlands in Australia - Western Australia (DBCA-045)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2020, *Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)*.

(Department of the Environment, W., Heritage and the Arts,) 2008, *Approved Conservation Advice for Diuris drummondii (Tall Donkey Orchid)*, Department of the Environment, Water, Heritage and the Arts. , Canberra

Department of Environment and Energy (DoEE) 2017, *Approved Conservation Advice for Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain*, Delegate of the Minister (for Environmenta and Energy). 13 July 2017.

Department of Water (DoW) 2008, *LiDAR Elevation Dataset, Swan Coastal Plain*, Perth.

Department of Water and Environmental Regulation (DWER) 2018, *Hydrography Linear (Heirarchy) (DWER-031)*, Perth.

Environment Australia 2000, *Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and Development of Version 5.1 - Summary Report*, Department of Environment and Heritage.

Detailed Flora and Vegetation Assessment

Carrabungup Road, Nirimba



Environment Australia 2001, *National Objectives and Targets for Biodiversity Conservation 2001-2005*, Commonwealth of Australia, Canberra.

Environmental Protection Authority (EPA) 2013, *Environmental Protection Bulletin No. 12 Swan Bioplan - Peel Regionally Significant Natural Areas*, Perth.

Environmental Protection Authority (EPA) 2016, *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, Perth.

ESCAVI 2003, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*, Department of the Environment and Heritage, Canberra.

Government of Western Australia 2018, *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of December 2017*, WA Department of Biodiversity, Conservation and Attractions, Perth.

Government of Western Australia 2019, *2018 South West Vegetation Complex Statistics. Current as of March 2019*, WA Department of Biodiversity, Conservation and Attractions, Perth.

Hedde, E. M., Loneragan, O. W. and Havel, J. J. 1980, '*Vegetation Complexes of the Darling System Western Australia*', in Department of Conservation and Environment (ed.), *Atlas of Natural Resources Darling System Western Australia*, Perth.

Hill, A. L., Semeniuk, C. A., Semeniuk, V. and Del Marco, A. 1996, *Wetlands of the Swan Coastal Plain: Volume 2A - Wetland Mapping, Classification and Evaluation*, Water and Rivers Commission and the Department of Environmental Protection, Perth.

Keighery, B. 1994, *Bushland Plant Survey: A guide to plant community survey for the community*, Wildflower Society of WA (Inc), Nedlands.

Keighery, B. J., Keighery, G. J., Longman, V. M. and Clarke, K. A. 2012, *Weed and Native Flora Data for the Swan Coastal Plain*, Departments of Environmental Protection and Conservation and Land Management, Western Australia.

Kendrick, G. W., Wyrwoll, K. H. and Szabo, B. J. 1991, *Pliocene-Pleistocene coastal events and history along the western margin of Australia*, Quaternary Science Reviews, 10: 419-439.

Miles, C. 2001, *NSW Murray Catchment Biodiversity Action Plan*, Nature Conservation Working Group Inc, Albury, New South Wales.

Ministry for Planning 1995, *Urban Bushland Strategy*, Commonwealth of Australia, Canberra.

Molloy, S., Wood, J., Hall, S., Wallrodt, S. and Whisson, G. 2009, *South West Regional Ecological Linkages Technical Report*, Western Australian Local Government Association and Department of Environment and Conservation, Perth.

Seddon, G. 2004, *A Sense of Place: a response to an environment, the Swan Coastal Plain Western Australia*, Blooming Books, Melbourne.

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Semeniuk, C. A. 1987, *Wetlands of the Darling System - a geomorphic approach to habitat classification*, Journal of the Royal Society of Western Australia, 69: 95-112.

Semeniuk, C. A. and Semeniuk, V. 1995, *A Geomorphic Approach to Global Classification for Inland Wetlands*, Vegetatio, 118(1/2): 103-124.

Western Australian Local Government Association and Perth Biodiversity Project (WALGA and PBP) 2004, *Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region*, Perth.

Wetlands Advisory Committee 1977, *The status of reserves in System Six*, Environmental Protection Authority, Perth.

7.2 Online references

Bureau of Meteorology (BoM) 2020, *Climate Averages*, viewed 28 October 2020, <<http://www.bom.gov.au/climate/data/>>.

Department of Biodiversity, Conservation and Attractions (DBCA) 2020, *NatureMap*, viewed 7 September 2020 <<https://naturemap.dbca.wa.gov.au/>>.

Department of Agriculture, Water and the Environment (DAWE) 2020a, *Protected Matters Search Tool*, viewed 7 September 2020, <<https://www.environment.gov.au/epbc/protected-matters-search-tool>>.

Department of Agriculture, Water and the Environment (DAWE) 2020c, *Weeds of National Significance*, viewed 28 October 2020, <<http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>>.

West Australian Land Information Authority (WALIA) 2020, *Landgate Map Viewer*, viewed 7 September 2020, <<http://landgate.wa.gov.au>>.

Western Australian Herbarium 2020, *FloraBase – the Western Australian Flora*, Department of Biodiversity, Conservation and Attractions (DBCA), viewed 28 October 2020 <<https://florabase.dpaw.wa.gov.au/>>.

