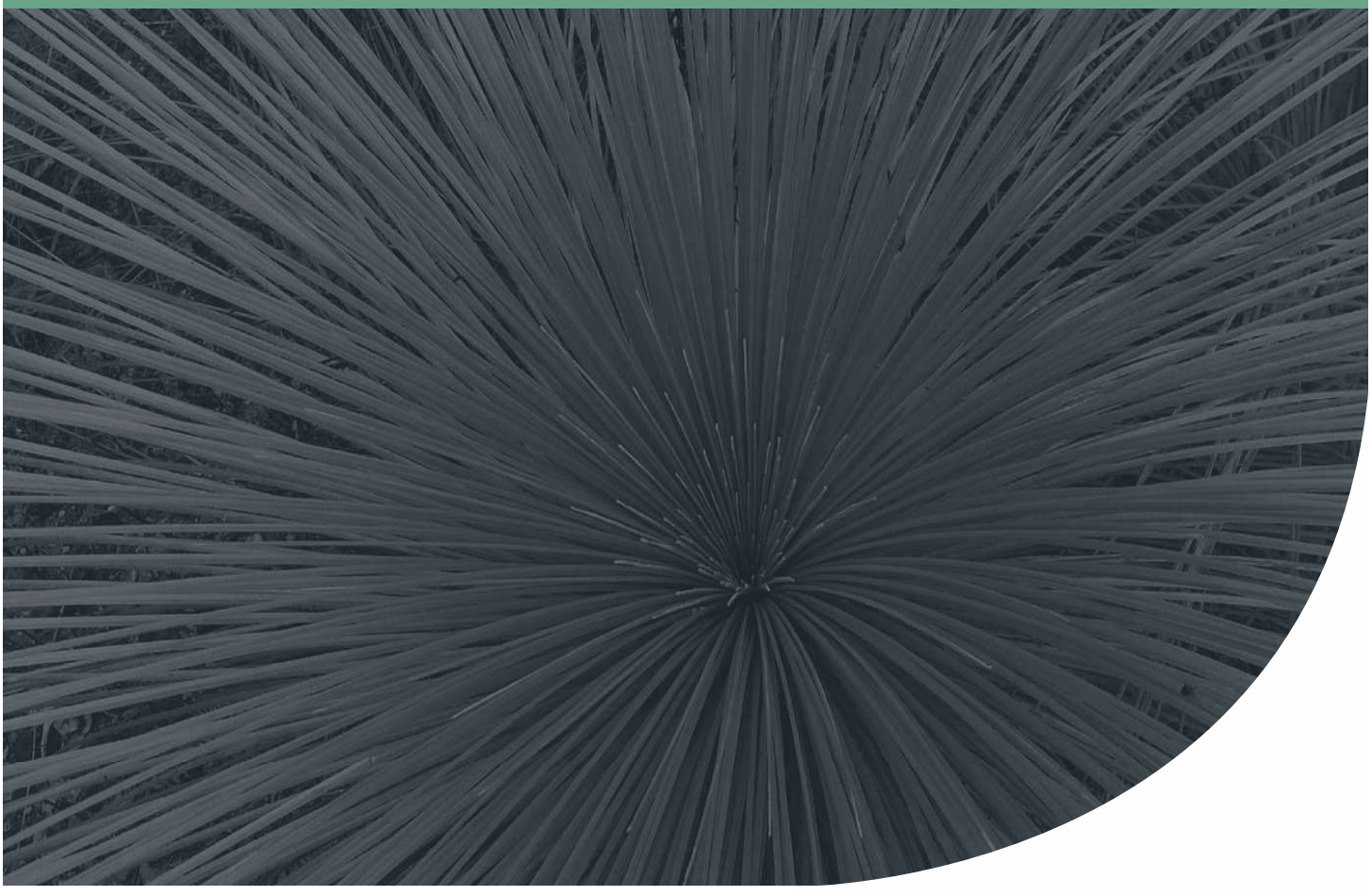
Detailed Flora and Vegetation Assessment

Proposed Brooking Road Extension, Parkerville

Project No: EP20-134(01)

Prepared for Shire of Mundaring
March 2021



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Executive Summary

The Shire of Mundaring engaged Emerge Associates to conduct a detailed flora and vegetation assessment to provide information on the flora and vegetation values within the proposed extension area of Brooking Road in Parkerville (referred to herein as the 'site').

As part of the assessment a desktop review of relevant background information was completed and a field survey was undertaken on 5 November 2020. During the field survey an experienced botanist assessed the type, condition and values of vegetation across the site.

Outcomes of the survey include the following:

- A total of 104 native and 36 non-native (weed) species were recorded in the site.
- No threatened or priority flora species were recorded within the site and none are considered likely to occur.
- Five plant communities were recorded within the site which extend over 2.69 ha (84% of the site). The remaining 0.50 ha of the site comprises cleared areas such as the road surface and shoulder .
- Approximately half of the site was mapped as being in 'degraded' and 'completely degraded' condition (1.6 ha/50.16 ha). The remainder of the site was mapped as being in 'very good' (0.06 ha), 'very good – good' (0.26 ha) and 'good' (1.27 ha) condition.
- No threatened or priority ecological communities were recorded within the site and none are considered likely to occur.
- Vegetation within the site may be considered significant as it:
    - is associated with Jane Brook
    - is part of extensive areas of native vegetation in the area and contributes to ecological linkages
    - has the potential to provide habitat for fauna including threatened species of black cockatoo.

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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
WALGA	Western Australia Local Government Association

Table A2: Abbreviations – General terms

General terms	
ESA	Environmentally sensitive area
IBRA	*Interim Biogeographic Regionalisation of Australia*
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
T	Threatened
TEC	Threatened ecological communities

Table A3: Abbreviations –Legislation

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

Table A4: 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

Emerge Associates (Emerge) were engaged by the Shire of Mundaring to characterise the flora and vegetation values within the proposed extension area of Brooking Road in Parkerville. The site boundary for the assessment comprises the unconstructed road reserve corridor of Brooking Road and adjacent parts of Richardson Road, Falls Road, Victoria Road and Owen Road, as shown in in **Figure 1**. The site is located approximately 26 kilometres (km) north east of the Perth Central Business District within the Shire of Mundaring.

The site is approximately 3.19 hectares (ha) in size and is bound by Richardson Road to the north, Falls Road, Victoria Road and Brooking Road to the south and rural residential land to all other sides.

1.2 Purpose and scope of work

The scope of work was specifically to undertake a flora and vegetation assessment to the standard required of a detailed survey with reference to 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.
- A field survey to record a comprehensive list of flora species and assess vegetation type and condition.
- 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, methodology, field survey and results into a report.

2 Environmental Context

2.1 Climate

Climate influences 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 1065.1 millimetres (mm) of rainfall is recorded annually from the Mundaring weather station, which is the closest weather station, located approximately 3.9 km south east from the site. The majority of this rainfall is received between the months of May and September. Mean maximum temperatures at the Bickley WA weather station, which is the nearest temperature recording station approximately 14.2 km south of the site, range from 15.1°C in July to 30.5°C in January and February, while mean minimum temperatures range from 13.5°C in July to 28°C in January (BoM 2021).

A total of 672.2 mm of rain was recorded from May to October 2020 prior to the survey, which is approximately 74% of the mean of 905.4 mm for this period (BoM 2021). Although lower than the mean this amount of rainfall was considered to have been sufficient to promote the flowering and emergence of native flora.

2.2 Geomorphology and soils

Landform and soils influence vegetation types at regional and local scales.

The site occurs on the Darling Plateau which lies east of Perth CBD and directly east of the Darling Scarp. The Darling Plateau is an ancient erosion surface capped with laterite and dissected by drainage channels (Beard 1990). The eastern part of the Plateau is characterised by flat-topped hills bound by breakaways and more prominent hills (monadnocks) which protrude above the general level of the plateau (Gozzard 2011). The western part comprises valleys with steep, rocky slopes and narrow, flat floors (Gozzard 2011).

Examination of broad scale soil mapping places the central and southern portions of the site within the Murray soil association which is described as 'deeply incised valleys with red and yellow earths on slopes; narrow alluvial terraces' (Churchward and McArthur 1980). The northern portion of the site is with the Dwellingup soil association which is described as a 'gently undulating landscape with duricrust on ridges; sands and gravels in shallow depressions' (Churchward and McArthur 1980).

The locations of soil associations mapped within the site are shown in **Figure 2**.

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

2.3 Topography

The elevation of the site ranges from 205 m in relation to the Australian height datum (mAHD) on the southern side and 235 on the northern side to 195 in the central southern portion (WALIA 2021).

