Lot 32 (No.325) Tom Cullity Drive, Wilyabrup - Native Vegetation Clearing Permit Application – Supporting Information

Attachment 2

Detailed Flora and Vegetation Assessment (Emerge Associates (2020b)

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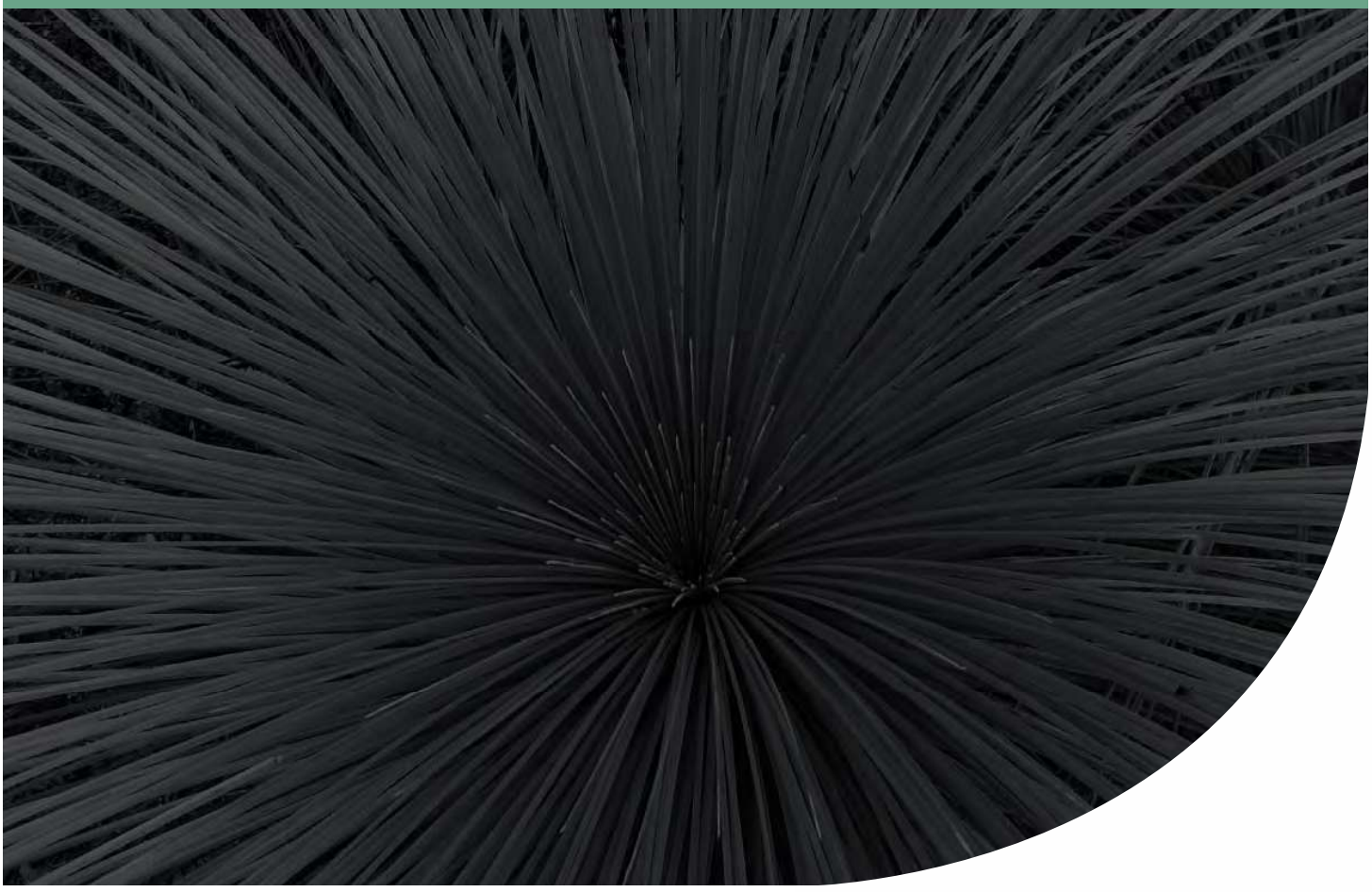
Detailed Flora and Vegetation Assessment