Figures



Figure 1: Site Location

Figure 2: Hydrological Features

Figure 3: Environmental Features

Figure 4: Conservation Significant Flora

Figure 5: Plant Communities

Figure 6: Vegetation Condition

Figure 7: Weeds

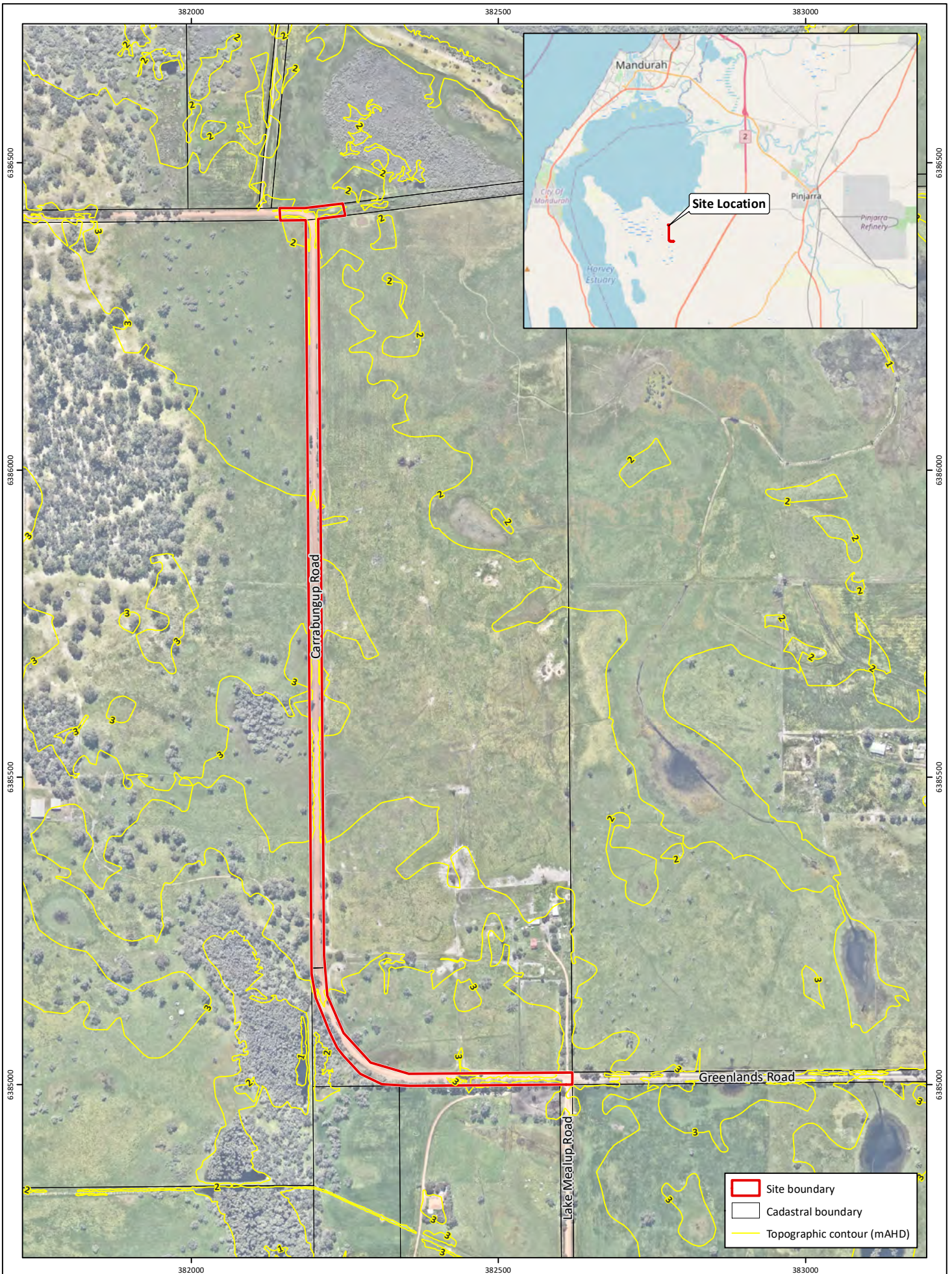


Figure 1: Site Location and Topographic Contours

Project: Detailed Flora and Vegetation Assessment
Carrabungup Road, Nirimba

Client: Shire of Murray

Plan Number: EP20-102(05)--F13
Drawn: GAR
Date: 21/01/2021
Checked: TAA
Approved: TAA
Date: 02/02/2021



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GDA 1994 MGA Zone 50



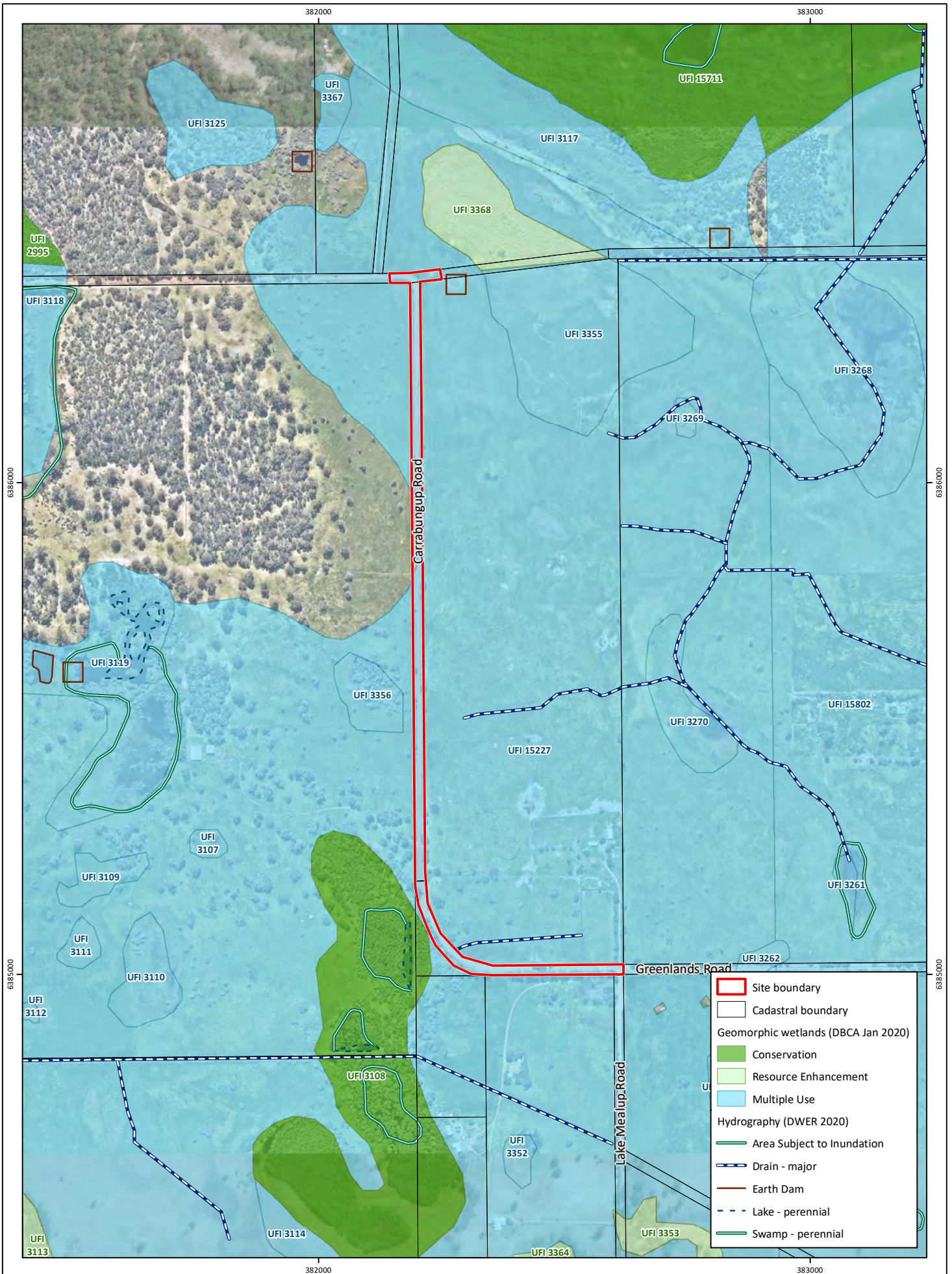


Figure 2: Hydrological Features

Project: Detailed Flora and Vegetation Assessment
Carrabungup Road, Nirimba

Client: Shire of Murray

Plan Number: EP20-102(05)--F14
Drawn: GAR
Date: 22/01/2021
Checked: TAA
Approved: TAA
Date: 02/02/2021