2.4 Hydrology and wetlands

Wetlands are areas of seasonally, intermittently or permanently waterlogged land such as poorly drained soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers and their tributaries (Wetlands Advisory Committee 1977). Wetlands can 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 2017c)
- *A Directory of Important Wetlands in Australia* (DBCA 2018)

No Ramsar or listed 'important wetlands' are located within or near the site.

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2018) shows one waterway occurs in the southern portion of the site. This watercourse is referred to as Jane Brook and flows beyond the site to the west.

The location of Jane Brook in the site is 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 Australia into floristic subregions (Environment Australia 2000).

The site is contained within the jarrah forest region and within the 'JF1' or northern jarrah forest subregion. The northern jarrah forest subregion is characterised by *Eucalyptus marginata* (jarrah) – *Corymbia calophylla* (marri) forest on laterite gravels with *Eucalyptus wandoo* – marri woodlands in the eastern part (DEC 2002).

Variations in native vegetation can be further classified based on regional vegetation mapping. DBCA (2019) mapping shows the site as comprising 'Murray 2' complex which is described as comprising an open forest of *Eucalyptus marginata* subsp. *thalassica-Corymbia calophylla-Eucalyptus patens*, a woodland of *Eucalyptus wandoo* with some *Eucalyptus accedens* on valley slopes to a woodland of *Eucalyptus rudis-Melaleuca rhaphiophylla* on the valley floors.

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).

The 'Murray 2' complex was determined to have 69.04% of its pre-European extent remaining, of which 15.89% is protected for conservation purposes (Government of Western Australia 2019). Therefore, the percentage of this complex protected for conservation lies below the 30% retention objective.

2.6 Historical land use

Review of historical images available from 1977 onwards shows that the southern portion of the site near the Brooking Road/Victoria Road intersection was cleared of vegetation within or prior to 1977. At this time forest vegetation is visible in the northern portion of the site. Since 1997 the vegetation appears to have been largely undisturbed and has regrown in the southern portion (WALIA 2021).

2.7 Conservation 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**. An assessment of the likelihood of occurrence of threatened and priority flora within the site was undertaken (refer to **Sections 3.1** and **4.2.1**). 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 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**. An assessment of the likelihood of occurrence of threatened and priority flora within the site was undertaken (refer to **Sections 3.1** and **4.3.1**).

2.7.2 Local and regional significance

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

Key reasons that vegetation within the site may be significant are listed below:

- The vegetation is associated with Jane Brook.
- The vegetation provides or contributes to an ecological linkage.
- The vegetation has potential value as habitat for threatened or priority fauna species including, in particular, black cockatoos listed as threatened under the EPBC Act and BC Act.

2.8 Weeds and pests

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. The likelihood of weeds occurring is higher in areas disturbed areas, especially areas that have been agricultural or urban landuse.

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.

The Commonwealth government has further 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 weeds and declared pests is provided in **Appendix A**.

2.9 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.

No ESAs are present over the site or in close proximity to the site.

2.10 DBCA managed or legislated lands

DBCA has tenure of or interests in numerous areas of land across the state for a range of purposes. Tenure categories include national parks, nature reserves, conservation parks, marine parks, marine nature reserves, marine management areas, section 5(1)(g) reserves, state forest and timber reserves. These areas are mapped within the *Legislated Lands and Waters* (DBCA 2017a) and *Lands of Interest* (DBCA 2017b) datasets. The *Legislated Lands and Waters* (DBCA 2017a) dataset includes lands subject to the following legislation; the *Conservation and Land Management Act 1984* (CALM Act 1984), *Swan and Canning Rivers Management Act 2006* (SCRM Act) and lands identified under the *Land Administration Act 1997* (LA Act). The *Lands of Interest* (DBCA 2017b) dataset includes all other lands of which DBCA is recognised as the manager but is not vested under any act. These lands comprise of crown land and freehold land which DBCA has been acknowledged by the Department of Lands as the responsible agency.

The southern portion of the site is mapped as Wooroloo Regional Park which extends to the east and west.

2.11 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).

The central and southern portions of the site lie within one mapped ecological linkage (no. 99). This linkage extends beyond the site to the east and west and connects to multiple other linkages. The location of linkage no. 99 is shown in **Figure 2**.

2.12 Previous surveys

No previous flora and vegetation surveys are known to have been undertaken within the site.

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. 24-1120FL).

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) and DBCA's threatened and priority ecological communities' databases (reference no. 44-1120EC).

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

A botanist from Emerge visited the site on 5 November 2020 to conduct the flora and vegetation field survey.

3.2.1 Flora and vegetation

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

Detailed sampling of the vegetation was undertaken using a non-permanent relevés. The relevés were completed over an approximate 10 x 10 m area without the use of physical markers. The position of each sample was recorded with a hand-held GPS unit.

The data recorded within each sample included:

- site details (site name, site number, observers, date, location)
- environmental information (slope, aspect, bare-ground, rock outcropping soil type and colour class, litter layer, topographical position, time since last fire event)
- biological information (vegetation structure and condition, degree of disturbance and species present).

Additional plant taxa not observed within samples were recorded opportunistically as the botanist traversed 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), as shown in **Table 2**.

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.

3.3 Mapping and 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 3**.

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 or 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.

3.3.2 Plant community identification and description

The 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 Threatened and ecological communities

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

3.3.4 Species accumulation curve

A species accumulation curve was plotted from sample data by generating a trendline (log) in Microsoft Excel. The trendline was forecast to locate the asymptote of the curve (the point at which the curve flattens), which provides an indication of amount of sampling that would be required before it can be assumed few species remain undetected. PRIMER v6 also offers a range of estimators to predict minimum species richness (Clarke and Gorley 2006). Both the Jacknife1 and Chao2 non-parametric estimators are reported, as these are known to perform well in comparison to simulated and real data sets and are also recommended for small sample sizes (Gotelli and Colwell 2011). Comparison between actual and estimated species accumulation assists in evaluating the adequacy of sampling effort.

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 4**.

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** is adequate to place the site and vegetation in context.
		No previous survey info was available
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by a qualified botanist with over ten years of botanical experience in Western Australia. Technical review was undertaken by a principal environmental consultant with 20 years' experience in environmental science in Western Australia.
Suitability of timing	No limitation	The survey was conducted in November and thus within the main flowering season. Sufficient rainfall was recorded 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. Some early flowering annual species including orchids may have been not visible during the survey but no threatened and priority flora species with potential to occur are considered to have been missed. The survey timing was considered adequate to allow the detection of species for which seasonal timing is critical.
Temporal coverage	Minor limitation	Detailed 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 sampled once which does not technically meet the full requirements of a 'detailed' survey. However, the site data was considered conclusive as it was collected in the spring main flowering period and the small size of the site enabled thorough coverage.
Spatial coverage and access	No limitation	Site coverage was comprehensive (track logged).
	No limitation	All parts of the site could be accessed as required.
Sampling intensity	No limitation	A total of 140 species were recorded, of which 82 were recorded from four sample locations and 58 were recorded opportunistically. Minimum species richness within site is estimated at between 131 (Jacknife1) and 233 (Chao2) species (refer species accumulation curve and estimates shown in **Plate 5**). The number of species recorded in the site is equal to that of the Jacknife1 estimate and, combined with the degraded nature of a large portion of the site and the time spent searching the vegetation, demonstrates that survey effort was adequate to prepare a comprehensive species inventory for the site.
Influence of disturbance	Minor limitation	Time since fire is greater than 40 years as interpreted form aerial imagery and therefore short-lived species more common after fire may not have been visible.
	No limitation	Historical ground disturbance was evident in parts of the site and some native vegetation in the site. 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.

4 Results

4.1 General site conditions

The site comprises a broad valley with sides that slope gently from the north and south towards Jane Brook which flows through the center. Soils are sandy clay with lateritic gravel throughout and some granitic rocks on a slope in the northern central portion.

The site has been subject to historical disturbance and vegetation comprises mainly native canopy trees over either native understorey, scattered native plants or non-native vegetation. Some areas lack native canopy and either support non-native planted trees or non-native grassland and herbland.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of 17 threatened and 30 priority flora species occurring or potentially occurring within a 10 km radius of the site. Information on these species including their habitat preferences and flowering period is provided in **Appendix B**.

Based on background information available for the site, suitable habitat was considered to potentially occur within the site for six threatened flora species and 15 priority flora species as shown in **Table 5**.