Lot 32 (No.325) Tom Cullity Drive, Wilyabrup

Project No: EP20-088(01)

Prepared for Montague VY No.1 Pty Ltd ATF Montague Trust
December 2020



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Executive Summary

Montague VY No. 1 Pty Ltd ATF Montague Trust (Montague Estate) engaged Emerge Associates (Emerge) to undertake a detailed flora and vegetation survey within Lot 32 (No.325) Tom Cullity Drive in Wilyabrup (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 in August and October 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:

- No threatened flora species were recorded in the site.
- One priority flora species, *Chordifex gracilior* (P3), was recorded within the western portion of the site.
- No threatened or other priority flora species were recorded or considered likely to occur in the site.
- The vegetation within the site was classified into six plant communities which comprise intact native vegetation, disturbed native vegetation and non-native vegetation.
- Half of the site was mapped as being in 'completely degraded condition' (20.31 ha/50.70% of the site). The remainder was mapped as 'very good' (9.87 ha/24.64% of the site), 'good' (7.53 ha/18.80% of the site), 'good – degraded' (0.13 ha/0.32% of the site) and 'degraded' (1.39 ha/3.47% of the site) condition.
- No threatened or priority ecological communities occur within the site.
- The site supports vegetation that may provide habitat for threatened fauna species such as three species of black cockatoo and western ringtail possum.
- The native vegetation in the site, particularly that in the western portion, is contiguous with extensive areas of intact native vegetation outside of the site and would contribute to ecological linkages.

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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	
ESA	Environmentally sensitive area
FCT	Floristic community type
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 community

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 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

1 Introduction

1.1 Project background

Montague VY No. 1 Pty Ltd ATF Montague Trust (Montague Estate) intends to develop part of Lot 32 (No.325) Tom Cullity Drive in Wilyabrup for viticultural and tourism purposes. This lot, referred to herein as the 'site', is located approximately 220 kilometres (km) south-west of the Perth Central Business District within the City of Busselton and is zoned 'viticulture and tourism' under the *Local Planning Scheme No. 21*.

The site is approximately 40.1 hectares (ha) in size and is bound by Tom Cullity Drive to the east and rural lots to the south, west and north. 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 Montague Estate to provide environmental consultancy services to support the planning process for the site. The purpose of this assessment is to provide sufficient information on the flora and vegetation values within the site to inform this process.

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.

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 1120.1 millimetres (mm) of rainfall is recorded annually from the Cowaramup weather station (Bureau of Meteorology (BoM) weather station number 9636), which is the closest weather station, located approximately 3 km south east of the site. The majority of this rainfall is received between the months of May and September. Mean maximum temperatures at the Witchcliffe weather station (BoM weather station number 9746), which is the nearest open temperature recording station located approximately 24 km south-east of the site, range from 16.4^{o}C in July to 27.2^{o}C in February, while mean minimum temperatures range from 8.2^{o}C in July and August to 14.4^{o}C in February (BoM 2020).

A total of 762.7 mm of rain was recorded from May to October 2020 prior to the survey, which is approximately 81% of the mean of 936.9 mm for this period (BOM 2020). This amount was considered to have been sufficient to promote the flowering and emergence of native flora.

2.2 Geomorphology and soils

Landform and soils influence fauna habitat and species at regional and local scales. The majority of the site lies in the Warren bioregion, as defined by the *Interim Biogeographic Regionalisation of Australia* (IBRA) (Environment Australia 2000). The Warren bioregion follows the coastline from Yallingup in the north-west to Albany in the south-east. A small portion of the north-eastern corner of the site lies in the Jarrah Forest bioregion.

The Department of Primary Industries and Regional Development (DPIRD) has compiled data from various surveys to produce a soil landscape mapping dataset for Western Australia (DPIRD 2018), which places the site within the following four soil landscapes:

- 'Cowaramup vales phase' which occurs over the majority of the site and is described as 'small, narrow V-shaped drainage depressions with gravelly duplex (Forest Grove) soils'.