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GDA 1994 MGA Zone 50



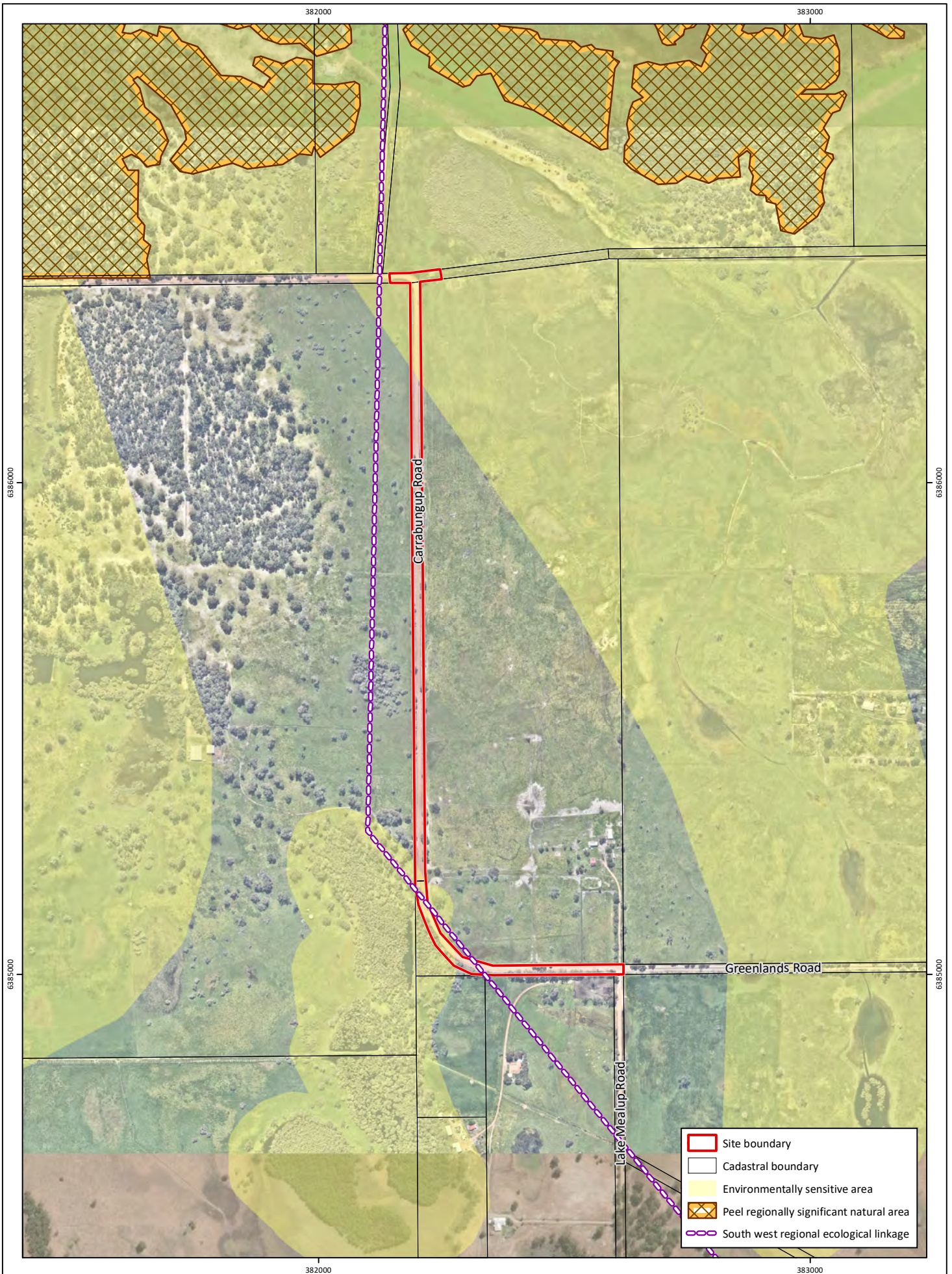


Figure 3: Environmental Features

Project: Detailed Flora and Vegetation Assessment
Carrabungup Road, Nirimba

Client: Shire of Murray

Plan Number: EP20-102(05)--F15
Drawn: GAR
Date: 22/01/2021
Checked: TAA
Approved: TAA
Date: 02/02/2021

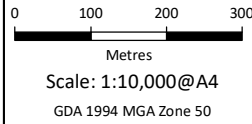




Figure 4: Conservation Significant Flora

Project: Detailed Flora and Vegetation Assessment
Carrabungup Road, Nirimba

Client: Shire of Murray

Plan Number: EP20-102(05)--F16
Drawn: GAR
Date: 22/01/2021
Checked: TAA
Approved: TAA
Date: 02/02/2021



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Scale: 1:6,000@A4
GDA 1994 MGA Zone 50



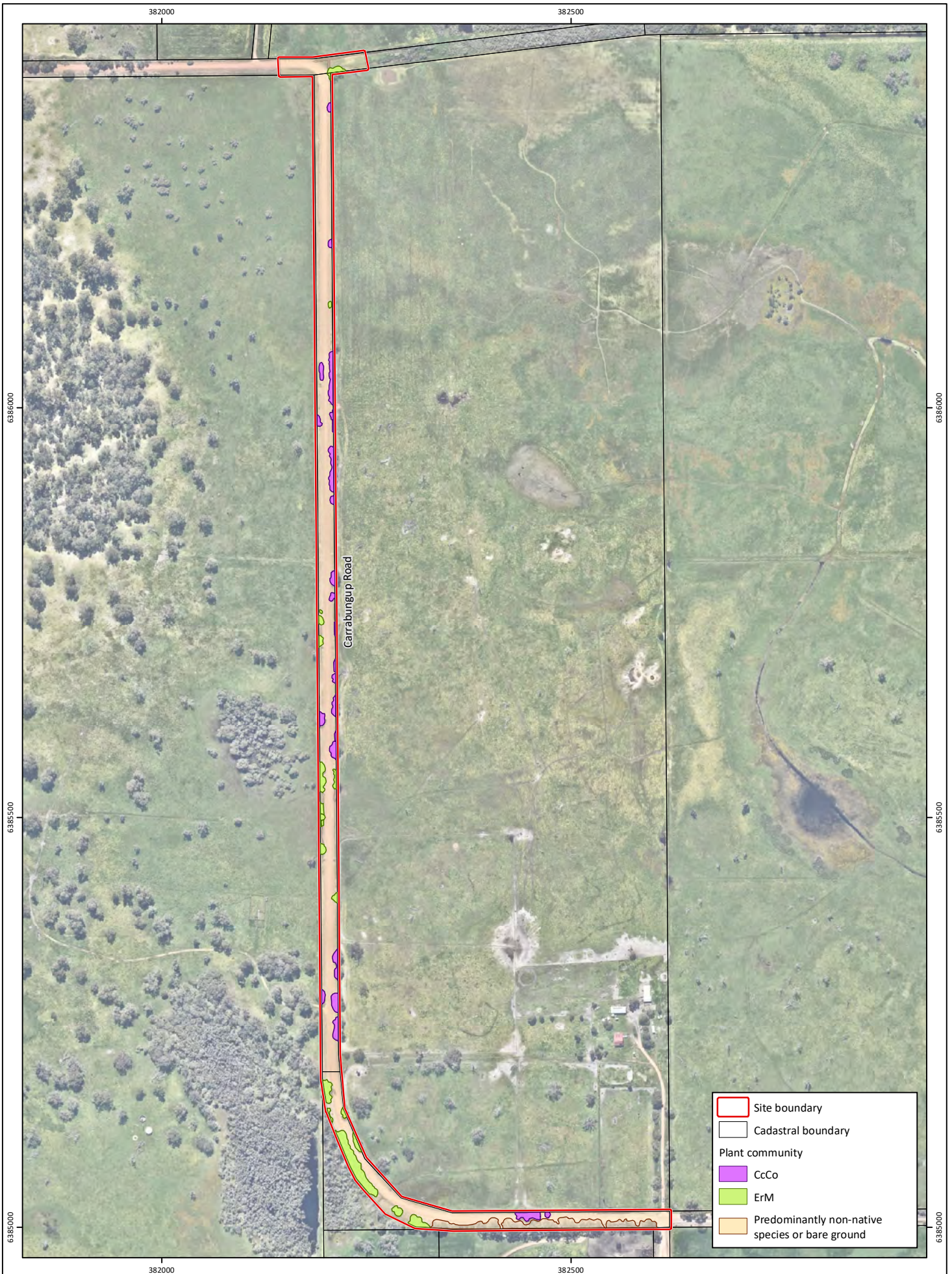


Figure 5: Plant Communities

Project: Detailed Flora and Vegetation Assessment
Carrabungup Road, Nirimba
Client: Shire of Murray