Table 4: Conservation significant flora species considered to have potential to occur in the site based on known habitat preferences

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Darwinia apiculata	EN	EN	P	Open jarrah-marri woodland on shallow gravely soil over laterite, or open heathland over sandy loams with granite boulders.	Oct-Nov
Grevillea christineae	EN	EN	P	Clay loam, sandy clay, often moist.	Aug-Sep
Thelymitra stellata	EN	EN	PG	Sandy loam, clay or gravel over laterite or gravel.	Sep-Nov
Acacia anomala	VU	VU	P	Shallow sand,loam,clay or gravel	Aug-Sep
Acacia aphylla	VU	VU	P	Laterite and granite outcrops on hillsides.	Aug-Oct
Grevillea flexuosa	VU	VU	P	Red-brown sand with laterite & gravel, sand over granite, on hilltops, slopes and in gullies.	May-Oct
Grevillea manglesii subsp. *ornithopoda*	P2	-	P	Red-brown loam over clay	Sep-Nov
Thelymitra variegata	P2	-	P	Sandy clay, sand, laterite.	Jun-Sep
Acacia drummondii subsp. *affinis*	P3	-	P	Lateritic gravelly soils.	Jul-Aug
Acacia horridula	P3	-	P	Gravelly soils over granite, sand, rocky hillsides.	May-Aug
Beaufortia purpurea	P3	-	P	Lateritic or granitic soils on rocky slopes.	Oct-Feb
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan
Grevillea manglesii subsp. *dissectifolia*	P3	-	P	Gravelly loam, moist. Roadsides.	Jun, Sep/Nov
Tetratheca pilifera	P3	-	P	Gravelly soils.	Aug-Oct
Boronia tenuis	P4	-	P	Laterite, stony soils, granite.	Aug-Nov
Calothamnus accedens	P4	-	P	Sandy soils over laterite.	Sep-Jan
Lasiopetalum bracteatum	P4	-	P	Sandy clay, clay, lateritic gravel along drainage lines, creeks, gullies, granite outcrops.	Aug-Nov
Persoonia sulcata	P4	-	P	Lateritic or granitic soils.	Sep-Nov
Pimelea rara	P4	-	P	Lateritic soils.	Dec-Jan
Senecio leucoglossus	P4	-	A	Gravelly lateritic or granitic soils on outcrops or slopes.	Aug-Dec
Stylidium striatum	P4	-	P	Brown clay over laterite on hill slopes.	Oct-Nov

EN=endangered, VU=vulnerable, P1-P4=Priority 1-Priority 4, P=perennial, PG=perennial geophyte.

4.2.2 Species inventory

A total of 104 native and 36 non-native (weed) species were recorded within the site during the field survey, representing 43 families. The dominant families containing native taxa were Fabaceae (18 native taxa and three weed taxa) and Myrtaceae (15 native taxa only). Of the species recorded 82 were recorded in sample locations and 58 were recorded opportunistically.

A complete species list is provided in **Appendix D**.

4.2.3 Threatened and priority flora

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

The threatened and priority flora species identified in the desktop assessment are not considered to occur in the site due to lack of suitable habitat and/or because they were not recorded during the field survey. The likelihood of occurrence assessment is provided as **Appendix B**.

4.2.4 Locally and regionally significant flora

No locally or regionally significant flora species were recorded within the site.

4.2.5 Declared pests

Four species listed as a declared pests pursuant to the BAM Act were recorded within the site:

- **Asparagus asparagoides* (bridal creeper) (s22(2) (exempt))
- **Gomphocarpus fruticosus* (narrowleaf cottonbush) (s22 (C3))
- **Moraea flaccida* (one-leaf cape tulip) (s22 (C3))
- **Zantedeschia aethiopica* (arum lily) (s22(2) (exempt)).

Arum lily was recorded as scattered plants near Jane Brook and the other species were scattered throughout the site. Bridal creeper is also listed as a weed of national significance (WoNS).

4.3 Vegetation

4.3.1 Desktop assessment

The database search results identified eight TECs and four 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 no TECs or PECs were considered to have potential to occur in the site.

4.3.2 Plant communities

A total of four relevés were sampled, as shown in **Figure 3**.

Five plant communities were identified within the site. Plant communities **CcGm** and **CcTo** exist in the southern portion of the site. Plant community **Er** also occurs in the southern portion of the site and is associated with Jane Brook. Plant community **CcX** occurs in the northern portion of the site.

The majority of the remainder of the site supports a **non-native** plant community. The portions of bitumised road and non-vegetated road shoulder within the site do not represent a plant community and were classified as **cleared**.

A description and the area of each plant community is provided in **Table 6** and representative photographs of each are provided in **Plate 1** to **Plate 5**. The location of each plant community is shown in **Figure 3** and raw sample data is provided in **Appendix F**.

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

Plant community	Description	Area (ha)
CcGm	Woodland *Corymbia calophylla* with *Eucalyptus marginata* over shrubland to open shrubland *Grevillea manglesii* subsp. *manglesii*, *Xanthorrhoea preissii*, *Acacia pycnantha* and *Leptospermum erubescens* over mixed open herbland *Thysanotus dichotomus*, *Lepidosperma* spp. and *Tetraria octandra* (**Plate 1**).	0.9
CcTo	Forest *Corymbia calophylla* over scattered shrubs **Acacia iteaphylla* over shrubland *Trymalium odoratissimum* subsp. *odoratissimum* and *Acacia pycnantha* over low open shrubland *Phyllanthus calycinus* over open herbland *Patersonia occidentalis* var. *occidentalis*, *Thysanotus dichotomus* and **Watsonia meriana* (**Plate 2**).	0.21
CcX	Forest *Corymbia calophylla* with *Eucalyptus marginata* over shrubland to open shrubland *Xanthorrhoea preissii* and *X. gracilis* over open herbland *Orthrosanthus laxus* var. *laxus*, *Stylidium* spp. and *Lomandra* spp. (or herbland absent) (**Plate 3**).	0.66
Er	Woodland *Eucalyptus rudis* subsp. *rudis* with scattered *Melaleuca rhaphiophylla* trees over non-native herbland **Bacopa monnieri*, **Oxalis purpurea* and **Lysimachia arvensis* (**Plate 4**).	0.28
Non-native	Heavily disturbed areas comprising non-native and planted trees and shrubs and scattered native plants over non-native grassland and herbland (**Plate 5**).	0.64
Cleared	Hard surfaces not supporting vegetation such as bitumised road.	0.50

*Plate 1: Plant community **CcGm** in 'very good – good' condition*

*Plate 2: Plant community **CcTo** in 'very good - good' condition*

*Plate 3: Plant community **CcX** in 'very good' condition*

*Plate 4: Plant community **Er** in 'degraded' condition*

*Plate 5: Plant community n**on-native** in 'completely degraded' condition*

4.3.3 Vegetation condition

The majority of the vegetation in the site has been subject to disturbance. The most intact vegetation was located in the north western portion of the site (approximately 0.06 ha of plant community **CcX**). This vegetation was mapped as being in 'very good condition' as it comprised the structure expected of a marri woodland in the local area and moderate species diversity. Some disturbance of this vegetation was evident but was generally considered to be low.

Two patches of vegetation in the south western portion of the site, plant community **CcTo** and part of plant community **CcGm**, were mapped as being in 'very good – good condition'. These areas supported moderate native species diversity and cover but had an altered vegetation structure, likely due to disturbance.

The remainder of plant community **CcGm** and parts of plant community **CcX** were mapped as being in 'good' condition. This vegetation supported low to moderate species diversity and cover and evidence of more intensive disturbance such as an altered vegetation structure and areas of base ground.

Vegetation with native canopy trees and very sparse to no native understorey cover were mapped as being in 'degraded' condition. The remainder of the site, the non-native plant community and cleared areas, were mapped as being in 'completely degraded' condition as they are highly disturbed and support very few to no native species.

The extent of vegetation by condition category is detailed in **Table 7** and shown in **Figure 4**.

Table 6: Extent of vegetation condition categories within the site

Condition category (Gibson *et al.* 1994)	Size (ha)
Pristine	0
Excellent	0
Very good	0.06
Very good – good	0.26
Good	1.27
Degraded	0.46
Completely degraded	1.14

4.3.4 Threatened and priority ecological communities

No TECs or PECs were identified within the site.

None of the TECs and PECs identified in the desktop assessment were recorded or considered likely to occur in the site. The likelihood of occurrence assessment is provided in **Appendix C**.

4.3.5 Locally and regionally significant vegetation

Mature eucalypt trees (diameter at breast height larger than 500 mm) including *Corymbia calophylla* (marri) and *Eucalyptus marginata* (jarrah) are present in the site. These trees have the potential to provide foraging, roosting and nesting habitat for threatened black cockatoos, along with other ecological services.

The vegetation within the site is connected to extensive areas of native vegetation located within private properties and John Forrest National Park. Vegetation within the site is associated with Jane Brook which flows through the site and connects to the Swan River.