- 'Cowaramup ironstone rises phase' which occurs in the western and eastern portions of the site and is described as 'flats and gentle slopes (0-5% gradient) with some lateritic outcrop and shallow gravelly sands over laterite'.
- 'Cowaramup flats phase' which occurs in the central southern and eastern portion of the site and is described as 'flats (0-2% gradient) with gravelly duplex (Forest Gove) and pale grey mottles (Mungite) soils'.
- 'Wilyabrup gentle slope phase' which occurs in the north-western corner of the site and is described as 'gradients 5-10%'.
- 'Cowaramup wet vales phase' which occurs in the south-eastern corner of the site and is described as 'small, broad U-shaped drainage depressions with swampy floors (with) gravelly duplex (Forest Grove) soils on sideslopes and poorly drained alluvial soils on valley floor'.

The soil landscapes 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 114 m in relation to the Australian height datum (mAHD) on the eastern side of the site to 90 mAHD on the north-western side of the site (DoW 2008) (**Figure 2**).

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 2017c)
- *A Directory of Important Wetlands in Australia* (DBCA 2018a).

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

A review of the regional wetland mapping database *Geomorphic Wetlands Leeuwin Naturaliste Ridge and Donnybrook to Nannup – Unreviewed* (DBCA 2018b) indicates that a palusvale wetland extends in a south-east to north-west direction through the site.

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2018) shows three or water related features within the site:

- one earth dam in the south-western portion
- part of an earth dam in the central-northern portion
- two tributaries of a waterway in the western and central portion of the site.

Aerial imagery also shows a dam in the central portion of the site, which is not mapped in the DWER (2018) hydrography dataset.

The locations of the hydrological features in the site 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) places the site on the border of the 'WAR01' (Warren) and 'JAF02' (Southern Jarrah Forest) subregions (Environment Australia 2000).

The majority of the site is contained within the Warren subregion, which is characterised as comprising tall *Eucalyptus diversicolor* (karri) on deep loams or forest or *Eucalyptus marginata* (jarrah) to *Corymbia calophylla* (marri) on leached sands and extensive *Melaleuca* (paperbark) and sedge swamps in valleys (Beard 1990). A small area in the far eastern corner of the site is contained within the Southern Jarrah Forest subregion, which is characterised as mainly containing *Eucalyptus marginata* (jarrah) forest on lateritic soils of the Plateau and on the loam soils of the valleys, with *Corymbia calophylla* (marri) – *Eucalyptus wandoo* (wandoo) woodland on the drier laterite-free soils (Beard 1990).

Variations in native vegetation within the site can be further classified based on regional vegetation associations. Beard *et al.* (2013) mapping shows the majority of the site as comprising vegetation association 'Boranup 3' and the eastern corner as comprising vegetation association 'Chapman 3'. Both of these associations are described as 'mainly jarrah and marri'.

'Boranup 3' association has 38.51% of its pre-European extent remaining in the Warren sub-region with 11.95% protected for conservation purposes (Government of Western Australia 2019). 'Chapman 3' association has 56.32% of its pre-European extent remaining in the Warren sub-region with 9.4% protected for conservation purposes (Government of Western Australia 2019).

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 percentage protected for conservation of the 'Boranup 3' and the 'Chapman 3' associations both fall below the 30% retention objective.

Finer scale mapping of vegetation complexes within the southern forests region by DBCA (2019) indicates the following three vegetation complexes occur within the site:

- 'Cowaramup Cw2' occurs in the central portion of the site and is described as a 'mixture of open forest to woodland of *Eucalyptus diversicolor-Corymbia calophylla* and woodland of *Eucalyptus marginata* subsp. *marginata -Corymbia calophylla* on slopes and low woodland of *Melaleuca preissiana-Banksia littoralis* on depressions in the hyperhumid zone'. This complex is associated with the 'Cowaramup vales phase' soil landscape (refer to **Section 2.2**).
- Cowaramup C2' occurs in the southern, western and north eastern portions of the site and is described as 'open forest of *Eucalyptus marginata* subsp. *marginata-Corymbia calophylla-*

Banksia grandis on lateritic uplands in perhumid and humid zones'. This complex is associated with the 'Cowaramup flats phase' and the 'Cowaramup ironstone rises phase' soil landscapes (refer to **Section 2.2**).