Plan Number: EP20-102(05)--F17
Drawn: GAR
Date: 22/01/2021
Checked: TAA
Approved: TAA
Date: 02/02/2021



0 50 100 150
Metres
Scale: 1:6,000@A4
GDA 1994 MGA Zone 50



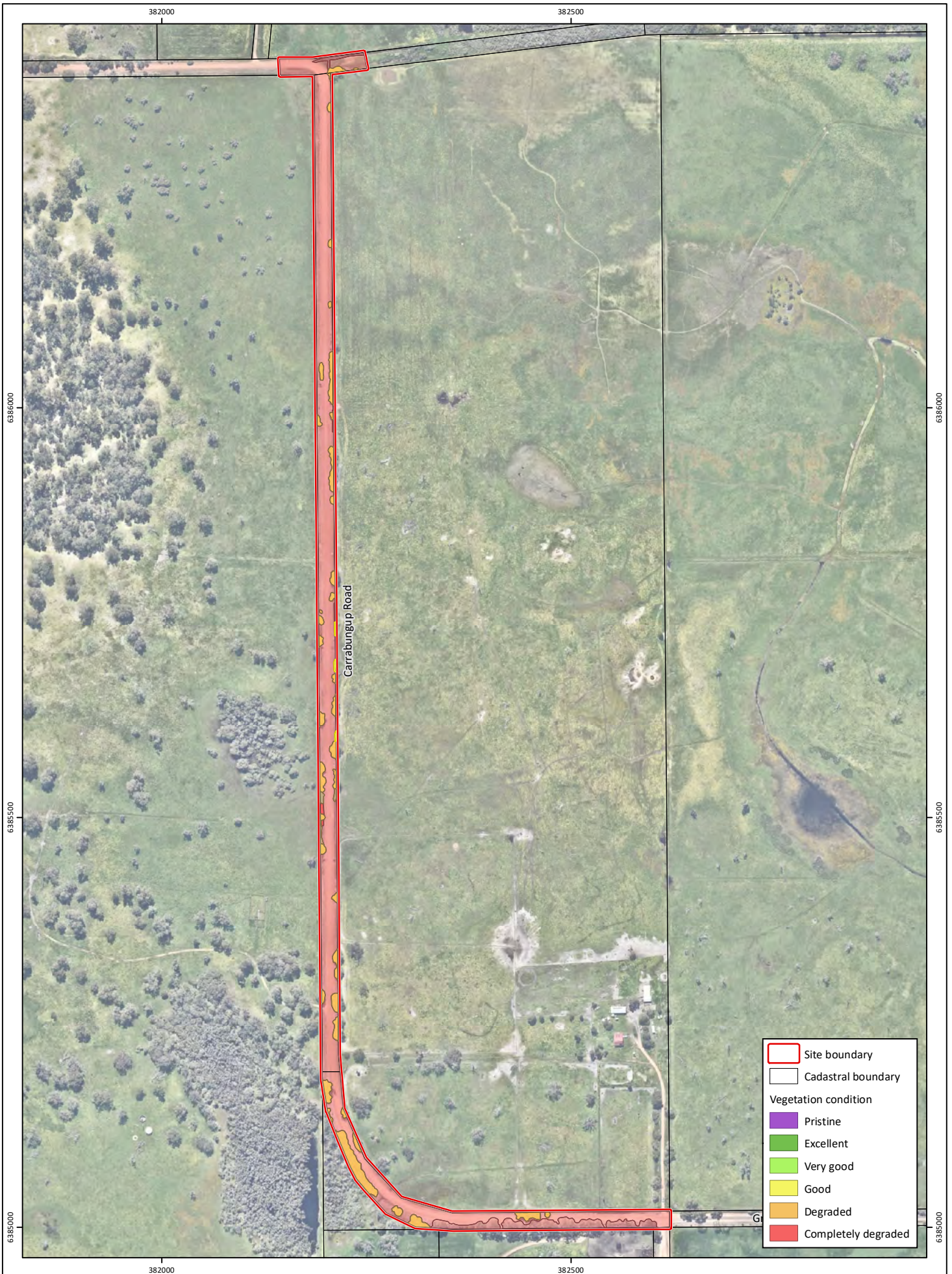


Figure 6: Vegetation Conditon

Project: Detailed Flora and Vegetation Assessment
Carrabungup Road, Nirimba

Client: Shire of Murray

Plan Number: EP20-102(05)--F18
Drawn: GAR
Date: 22/01/2021
Checked: TAA
Approved: TAA
Date: 02/02/2021



0 50 100 150
 Metres
 Scale: 1:6,000@A4
 GDA 1994 MGA Zone 50





Figure 7a: Weeds - Grasses and Herbs

Project: Detailed Flora and Vegetation Assessment
Carrabungup Road, Nirimba
Client: Shire of Murray

Plan Number: EP20-102(05)--F19
Drawn: GAR
Date: 22/01/2021
Checked: TAA
Approved: TAA
Date: 02/02/2021



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Scale: 1:6,000@A4
GDA 1994 MGA Zone 50