4.4 Species richness

A total of 82 species were recorded from four samples. A species accumulation curve derived from sample data is presented in **Plate 5**. After four samples the curve is still increasing and has not reached its asymptote. This indicates that a proportion of species likely remain undetected by sampling.

Species richness was estimated in PRIMER v6 to be between 131 (Jacknife1) and 233 (Chao2). Based on the trend of the species accumulation curve approximately 30 to 40 samples would be required to capture that many species. Including the 58 additional species recorded opportunistically, a total of 140 species was recorded in the site. This indicates that between 100% and 60% of the estimated 131-233 species in the site were recorded. Considering the degraded nature of a large portion of the site and the time spent sampling and searching the vegetation, the survey effort was considered to be adequate to prepare a comprehensive species inventory.

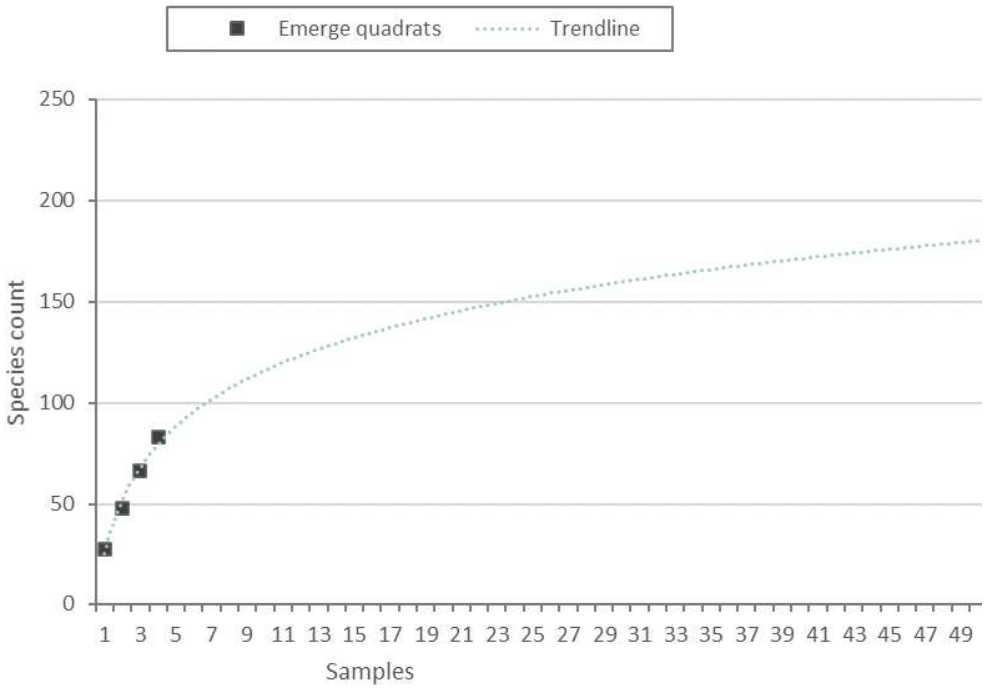

Plate 6: Species accumulation curve derived from sample data (y =39.736ln(x) + 24.658, R^2 = 0.9801)

5 Discussion

The site has been subject to historical disturbance which has reduced the native species diversity, cover and structure across most of the site. Some small patches of higher quality vegetation occur within the site but in general the vegetation is modified.

5.1 Threatened and priority flora

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

The survey was conducted within the main flowering season for the majority of threatened and priority flora species identified in the desktop assessment and thus they should have been visible at the time of the survey, if present. The remaining species that flower outside of November are perennials and should be visible throughout the year, although they may require flowers for taxonomic identification. However, no unidentified specimens which had potential to comprise these species or any other conservation significant species were collected. Therefore, the survey effort is considered sufficient to conclude that no threatened or priority flora species are likely to occur in the site.

5.2 Vegetation condition

Assigning vegetation condition categories to the vegetation within the site was mostly straightforward. However, using a categorical scale is most difficult when vegetation qualities are close to the boundary between two categories. A compound condition category ('very good – good') was included for patches of vegetation which comprised characteristics of each category. This vegetation supported native species diversity and cover that would usually be associated with vegetation in 'very good' condition but comprised an altered structure more similar to 'good' condition vegetation, likely due to disturbance. Therefore, the compound condition category was considered appropriate to differentiate this vegetation from that mapped as 'good' and very good'.

5.3 Threatened and priority ecological communities

No threatened or priority ecological communities were recorded or are considered likely to occur in the site. All except one of the TECs and PECs identified in the desktop assessment occur on the Swan Coastal Plain. Since the site is located on the Darling Plateau these communities were not considered to have potential to occur in the site. The remaining community, 'central northern Darling Scarp granite shrubland community' TEC/PEC, was not considered likely to occur in the site due to the lack of granite shrubland geology and vegetation.

5.4 Local and regional significance

Plant communities **CcGm**, **CcTo**, **CcX**, **Er** and, to a lesser extent, **non-native**, contain plants known to provide foraging habitat for threatened species of black cockatoo. In addition, large mature trees such as *Corymbia calophylla* and *Eucalyptus marginata* are present within the site and have the potential to provide breeding habitat for black cockatoos, along with other ecological services.

6 Conclusions

The site has been subject to historical disturbance and supports patches of native and non-native vegetation and non-vegetated bitumen surface or non-vegetated road shoulder.

No threatened or priority flora species were recorded within the site and none are considered likely to occur due to lack of suitable habitat or because they were not recorded during the field survey.

Five plant communities were recorded within the site which extend over 2.69 ha (84% of the site). The remaining 0.50 ha of the site comprises cleared areas such as the road surface and shoulder.

Approximately half of the site was mapped as being in 'degraded' and 'completely degraded' condition (1.6 ha/50.16 ha). The remainder of the site was mapped as being in 'very good' (0.06 ha), 'very good – good' (0.26 ha) and 'good' (1.27 ha) condition.

No TECs or PECs were recorded within the site and none are considered likely to occur.

Vegetation within the site may be considered significant as it:

- is associated with Jane Brook
- is part of extensive areas of native vegetation in the area and contributes to ecological linkages
- has the potential to provide habitat for fauna including threatened species of black cockatoo.