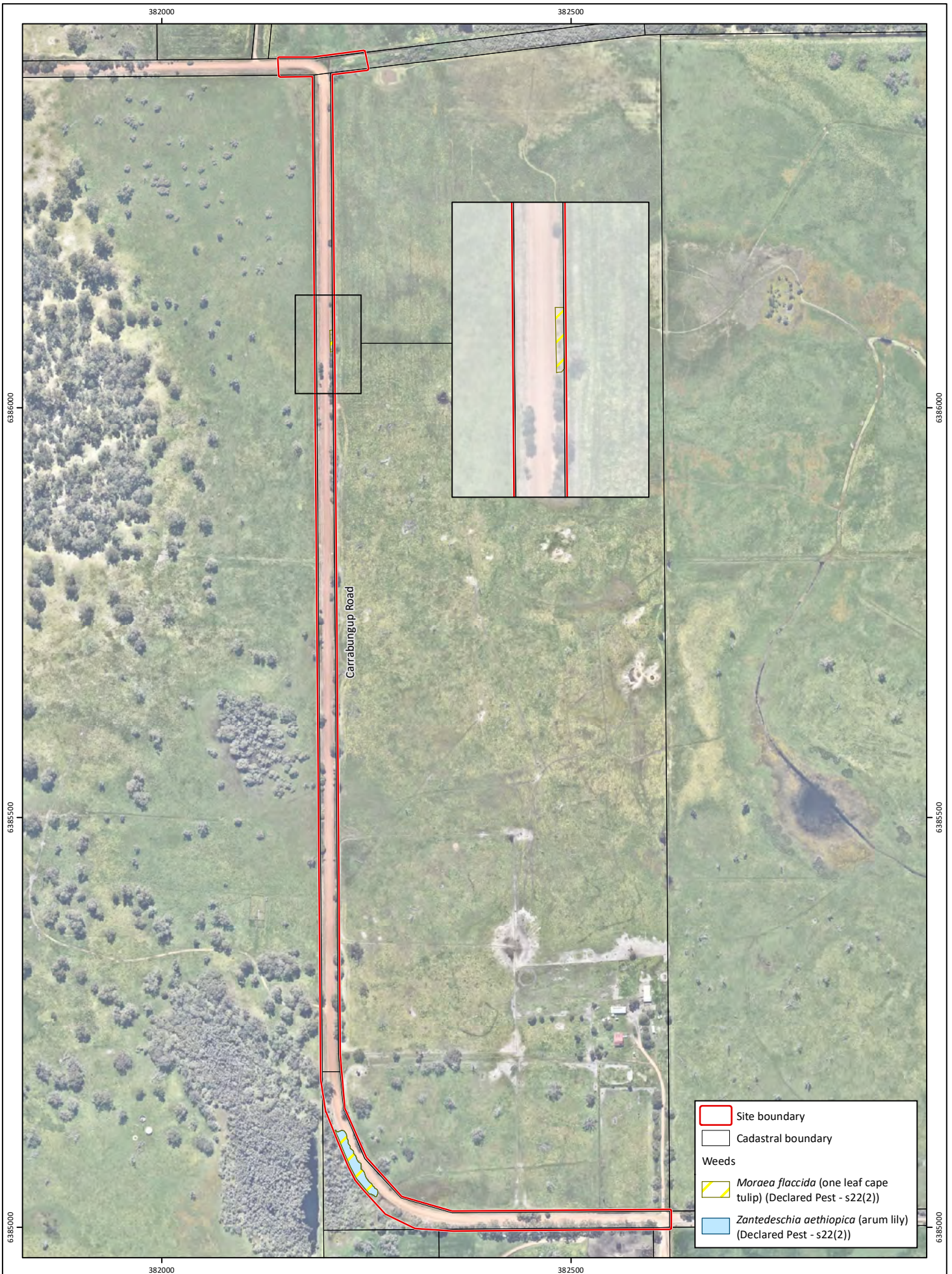


Figure 7b: Weeds - Bulbs

Project: Detailed Flora and Vegetation Assessment
Carrabungup Road, Nirimba

Client: Shire of Murray

Plan Number: EP20-102(05)--F20
Drawn: GAR
Date: 22/01/2021
Checked: TAA
Approved: TAA
Date: 02/02/2021



0 50 100 150
Metres
Scale: 1:6,000@A4
GDA 1994 MGA Zone 50



Appendix A

Additional Information



Conservation Significant Flora and Vegetation

Threatened and priority flora

Flora species considered rare or under threat warrant special protection under Commonwealth and/or State legislation. At the Commonwealth level, flora species can be listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Flora species considered 'threatened' pursuant to Schedule 1 of the EPBC Act are assigned categories according to their conservation status, as outlined in **Table 1**.

In Western Australia, plant taxa may be classed as 'threatened' under the *Biodiversity Conservation Act 2016* (BC Act) which is enforced by Department of Biodiversity Conservation and Attractions (DBCA). Threatened flora species are listed under sections 19(1) and 26(2) of the BC Act. It is an offence to 'take' or disturb threatened flora without Ministerial approval. Section 5(1)1 of the Act defines to take as including "... to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means" or to cause or permit the same to be done. The definition of threatened flora under the BC Act is provided in **Table 1**.

Section 43 of the BC Act requires that an occurrence of a threatened species or threatened ecological community is reported to DBCA where the occurrence has been identified as part of field work completed:

- as part of an assessment under Part IV of the *Environmental Protection Act 1986*; or
- in relation to an application for a clearing permit under the *Environmental Protection Act 1986* section 51E(1)(d).

Penalties apply to individuals and organisations that fail to provide accurate reports of threatened species or communities.

The *Biodiversity Conservation Regulations 2018* (BC Regulations 2018) came into effect on January 1 2019. The BC Regulations include provisions for licencing, charges, penalties and other provisions associated with the BC Act.

Flora species that may be threatened or near threatened but lack sufficient information to be listed under the BC Act may be added to the DBCA's *Priority Flora List* (DBCA 2018c). Priority flora species are considered during State approval processes. Priority flora categories and definitions are listed in **Table 1**.

Additional Background Information



Table 1: Definitions of conservation significant flora species pursuant to the EPBC Act and BC Act and on DBCA's Priority Flora List (DBCA 2018c)

Conservation code	Description
EX [†]	Threatened Flora – Presumed Extinct Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
T [†]	Threatened Flora – Extant Taxa which are declared to be likely to become extinct or is rare, or otherwise in need of special protection.
CR [^]	Threatened Flora – Critically Endangered Taxa which are considered to be facing an extremely high risk of extinction in the wild.
EN [^]	Threatened Flora – Endangered Taxa which are considered to be facing a very high risk of extinction in the wild.
VU [^]	Threatened Flora – Vulnerable Taxa which are considered to be facing a high risk of extinction in the wild.
P1 [□]	Priority One – Poorly Known Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat e.g. road verges, urban areas, farmland, active mineral leases etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2 [□]	Priority Two – Poorly Known Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but urgently need further survey.
P3 [□]	Priority Three – Poorly Known Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but needs further survey.
P4 [□]	Priority Four – Rare Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

[^]pursuant to the EPBC Act, [†]pursuant to the BC Act, [□]on DBCA's Priority Flora List

Threatened and priority ecological communities

'Threatened ecological communities' (TECs) are recognised as ecological communities that are rare or under threat and therefore warrant special protection. Selected TECs are afforded statutory protection at a Commonwealth level under section 181 of the EPBC Act. TECs nominated for listing under the EPBC Act are considered by the Threatened Species Scientific Committee and a final decision is made by the Commonwealth Minister for the Environment. Once listed under the EPBC Act, communities are categorised as either 'critically endangered', 'endangered' or 'vulnerable' as defined in **Table 2**. Any action likely to have a significant impact on a community listed under the EPBC Act requires approval from the Minister for the Environment.

Additional Background Information



Within Western Australia TECs are determined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (WATECSAC) and endorsed by the State Minister for the Environment. The WATECSAC is an independent group comprised of representatives from organisations including tertiary institutions, the Western Australian Museum and DBCA. The TECs endorsed by the State Minister are published by DBCA (DBCA 2018b).

TECs are assigned to one of the categories outlined in **Table 2** according to their status (in relation to the level of threat). TECs are afforded direct statutory protection at a State level under the BC Act and BC Regulations. Ecological communities are listed under Section 27(1) and 33 of the BC Act. Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Table 2: Categories of threatened ecological communities (English and Blyth 1997; DEC 2009)

Conservation code	Description
PD	Presumably Totally Destroyed An ecological community that has been adequately searched for but for which no representative occurrences have been located.
CE	Critically Endangered An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
E	Endangered An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future.
V	Vulnerable An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

An ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined may be listed as a 'priority ecological community' (PEC). PECs are categorised as priority category 1, 2 or 3 as described in **Table 3**. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for 'near threatened', or that have been recently removed from the threatened list, are placed in 'priority 4'. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in 'priority 5' (DEC 2013). Listed PECs are published by DBCA (DBCA 2017b).

Additional Background Information



Table 3: Categories of priority ecological communities (DEC 2013)

Priority code	Description
P1	<p>Priority One: Poorly known ecological communities</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
P2	<p>Priority Two: Poorly known ecological communities</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
P3	<p>Priority Three: Poorly known ecological communities</p> <p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or;</p> <p>(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
P4	<p>Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.</p> <p>(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category.</p> <p>(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>
P5	<p>Priority Five: Conservation Dependent ecological communities</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Weeds

A number of legislative and policy documents exist in relation to weed management at state and national levels. The *Biosecurity and Agriculture Management Act 2007* (BAM Act) is the principle legislation guiding weed management in Western Australia and lists declared pest species. At a national level, the Australian government has compiled a list of 32 Weeds of National Significance (WoNS) (DoEE 2018), of which many are also listed under the BAM Act.