7 References

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Figures

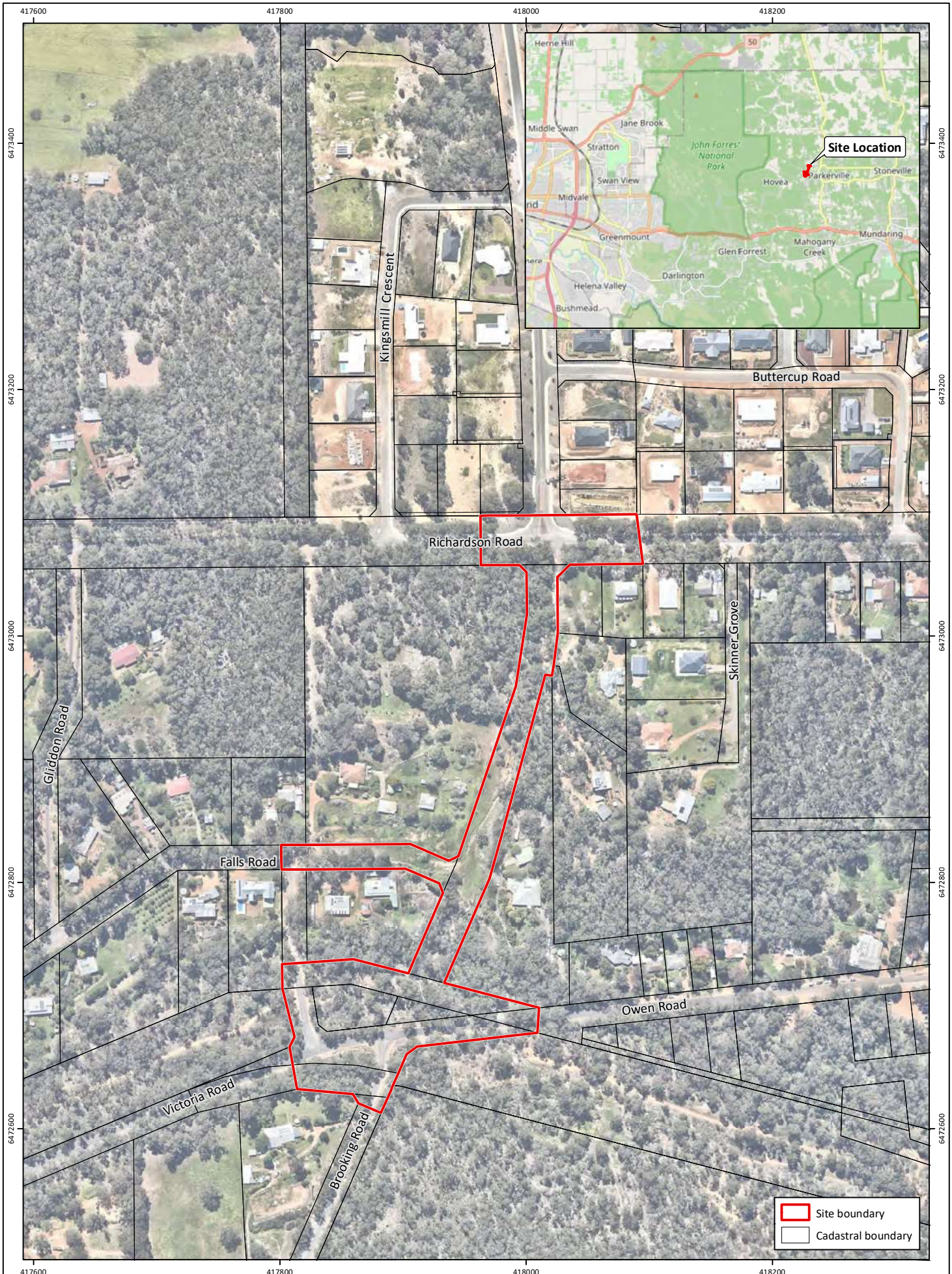

Figure 1: Site Location

Project:	Detailed Flora and Vegetation Assessment Proposed Brooking Road Extension, Parkerville
Client:	Shire of Mundaring

Plan Number:
EP20-134(01)--F03

Drawn:	GAR
Date:	11/03/2021
Checked:	RAW
Approved:	TAA
Date:	12/03/2021

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Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

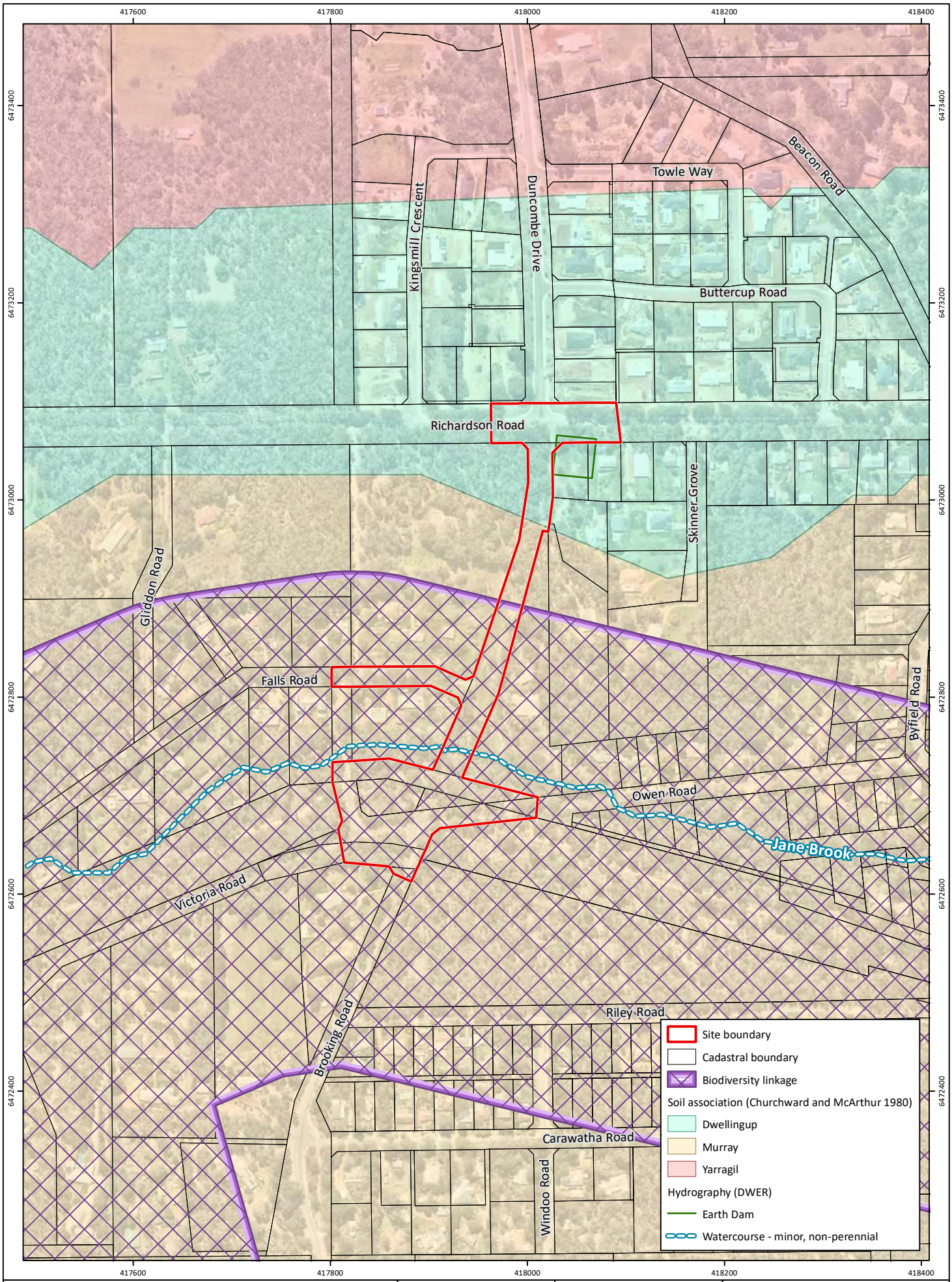

Figure 2: Environmental Features

Project:	Detailed Flora and Vegetation Assessment Proposed Brooking Road Extension, Parkerville
Client:	Shire of Mundaring

Plan Number:
EP20-134(01)--F04

Drawn:	GAR
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Checked:	RAW
Approved:	TAA
Date:	12/03/2021

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Scale: 1:5,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

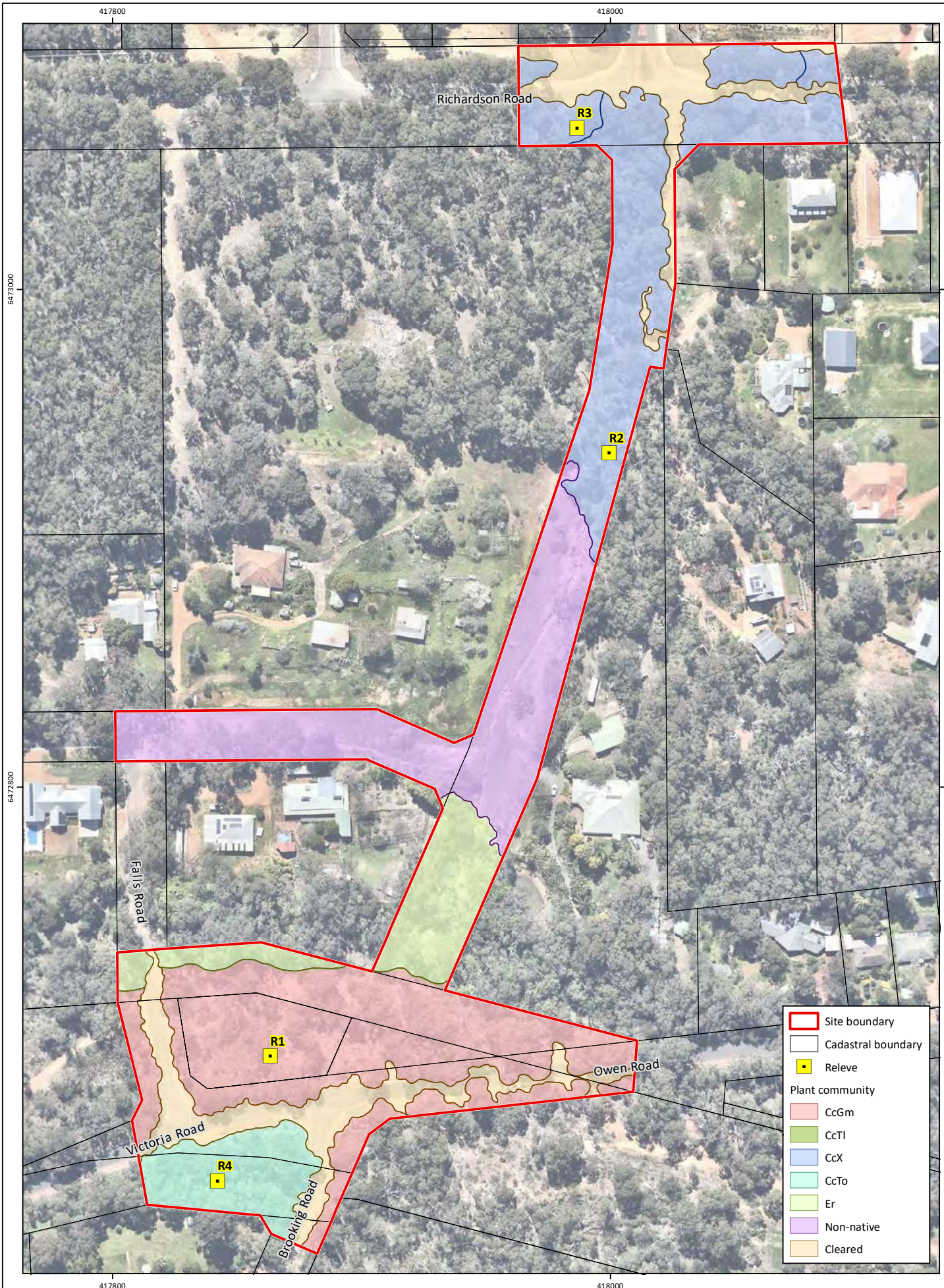

Figure 3: Plant Communities

Project:	Detailed Flora and Vegetation Assessment Proposed Brooking Road Extension, Parkerville
Client:	Shire of Mundaring

Plan Number:
EP20-134(01)--F05

Drawn:	GAR
Date:	11/03/2021
Checked:	RAW
Approved:	TAA
Date:	12/03/2021

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Metres

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

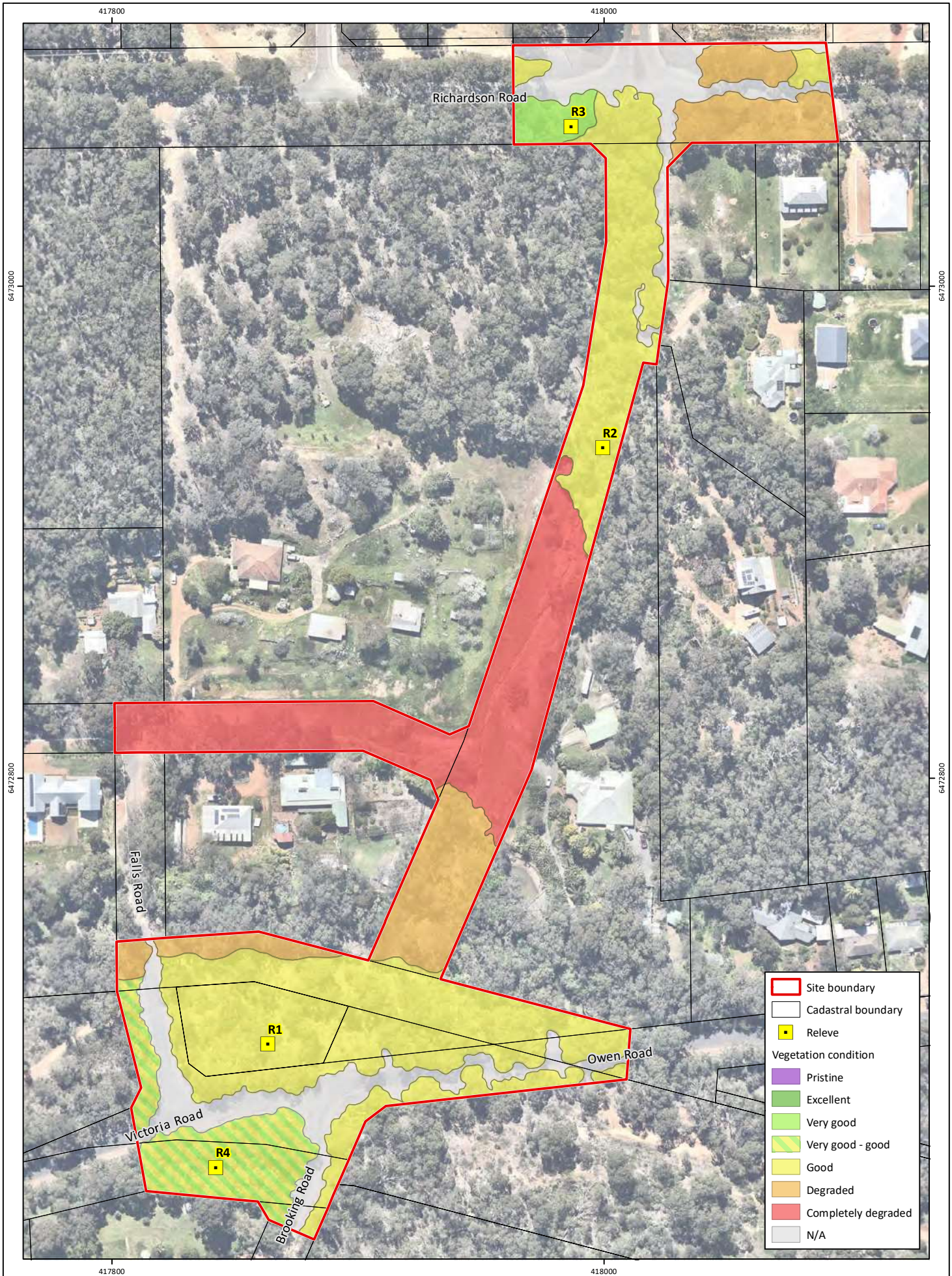

Figure 4: Vegetation Conditon

Project:	Detailed Flora and Vegetation Assessment Proposed Brooking Road Extension, Parkerville
Client:	Shire of Mundaring

Plan Number:
EP20-134(01)--F06

Drawn:	GAR
Date:	11/03/2021
Checked:	RAW
Approved:	TAA
Date:	12/03/2021

N

0 20 40 60
Metres

Scale: 1:2,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

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 2018b). Priority flora species are considered during State approval processes. Priority flora categories and definitions are listed in **Table 1**.

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

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.

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 2018a).

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 2017).

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

Priority code	Description
P1	Priority One: Poorly known ecological communities 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.
P2	Priority Two: Poorly known ecological communities 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.
P3	Priority Three: Poorly known ecological communities (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: (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; (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. 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.
P4	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. (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. (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. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5	Priority Five: Conservation Dependent ecological communities 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.

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 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.

References

General references

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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>.