Declared Pests

Part 2.3.23 of the BAM Act requires a person must not; “a) keep, breed or cultivate the declared pest; b) keep, breed or cultivate an animal, plant or other thing that is infected or infested with the declared pest; c) release into the environment the declared pest, or an animal, plant or other thing that is infected or infested with the declared pest; or d) intentionally infect or infest, or expose to infection or infestation, a plant, animal or other thing with a declared pest”.

Under the BAM Act, all declared pests are assigned a legal status, as described in **Table 4**. Species assigned to the ‘declared pest, prohibited - s12’ category are placed in one of three control categories, as described in **Table 5**.

The *Biosecurity and Agriculture Management Regulations 2013* specify keeping categories for species assigned to the ‘declared pest - s22(2)’ category, which relate to the purposes of which species can be kept, as well as the entities that can keep them. The categories are described in **Table 6**.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DPIRD 2020).

Table 4: Legal status of declared pest species listed under the BAM Act (DPIRD 2020)

Category	Description
Declared Pest Prohibited - s12	May only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Declared Pest s22(2)	Must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia

Table 5: Control categories of declared pest species listed under the BAM Act (DPIRD 2020)

Category	Description
C1	Exclusion Not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2	Eradication Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3	Management Established in Western Australia but it is feasible, or desirable, to manage them in order to limit their

Additional Background Information

Category	Description
	damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Table 6: Keeping categories of declared pest species listed under the BAM Act (DPIRD 2020)

Category	Description
Prohibited	Can only be kept under a permit for public display and education purposes, and/or genuine scientific research, by entities approved by the state authority.
Exempt	No permit or conditions are required for keeping.
Restricted	Organisms which, relative to other species, have a low risk of becoming a problem for the environment, primary industry or public safety and can be kept under a permit by private individuals.

Wetland Habitat

Geomorphic wetland types

On the Swan Coastal Plain DBCA (2017a) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period) as outlined in **Table 7**.

Table 7: Geomorphic Wetlands of the Swan Coastal Plain classification categories (DBCA 2017a)

Level of inundation	Geomorphology			
	Basin	Flat	Channel	Slope
Permanently inundated	Lake	-	River	-
Seasonally inundated	Sumpland	Floodplain	Creek	-
Seasonally waterlogged	Dampland	Palusplain	-	Paluslope

Wetland management categories

DBCA maintains the *Geomorphic Wetland of the Swan Coastal Plain* dataset (DBCA 2018a), which also categorises individual wetlands into specific management categories as described in **Table 8**.

Table 8: Geomorphic Wetlands of the Swan Coastal Plain classification categories (DBCA 2017a)

Management category	Description of wetland	Management objectives
Conservation (CCW)	Support high levels of attributes	Preserve wetland attributes and functions through reservation in national parks, crown reserves and state owned land. Protection provided under environmental protection policies.
Resource enhancement (REW)	Partly modified but still supporting substantial functions and attributes	Restore wetland through maintenance and enhancement of wetland functions and attributes. Protection via crown reserves, state or local government owned land, environmental protection policies and sustainable management on private properties.
Multiple use (MUW)	Few wetland attributes but still provide important hydrological functions	Use, development and management considered in the context of water, town and environmental planning through land care.

The management categories of wetland features are determined based on hydrological, biological and human use features. The DBCA document *A methodology for the evaluation of specific wetland types on the Swan Coastal Plain, Western Australia* (DBCA 2017a) details the methodology by which wetlands on the Swan Coastal Plain are assigned management categories based on a two tiered evaluation system, with preliminary and secondary evaluation stages. The preliminary evaluation aims to identify any features of conservation significance that would immediately place the wetland within the CCW management category. Examples of these significant features include presence on significant wetland lists, presence of TECs or PECs (Priority 1 and 2), presence of threatened flora and

over 90% of vegetation in good or better condition based on the Keighery (1994) scale. If such environmental values are identified the wetland would be categorised as CCW without further evaluation.

Should the preliminary evaluation indicate that no such features occur, the secondary evaluation and site assessment are then applied. In the secondary evaluation, an appropriate management category is determined through the assessment of a range of environmental attributes, functions and values.

Wetland reclassification

DBCA have a protocol for proposing changes to the wetland boundaries and management categories of the existing geomorphic wetland dataset (DEC 2007). The procedure involves a wetland desktop evaluation and site assessment which culminates in a recommended management category.

Relevant information should be obtained in the optimal season for vegetation condition and water levels, which is usually spring (DEC 2007). In the case of larger wetlands that have undergone a degree of disturbance, a separate management category may be assigned to parts of the wetland in order to reflect the current values.

References

General references

Department of Biodiversity, Conservation and Attractions (DBCA) 2017a, *A methodology for the evaluation of wetlands on the Swan Coastal Plain*, draft prepared by the Wetlands Section of the Department of Biodiversity, Conservation and Attractions and the Urban Water Branch of the Department of Water and Environmental Regulation, Perth.

Department of Biodiversity Conservation and Attractions (DBCA) 2017b, *Priority Ecological Communities for Western Australia Version 27*, Species and Communities Branch, Department of Biodiversity, Conservation and Attractions.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018a, *Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018b, *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment*, Perth.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018c, *Threatened and Priority Flora List 16 January 2018*, Perth.

Department of Environment and Conservation (DEC) 2007, *Protocol for proposing modifications to the Geomorphic Wetlands Swan Coastal Plain dataset*, Perth.

Department of Environment and Conservation (DEC) 2009, *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*, Perth.

Department of Environment and Conservation (DEC) 2013, *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*, Perth.

English, V. and Blyth, J. 1997, *Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province*, ANCA National Reserves System Cooperative Program, Project Number N702, Perth.

Keighery, B. 1994, *Bushland Plant Survey: A guide to plant community survey for the community*, Wildflower Society of WA (Inc), Nedlands.

Semeniuk, C. A. 1987, *Wetlands of the Darling System - a geomorphic approach to habitat classification*, Journal of the Royal Society of Western Australia, 69: 95-112.

Semeniuk, C. A. and Semeniuk, V. 1995, *A Geomorphic Approach to Global Classification for Inland Wetlands*, Vegetatio, 118(1/2): 103-124.

Online references

Department of Environment and Energy (DoEE) 2018, *Weeds of National Significance*, <<http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>>.

Additional Background Information



Department of Primary Industries and Regional Development (DPIRD) 2020, The Western Australian Organism List (WAOL), < <https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol>>.