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
	WA	EPBC Act				
Calectasia cyanea	CR	CR	P	Heathland on white sand or laterite gravel over laterite. Known only from one population near Albany.	Jun-Oct	Unlikely
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	CR	P	Low woodland on grey, clayey sand with lateritic pebbles (Pinjarra Plain) near winter wet flats.	Sep-Nov	Unlikely
Synaphea sp. Pinjarra Plain (A.S. George 17182)	EN	CR	P	White grey clayey sand on edges of seasonally inundated low lying areas.	Sep-Oct	Unlikely
Darwinia apiculata	EN	EN	P	Open jarrah-marri woodland on shallow gravely soil over laterite, or open heathland over sandy loams with granite boulders.	Oct-Nov	Unlikely
Diplolaena andrewsii	EN	EN	P	Granite outcrops & hillsides.	Jul-Oct	Unlikely
Diuris purdiei	EN	EN	PG	Sand to sandy clay soils in areas subject to winter inundation.	Sep to mid-October, only after a summer or early autumn fire	Unlikely
Eucalyptus x balanites	CR	EN	P	Light coloured sandy soils over laterite. Habitat consists of gently sloping heathlands; open mallee woodland over shrubland (Population 2) or heathland with emergent mallees (population 1)	Oct - Feb	Unlikely
Grevillea christineae	EN	EN	P	Clay loam, sandy clay, often moist.	Aug-Sep	Unlikely
Thelymitra dedmaniarum	CR	EN	PG	Red brown sandy loam with dolerite and granite outcrops.	Oct-Nov	Unlikely
Thelymitra stellata	EN	EN	PG	Sandy loam, clay or gravel over laterite or gravel.	Sep-Nov	Unlikely
Andersonia gracilis	VU	EN	P	Seasonally damp, black sandy clay flats near or on the margins of swamps.	Sep-Nov	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Acacia anomala	VU	VU	P	Shallow sand,loam,clay or gravel	Aug-Sep	Unlikely
Acacia aphylla	VU	VU	P	Laterite and granite outcrops on hillsides.	Aug-Oct	Unlikely
Anthocercis gracilis	VU	VU	P	Steep granite slopes along the Darling Scarp in shallow, humis-rich sandy or loamy soils.	Sep-Oct, Apr	Unlikely
Diuris micrantha	VU	VU	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep-early Oct	Unlikely
Eleocharis keigheryi	VU	VU	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	Unlikely
Grevillea flexuosa	VU	VU	P	Red-brown sand with laterite & gravel, sand over granite, on hilltops, slopes and in gullies.	May-Oct	Unlikely
Grevillea manglesii subsp. ornithopoda	P2	-	P	Red-brown loam over clay	Sep-Nov	Unlikely
Thelymitra variegata	P2	-	P	Sandy clay, sand, laterite.	Jun-Sep	Unlikely
Thysanotus sp. Badgingarra (E.A. Griffin 2511)	P2	-	P	Grey sand with lateritic gravel.	Dec	Unlikely
Acacia drummondii subsp. affinis	P3	-	P	Lateritic gravelly soils.	Jul-Aug	Unlikely
Acacia horridula	P3	-	P	Gravelly soils over granite, sand, rocky hillsides.	May-Aug	Unlikely
Acacia oncinophylla subsp. oncinophylla	P3	-	P	Granitic soils	Aug-Oct	Unlikely
Adenanthos cygnorum subsp. chamaephyton	P3	-	P	Grey sand, lateritic gravel.	Jul or Sep to Dec or Jan	Unlikely
Beaufortia purpurea	P3	-	P	Lateritic or granitic soils on rocky slopes.	Oct-Feb	Unlikely
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan	Unlikely
Grevillea manglesii subsp. dissectifolia	P3	-	P	Gravelly loam, moist. Roadsides.	Jun, Sep/Nov	Unlikely
Halgania corymbosa	P3	-	P	Gravelly soils, soils over granite.	Aug-Nov	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Isopogon autumnalis	P3	-	P	Yellow-grey sand.	Feb,Mar,Apr,May or June	Unlikely
Lasiopetalum glutinosum subsp. glutinosum	P3	-	P	Brown clay loam on slopes	Sep-Dec	Unlikely
Lepyrodia heleocharoides	P3	-	P	Moist peaty sand. Dry or seasonally inundated heath or woodland, swamps.	Dec	Unlikely
Meionectes tenuifolia	P3	-	P	Clay loam in seasonally wet areas.	Oct-Dec	Unlikely
Pithocarpa corymbulosa	P3	-	P	Gravelly or sandy loam, amongst granite outcrops.	Jan-Apr	Unlikely
Sporobolus blakei	P3	-	P	Red sandy clay, loam. Creeks.	Mar or Jun to July	Unlikely
Tetratheca pilifera	P3	-	P	Gravelly soils.	Aug-Oct	Unlikely
Thysanotus anceps	P3	-	P	White or grey sand, lateritic gravel, laterite.	Oct-Dec	Unlikely
Verticordia serrata var. linearis	P3	-	P	White sand, gravel.	Sep-Oct	Unlikely
Boronia tenuis	P4	-	P	Laterite, stony soils, granite.	Aug-Nov	Unlikely
Calothamnus accedens	P4	-	P	Sandy soils over laterite.	Sep-Jan	Unlikely
Darwinia pimelioides	P4	-	P	Loam, sandy loam on granite outcrops.	Sep-Oct	Unlikely
Grevillea pimeleoides	P4	-	P	Gravelly soils over granite. Rocky hillsides.	May-Nov	Unlikely
Lasiopetalum bracteatum	P4	-	P	Sandy clay, clay, lateritic gravel along drainage lines, creeks, gullies, granite outcrops.	Aug-Nov	Unlikely
Persoonia sulcata	P4	-	P	Lateritic or granitic soils.	Sep-Nov	Unlikely
Pimelea rara	P4	-	P	Lateritic soils.	Dec-Jan	Unlikely
Senecio leucoglossus	P4	-	A	Gravelly lateritic or granitic soils on outcrops or slopes.	Aug-Dec	Unlikely
Stylidium striatum	P4	-	P	Brown clay over laterite on hill slopes.	Oct-Nov	Unlikely
Thysanotus glaucus	P4	-	P	White, grey or yellow sand, sandy gravel.	Oct-Mar	Unlikely

Note: T=threatened, CR=critically endangered, EN=endangered, VU=vulnerable, P1=Priority 1, P2=Priority 2, P3=Priority 3, P4=Priority 4, P=perennial, PG=perennial geophyte, A=annual. Species 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
			State	EPBC Act	
SCP3a	*Corymbia calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain	TEC	CR	EN	Does not occur
SCP3c	*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain	TEC	CR		Does not occur
SCP20c	Shrublands and woodlands of the eastern side of the Swan Coastal Plain	TEC	CR		Does not occur
SCP20b	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain	TEC	EN	EN	Does not occur
	Banksia woodlands of the Swan Coastal Plain	TEC/ PEC	P3		Does not occur
SCP21c	Low lying *Banksia attenuata* woodlands or shrublands	TEC/ PEC	P3		Does not occur
	Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain	TEC/ PEC	P3	CR	Does not occur
Central Granite Shrublands (Com 5, Markey)	Central Northern Darling Scarp Granite Shrubland Community	TEC/ PEC	P4	-	Does not occur
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

Family	Status	Species
Apiaceae		
		Daucus glochidiatus
		Pentapeltis peltigera
		Xanthosia huegelii
Apocynaceae		
	*DP	*Gomphocarpus fruticosus*
	*	*Vinca major*
Araceae		
	*DP	*Zantedeschia aethiopica*
Araliaceae		
		Trachymene pilosa
Asparagaceae		
	*DP, WoNS	*Asparagus asparagoides*
		Dichopogon capillipes
		Laxmannia squarrosa
		Lomandra hermaphrodita
		Lomandra nigricans
		Lomandra preissii
		Lomandra sericea
		Thysanotus dichotomus
		Thysanotus multiflorus
Asteraceae	*	*Hypochaeris glabra*
	*	*Osteospermum ecklonis*
	*	*Sonchus asper*
	*	*Sonchus oleraceus*
	*	*Ursinia anthemoides*
Bignoniaceae		
	*	*Pandorea pandorana*
Campanulaceae		
	*	*Wahlenbergia capensis*
Colchicaceae		
		Burchardia congesta
Convolvulaceae		
	*	*Ipomoea sp.*
Cyperaceae		
		Lepidosperma longitudinale
		Lepidosperma ?apricola
		Mesomelaena tetragona
		Tetraria octandra
Dilleniaceae		
		Hibbertia commutata
		Hibbertia hypericoides
		Hibbertia sp.
Ericaceae		
		Leucopogon verticillatus
		Styphelia pallida

Family	Status	Species
Fabaceae		
		Acacia alata var. alata
		Acacia celastrifolia
		Acacia extensa
	*	*Acacia iteaphylla*
	*	*Acacia longifolia*
		Acacia pulchella var. pulchella
		Acacia pycnantha
		Acacia saligna
		Bossiaea eriocarpa
		Chorizema cordatum
		Daviesia angulata
		Daviesia cordata
		Daviesia decurrens
		Gastrolobium villosum
		Gastrolobium sp.
		Gompholobium marginatum
		Gompholobium polymorphum
		Gompholobium tomentosum
		Hovea trisperma
		Kennedia prostrata
	*	*Lotus subbiflorus*
Goodeniaceae		
		Dampiera alata
		Lechenaultia biloba
		Scaevola calliptera
Haemodoraceae		
		Anigozanthos manglesii
		Conostylis setigera
		Haemodorum laxum
		Haemodorum sp.
Hemerocallidaceae		
		Agrostocrinum hirsutum
		Caesia micrantha
		Stypandra glauca
		Tricoryne elatior
Iridaceae		
	*	*Freesia alba × leichtlinii*
	*DP	*Moraea flaccida*
		Orthrosanthus laxus var. laxus
		Patersonia babianoides
		Patersonia occidentalis var. occidentalis
	*	*Romulea rosea*
	*	*Watsonia meriana*
Juncaceae		
		Juncus pallidus
Lamiaceae		
		Hemiandra pungens

Family	Status	Species
		Hemigenia incana
Lauraceae		
		Cassytha glabella
Moraceae		
	*	*Ficus carica*
Myrtaceae		
		Astartea ?leptophylla
		Calothamnus quadrifidus subsp. quadrifidus
		Calothamnus torulosus
		Corymbia calophylla
		Darwinia thymoides subsp. thymoides
		Eucalyptus marginata
		Eucalyptus patens
		Eucalyptus rudis subsp. rudis
		Eucalyptus wandoo
		Hypocalymma robustum
		Kunzea micrantha subsp. petiolata
		Leptospermum erubescens
		Melaleuca rhaphiophylla
		Melaleuca viminea
		Verticordia plumosa
Oleaceae		
	*	*Olea europaea*
Orchidaceae		
	*	*Disa bracteata*
		Microtis media subsp. media
		Thelymitra macrophylla
		Thelymitra ?graminea
Oxalidaceae		
	*	*Oxalis purpurea*
Papaveraceae		
	*	*Fumaria capreolata*
Phyllanthaceae		
		Phyllanthus calycinus
Pittosporaceae		
		Billardiera heterophylla
Plantaginaceae		
	*	*Bacopa monnieri*
	*	*Plantago lanceolata*
Poaceae		
		Austrostipa campylachne
	*	*Avena barbata*
	*	*Briza maxima*
	*	*Briza minor*
	*	*Ehrharta calycina*
	*	*Eragrostis curvula*
		Microlaena stipoides
		Neurachne alopecuroidea

Family	Status	Species
		Rytidosperma pilosum
		Tetrarrhena laevis
	*	*Vulpia bromoides*
Polygalaceae		
		Comesperma sp.
	*	*Polygala myrtifolia*
Primulaceae		
	*	*Lysimachia arvensis*
Proteaceae		
		Banksia bipinnatifida
		Banksia dallanneyi
		Banksia undata
		Grevillea bipinnatifida
		Grevillea manglesii subsp. manglesii
		Hakea amplexicaulis
		Hakea trifurcata
		Hakea undulata
	*	*Macadamia sp.*
Ranunculaceae		
		Clematis pubescens
Restionaceae		
		Desmocladus asper
		Desmocladus flexuosus
Rhamnaceae		
		Trymalium odoratissimum subsp. odoratissimum
Rubiaceae		
		Opercularia echinocephala
		Opercularia vaginata
Stylidiaceae		
		Stylidium amoenum
		Stylidium ciliatum
Thymelaeaceae		
		Pimelea ciliata
Tropaeolaceae		
	*	*Tropaeolum majus*
Xanthorrhoeaceae		
		Xanthorrhoea gracilis
		Xanthorrhoea preissii
Zamiaceae		
		Macrozamia fraseri

*=non-native, DP=declared pest under the BAM Act, WoNS=weed of national significance

Appendix E

Sample Data

Vegetation Sample Data
Proposed Brooking Road Extension, Parkerville

Sample Name: R1

Project no.: EP20-134
Date: 5/11/2020 **Status** Non-permanent
Author: RAW R1: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	417863.3059	NW corner northing:	6472692.144
Altitude (m):	0	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	mid-slope
Time since fire:	> 5 yrs	Disturbance:	moderate - Clearing, weeds
Soil type/texture	sand/clay	Bare ground (%):	10
Rocks (%) and type:	10%, laterite	Soil colour:	brown
Litter:	30% (leaves,twigs,branches)	Vegetation condition:	very good

Vegetation Sample Data
Proposed Brooking Road Extension, Parkerville

Sample Name: R1

Project no.: EP20-134
Date: 5/11/2020 **Status** Non-permanent
Author: RAW

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia pycnantha
	Agrostocrinum hirsutum
*	*Briza maxima*
	Corymbia calophylla
*	*Ehrharta calycina*
*	*Eragrostis curvula*
	Gastrolobium villosum
	Gompholobium marginatum
	Gompholobium tomentosum
	Grevillea manglesii subsp. manglesii
	Hibbertia hypericoides
	Leptospermum erubescens
	Macrozamia fraseri
	Mesomelaena tetragona
	Patersonia occidentalis var. occidentalis
*	*Romulea rosea*
	Thysanotus dichotomus
*	*Ursinia anthemoides*
*	*Watsonia meriana*
	Xanthorrhoea preissii

Vegetation Sample Data
Proposed Brooking Road Extension, Parkerville

Sample Name: R2

Project no.: EP20-134
Date: 5/11/2020 **Status** Non-permanent
Author: RAW R2: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	417999.5169	NW corner northing:	6472934.265
Altitude (m):	0	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	mid-slope
Time since fire:	> 5 yrs	Disturbance:	moderate - Clearing, weeds
Soil type/texture	sand/clay	Bare ground (%):	5
Rocks (%) and type:	15%, laterite, granite	Soil colour:	brown
Litter:	40% (leaves,twigs,branches)	Vegetation condition:	very good

Vegetation Sample Data
Proposed Brooking Road Extension, Parkerville

Sample Name: R2

Project no.: EP20-134
Date: 5/11/2020 **Status** Non-permanent
Author: RAW R2: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name
*	*Acacia iteaphylla*
*DP, WoNS	*Asparagus asparagoides*
	Austrostipa campylachne
*	*Avena barbata*
	Bossiaea eriocarpa
*	*Briza maxima*
	Caesia micrantha
	Corymbia calophylla
	Desmocladus flexuosus
*	*Disa bracteata*
	Grevillea bipinnatifida
	Haemodorum laxum
	Hypocalymma robustum
	Hypochaeris glabra
	Lepidosperma ?apricola
*	*Lysimachia arvensis*
	Microlaena stipoides
	Microlaena stipoides
*	*Moraea flaccida*
	Neurachne alopecuroidea
	Phyllanthus calycinus
	Pimelea ciliata
*	*Plantago lanceolata*
	Rytidosperma pilosum
*	*Ursinia anthemoides*
*	*Vulpia bromoides*
	Xanthorrhoea preissii

Vegetation Sample Data
Proposed Brooking Road Extension, Parkerville

Sample Name: R3

Project no.: EP20-134
Date: 5/11/2020 **Status** Non-permanent
Author: RAW R3: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	417990.4934	NW corner northing:	6473063.311
Altitude (m):	0	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	upper slope
Time since fire:	> 5 yrs	Disturbance:	low - Clearing, weeds
Soil type/texture	sand/clay	Bare ground (%):	2
Rocks (%) and type:	10%, laterite	Soil colour:	brown
Litter:	10% (leaves,twigs,logs)	Vegetation condition:	very good

Vegetation Sample Data
Proposed Brooking Road Extension, Parkerville

Sample Name: R3

Project no.: EP20-134
Date: 5/11/2020 **Status** Non-permanent
Author: RAW

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia pulchella var. pulchella
	Bossiaea eriocarpa
*	*Briza maxima*
	Cassytha glabella
	Clematis pubescens
	Comesperma sp.
	Corymbia calophylla
	Dampiera alata
	Daviesia cordata
	Dichopogon capillipes
	Eucalyptus marginata
	Gastrolobium sp.
	Gompholobium polymorphum
	Hakea amplexicaulis
	Kennedia prostrata
	Lechenaultia biloba
	Lepidosperma ?apricola
	Lomandra hermaphrodita
	Lomandra nigricans
*	*Macadamia sp.*
	Opercularia vaginata
	Orthrosanthus laxus var. laxus
	Patersonia babianoides
	Pentapeltis peltigera
	Pimelea ciliata
	Rytidosperma pilosum
	Scaevola calliptera
	Stylidium amoenum
	Stylidium ciliatum
	Styphelia pallida
	Tetrarrhena laevis
	Thysanotus multiflorus
	Xanthorrhoea gracilis
	Xanthorrhoea preissii

Vegetation Sample Data
Proposed Brooking Road Extension, Parkerville

Sample Name: R4

Project no.: EP20-134
Date: 5/11/2020 **Status** Non-permanent
Author: RAW R4: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	417842.2604	NW corner northing:	6472642.046
Altitude (m):	0	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	mid-slope
Time since fire:	> 5 yrs	Disturbance:	moderate - Clearing, weeds
Soil type/texture	sand/clay	Bare ground (%):	5
Rocks (%) and type:	10%, laterite	Soil colour:	brown
Litter:	20% (leaves,twigs,branches)	Vegetation condition:	very good

Vegetation Sample Data
Proposed Brooking Road Extension, Parkerville

Sample Name: R4

Project no.: EP20-134
Date: 5/11/2020 **Status** Non-permanent
Author: RAW

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia celastrifolia
	Acacia extensa
*	*Acacia iteaphylla*
	Acacia pycnantha
	Agrostocrinum hirsutum
	Anigozanthos manglesii
	Bossiaea eriocarpa
*	*Briza maxima*
	Corymbia calophylla
	Daviesia cordata
	Disa bracteata
*	*Ehrharta calycina*
*	*Freesia alba × leichtlinii*
	Hemiandra pungens
	Hibbertia sp.
	Lepidosperma longitudinale
	Macrozamia fraseri
	Microlaena stipoides
	Microtis media subsp. media
	Opercularia echinocephala
*	*Osteospermum ecklonis*
	Patersonia occidentalis var. occidentalis
	Phyllanthus calycinus
	Thysanotus dichotomus
	Trymalium odoratissimum subsp. odoratissimum
*	*Vinca major*
*	*Wahlenbergia capensis*
	Xanthorrhoea preissii