Appendix B

Conservation Significant Flora Species and Likelihood of
Occurrence Assessment



Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence (Prior to survey)	Likelihood of occurrence (Post survey)
	WA	EPBC Act					
<i>Diuris micrantha</i>	VU	V	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep-early Oct	Possible	Unlikely
<i>Diuris drummondii</i>	VU	V	PG	In low-lying depressions in peaty and sandy clay swamps.	Nov-Jan	Likely	Recorded
<i>Drakaea micrantha</i>	EN	V	PG	Open sandy patches often adjacent to winter-wet swamps.	Sept- early Oct	Unlikely	Unlikely
<i>Eleocharis keigheryi</i>	VU	V	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	Unlikely	Unlikely
<i>Eucalyptus argutifolia</i>	VU	V	P	Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops	Mar-Apr	Unlikely	Unlikely
<i>Caladenia huegelii</i>	CR	E	PG	Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels.	Sep-early Nov	Possible	Unlikely
<i>Diuris purdiei</i>	EN	E	PG	Sand to sandy clay soils in areas subject to winter inundation.	late September to mid-October, but only after a summer or early autumn fire (Brown et al., 1998)	Possible	Unlikely
<i>Andersonia gracilis</i>	VU	E	P	Seasonally damp, black sandy clay flats near or on the margins of swamps.	Sep-Nov	Unlikely	Unlikely
<i>Drakaea elastica</i>	CR	E	PG	Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps. Typically in banksia woodland or thickets of <i>Kunzea glabrescens</i> .	late Sep-Oct/Nov, survey Jul-Aug	Unlikely	Unlikely
<i>Synaphea stenoloba</i>	CR	E	P	Swampy loam in depressions that are occasionally inundated.	Aug but mainly Sep-Oct	Unlikely	Unlikely

	WA	EPBC Act				(Prior to survey)	(Post survey)
<i>Synaphea sp. Pinjarra Plain (A.S. George 17182)</i>	EN	CR	P	White grey clayey sand on edges of seasonally inundated low lying areas.	Sep-Oct	Possible	Unlikely
<i>Synaphea sp. Serpentine (G.R. Brand 103)</i>	CR	CR	P	Seasonally damp areas, loam - sand.	Sep-Oct	Possible	Unlikely
<i>Synaphea sp. Fairbridge Farm (D. Papenfus 696)</i>	CR	CR	P	Low woodland on grey, clayey sand with lateritic pebbles (Pinjarra Plain) near winter wet flats.	Sep-Nov	Unlikely	Unlikely
<i>Grevillea bipinnatifida subsp. pagna</i>	P1	-	P	Grey sandy clay and loam, ironstone. Seasonal wetlands, swamps, roadsides.	Aug or Oct-Nov	Possible	Unlikely
<i>Caladenia swartsiorum</i>	P2	-	PG	Winter-wet creeklines and plains (limited information)	Oct	Possible	Unlikely
<i>Cardamine paucijuga</i>	P2	-	A	Winter wet areas, sand or clay	Sep-Oct	Possible	Unlikely
<i>Eryngium pinnatifidum subsp. Umbraphilum (G.J. Keighery 13967)</i>	P2	-	A/P	Winter wet, clay, sand or limestone soils.	Oct-Nov	Possible	Unlikely
<i>Trithuria australis</i>	P2	-	A	Seasonally wet areas. Edge of wetlands. Grey clay, clay over sand. Sand over laterite.	Oct-Nov	Possible	Unlikely
<i>Chamaescilla gibsonii</i>	P3	-	P	Clay to sandy clay in winter-wet flats, shallow water-filled claypans.	Sep	Possible	Unlikely
<i>Dillwynia dillwynioides</i>	P3	-	P	Winter wet depressions on sandy soils	Aug - Dec	Possible	Unlikely
<i>Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)</i>	P3	-	P	Grey brown sand or clay in winter wet flats.	Sep-Nov	Possible	Unlikely
<i>Hemigenia microphylla</i>	P3	-	P	Sandy clay, peaty clay, granite. Winter-wet depressions.	Sep-Dec	Possible	Unlikely
<i>Jacksonia gracillima</i>	P3	-	P	Sand, often adjacent to winter wet areas	Sep-Dec	Possible	Unlikely
<i>Schoenus sp. Waroona (G.J. Keighery 12235)</i>	P3	-	A	Clay or sandy clay. Winter-wet flats.	Oct-Nov	Possible	Unlikely
<i>Acacia semitrullata</i>	P4	-	P	White/grey sand, sometimes over laterite, clay sometimes in sandplains, swampy areas.	May-Oct	Possible	Unlikely
<i>Rumex drummondii</i>	P4	-	P	Winter-wet disturbed areas.	Aug-Nov	Possible	Unlikely
<i>Acacia benthamii</i>	P2	-	P	Sand, typically on limestone breakaways	Aug - Sept	Unlikely	Unlikely
<i>Blennospora doliiformis</i>	P3	-	A	Grey or red clay soils over ironstone. Seasonally-wet flats.	Oct-Nov	Unlikely	Unlikely

	WA	EPBC Act				(Prior to survey)	(Post survey)
<i>Tripterococcus sp.</i> <i>Brachylobus</i> (A.S. George 14234)	P4	-	P	Winter-wet areas on grey sand.	Oct-Feb	Possible	Unlikely
<i>Conostylis pauciflora</i> <i>subsp. pauciflora</i>	P4	-	P	Grey sand, limestone. Hillslopes, consolidated dunes.	Aug-Oct	Unlikely	Unlikely
<i>Craspedia sp. Waterloo</i> (G.J. Keighery 13724)	P2	-	P	Winter wet flats with clay and sandy clay in wandoo woodland.	Aug-Sep	Unlikely	Unlikely
<i>Eryngium sp. Ferox</i> (G.J. Keighery 16034)	P3	-	P	Winter wet flats on clay	Oct-Mar	Unlikely	Unlikely
<i>Eryngium sp.</i> <i>Subdecumbens</i> (G.J. Keighery 5390)	P3	-	A	Clay in seasonal wetlands.	Sep-Nov	Unlikely	Unlikely
<i>Eucalyptus rudis subsp.</i> <i>cratyantha</i>	P4	-	P	Loam on flats and hillsides.	Jul-Sep	Unlikely	Unlikely
<i>Grevillea manglesii</i> <i>subsp. ornithopoda</i>	P2	-	P	Red-brown loam over clay	Sep-Nov	Unlikely	Unlikely
<i>Meionectes tenuifolia</i>	P3	-	P	Clay loam in seasonally wet areas.	Oct-Dec	Unlikely	Unlikely
<i>Myriophyllum</i> <i>echinatum</i>	P3	-	A	Clay in winter-wet flats.	Nov	Unlikely	Unlikely
<i>Ornduffia submersa</i>	P4	-	A	Sandy clay in inundated wetland/creek.	Aug-Nov	Unlikely	Unlikely
<i>Phyllangium palustre</i>	P2	-	A	Winter-wet claypans, low-lying seasonal wetlands on clay	Oct-Nov	Unlikely	Unlikely
<i>Schoenus natans</i>	P4	-	A	Aquatic, in winter-wet depressions.	Oct	Unlikely	Unlikely
<i>Sphaerolobium calcicola</i>	P3	-	P	White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Jun/Sep-Nov	Unlikely	Unlikely
<i>Stylidium aceratum</i>	P3	-	A	Sandy soils in swamp heathland.	Oct-Nov	Unlikely	Unlikely
<i>Stylidium longitubum</i>	P4	-	A	Sandy clay, clay. Seasonal wetlands.	Oct-Dec	Unlikely	Unlikely
<i>Stylidium paludicola</i>	P3	-	P	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland	Oct-Dec	Unlikely	Unlikely
<i>Stylidium periscelanthum</i>	P3	-	P	Loamy clay, moist soils pockets on wet flats and low granitic hills.	Sep-Oct	Unlikely	Unlikely
<i>Stylidium roseonanum</i>	P3	-	A	Swamps	Oct	Unlikely	Unlikely

	WA	EPBC Act				(Prior to survey)	(Post survey)
<i>Stylidium torticarpum</i>	P3	-	P	Sandy clay and clay loam over laterite adjacent to creeklines, depressions, and beneath breakaways in heath or mallee shrubland.	Sep-Nov	Unlikely	Unlikely
<i>Caladenia speciosa</i>	P4	-	PG	White, grey or black sand.	Sep-Oct	Possible	Unlikely

Note: T=threatened, CE=critically endangered, E=endangered, V=vulnerable, P1=Priority 1, P2=Priority 2, P3=Priority 3, P4=Priority 4, P=perennial, PG=perennial geophyte, A=annual. Species recorded or considered to potentially occur within the site are shaded green

Appendix C

Conservation Significant Communities and Likelihood of
Occurrence Assessment



Code	Community name	TEC/PEC	Level of significance		Likelihood of occurrence	
			WA	EPBC Act	Prior to survey	Post survey
SCP10a	Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson et al. (1994))	TEC	EN	CR	Possible	Unlikely
Tuart woodlands	Tuart (<i>Eucalyptus gomphocephala</i>) woodlands and forests of the Swan Coastal Plain	TEC/PEC	P3	CR	Possible	Unlikely
SCP07	Herb rich saline shrublands in clay pans (floristic community type 7 as originally described in Gibson et al. (1994))	TEC	VU	CR	Possible	Unlikely
SCP3a	<i>Corymbia calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils, Swan Coastal Plain (floristic community type 3a as originally described in Gibson et al. (1994))	TEC	CR	EN	Unlikely	Unlikely
SCP3c	<i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain (floristic community type 3c as originally described in in Gibson et al. (1994))	TEC	CR	EN	Unlikely	Unlikely
Clifton-microbialite	Stromatolite like freshwater microbialite community of coastal brackish lakes (Lake Clifton)	TEC	CR		Unlikely	Unlikely
SCP15	Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain (floristic)	TEC	VU		Possible	Unlikely
Coastal Saltmarsh	Subtropical and Temperate Coastal Saltmarsh	TEC/PEC	P3	VU	Unlikely	Unlikely
Banksia WL SCP	Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	PEC	P3	EN	Unlikely	Unlikely
SCP25	Southern <i>Eucalyptus gomphocephala</i> - <i>Agonis flexuosa</i> woodlands	PEC	P3		Possible	Unlikely

Note: TEC=threatened ecological community, PEC=priority ecological community, CR=critically endangered, EN=endangered, VU=vulnerable, P3=priority 3, P4=priority 4

Appendix D

Species List



Flora Species - Carabungup Road, Nirimba

Family	Status	Species
Araceae	DP	<i>Zantedeschia aethiopica</i>
Asphodelaceae	*	<i>Asphodelus fistulosus</i>
Asteraceae	*	<i>Arctotheca calendula</i>
	*	<i>Cotula coronopifolia</i>
	*	<i>Hypochaeris glabra</i>
	*	<i>Sonchus oleraceus</i>
Casuarinaceae		<i>Casuarina obesa</i>
Cyperaceae		<i>Baumea juncea</i> <i>Bolboschoenus caldwellii</i> <i>Isolepis cernua</i> <i>Lepidosperma longitudinale</i> <i>Typha</i> sp.
Euphorbiaceae	*	<i>Euphorbia peplus</i>
Fabaceae		<i>Acacia saligna</i>
	*	<i>Lotus subbiflorus</i>
	*	<i>Lupinus angustifolius</i>
	*	<i>Trifolium</i> sp. (1)
	*	<i>Trifolium</i> sp. (2)
Lamiaceae	*	<i>Stachys arvensis</i>
Iridaceae	*	<i>Watsonia ?meriana</i>
	DP	<i>Moraea flaccida</i>
Juncaceae	*	<i>Juncus bufonius</i> <i>Juncus pallidus</i>

Myrtaceae

	<i>Corymbia calophylla</i>
*PI	<i>Eucalyptus cladocalyx</i>
PI	<i>Eucalyptus gomphocephala</i>
*PI	<i>Eucalyptus grandis</i>
*PI	<i>Eucalyptus</i> sp. (1)
*PI	<i>Eucalyptus</i> sp. (2)
	<i>Eucalyptus rudis</i>
	<i>Melaleuca preissiana</i>
	<i>Melaleuca raphiophylla</i>
	<i>Melaleuca teretifolia</i>

Orchidaceae

T	<i>Diuris drummondii</i>
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Oxalidaceae

*	<i>Oxalis pes-caprae</i>
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Poaceae

*	<i>Avena</i> sp.
*	<i>Briza minor</i>
*	<i>Bromus ?diandrus</i>
*	<i>Cynodon dactylon</i>
*	<i>Ehrharta calycina</i>
*	<i>Ehrharta longiflora</i>
*	<i>Eragrostis curvula</i>
*	<i>Lolium</i> sp.
*	<i>Paspalum dilatatum</i>
*	<i>Vulpia</i> sp.

Xanthorrhoeaceae

	<i>Xanthorrhoea preissii</i>
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Zamiaceae

	<i>Macrozamia fraseri</i>
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T= threatened under the EPBC Act and BC Act, *=non-native, PI=planted, DP= declared pest under the BAM Act

Appendix E

Species x Plant Community Matrix



Flora Species x Plant Community Matrix - Carabungup Road, Nirimba

Species	Plant community		
	CcCo	ErM	Predominantly non-native species or bare ground
<i>Acacia saligna</i>		X	X
<i>Arctotheca calendula</i>	X	X	X
<i>Asphodelus fistulosus</i>	X	X	X
<i>Avena sp.</i>	X	X	X
<i>Baumea juncea</i>	X		
<i>Bolboschoenus caldwellii</i>		X	
<i>Bromus ?diandrus</i>	X	X	X
<i>Casuarina obesa</i>	X		
<i>Corymbia calophylla</i>	X		
<i>Cotula coronopifolia</i>	X	X	X
<i>Cynodon dactylon</i>	X	X	X
<i>Diuris drummondii</i>		X	
<i>Ehrharta calycina</i>	X		X
<i>Ehrharta longiflora</i>	X	X	X
<i>Eragrostis curvula</i>	X	X	X
<i>Eucalyptus cladocalyx</i>			X
<i>Eucalyptus gomphocephala</i>			X
<i>Eucalyptus grandis</i>			X
<i>Eucalyptus rudis</i>		X	
<i>Eucalyptus sp.</i>			X
<i>Eucalyptus sp. 2</i>			X
<i>Euphorbia peplus</i>	X	X	X
<i>Hypochaeris glabra</i>	X	X	X
<i>Isolepis cernua</i>	X	X	X
<i>Juncus bufonius</i>	X	X	X
<i>Juncus pallidus</i>		X	
<i>Lepidosperma longitudinale</i>	X		
<i>Lolium sp.</i>	X	X	X
<i>Lotus subbiflorus</i>	X	X	X
<i>Lupinus angustifolius</i>			X
<i>Lythrum hyssopifolia</i>	X	X	X
<i>Macrozamia fraseri</i>	X		
<i>Melaleuca preissiana</i>		X	
<i>Melaleuca rhapsiophylla</i>		X	
<i>Melaleuca teretifolia</i>		X	
<i>Moraea ?flaccida</i>	X		X
<i>Oxalis pes-caprae</i>	X	X	X
<i>Paspalum dilatatum</i>	X	X	X
<i>Sonchus oleraceus</i>	X	X	X
<i>Stachys arvensis</i>	X	X	X
<i>Trifolium sp.</i>	X	X	X
<i>Trifolium sp.</i>	X	X	X
<i>Typha sp.</i>	X	X	X
<i>Vulpia sp.</i>	X		X
<i>Watsonia ?meriana</i>		X	
<i>Xanthorrhoea preissii</i>	X		X
<i>Zantedeschia aethiopica</i>		X	