- 'Wilyabrup W2' occurs in the north western portion of the site and is described as 'open forest of *Corymbia calophylla-Allocasuarina decussata-Agonis flexuosa* on deeply incised valleys in perhumid and humid zones'. This complex is associated with the 'Wilyabrup gentle slope phase' soil landscape (refer to **Section 2.2**).

2.6 Historic land use

Review of historical images available from 1996 onwards shows that much of the site was cleared of native vegetation prior to 1996, likely for grazing and/or viticultural purposes (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**. An assessment of the likelihood of occurrence of threatened and priority flora within the site was undertaken (refer to **Sections 3.1**, **4.2.1** and **4.2.3**).

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 2020c). '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 protected 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**, **4.3.1** and **4.3.4**).

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.

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

- The site is in close proximity to regional or National park.
- The vegetation within the site is associated with wetlands/water courses.
- The vegetation within the site has potential value as habitat for threatened or priority fauna species including, in particular, Carnaby's black cockatoo and the forest red-tailed black cockatoo, which are listed as 'vulnerable' under the EPBC Act and 'endangered' under the BC Act.

The site was assessed for these features during the field survey (refer **Section 3.2**).

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-statuatory, 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 some 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.

No ESAs are present over the site or in close proximity to the site. The closest environmentally sensitive area occurs approximately 5.5 km west of the site.

2.9 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.

No DBCA legislated lands or water occur in or near the site. 'Walburra Nature Reserve' is located approximately 5.5 km north. Additional DBCA legislated lands and waters are located in the wider area of the site including Leeuwin-Naturaliste National Park (approximately 5.3 km to the west) and Yelverton National Park (approximately 4.5 km to the north).

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).

There are no mapped ecological linkages within or adjacent to the site. Review of aerial imagery indicates that much of the vegetation within the site is connected to extensive areas of native vegetation within the local area.

2.11 Previous surveys

No flora or vegetation surveys are known to have been previously 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) and *NatureMap* (DBCA 2020). A search of DBCA's threatened and priority flora database was also conducted using a 20 km radius, as recommended by DBCA (reference no 10-0820FL).

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' database (reference no. 28-0820EC).

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 12-13 August and 26-28 October 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 combination of non-permanent 10 x 10 m quadrats and relevés. The quadrats were established using fence droppers bound by measuring tape. The relevés were completed over an equivalent 10 x 10 m area without the use of physical markers and were included to provide a more rapid sample of patches of vegetation in poorer condition and/or of smaller size.

A total of six locations were sampled, comprised of three quadrats and three relevés. The position of each sample location was recorded with a hand-held GPS unit, as shown in **Figure 3**.

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, 'foliage projective cover' (FPC), 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 1**.

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 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 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 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 Threatened and priority 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 provided in relevant documentation.

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 3**.

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 surveys are known to have been undertaken within the site.
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 senior environmental consultant with 18 years' experience in environmental science in Western Australia.
Suitability of timing	No limitation	The survey was conducted within the main flowering season. High 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 August and October 2020. The August site visit provided information on early flowering species and the November site visit provided an insight into the vegetation condition and composition within the main flowering period. Therefore, 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.
Sampling intensity	No limitation	A total of 154 species were recorded, of which 101 were recorded from six sample locations and 53 were recorded opportunistically. Minimum species richness within site is estimated at between 150 (Jacknife1) and 163 (Chao2) (refer species accumulation curve and estimates shown in **Plate 7**). Since the number of species recorded in the site is equal or greater than the estimates, the survey effort was considered to be adequate to prepare a comprehensive species inventory.
Influence of disturbance	Minor limitation	Time since fire is greater than 10 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. 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 gently undulating landscape with sandy clay soils and lateritic gravel. Two creeklines associated with dams through the western portion of the site and join up outside of the site to the north west.

A large portion of the site supports non-native pasture grasses, planted trees and vineyards. Intact patches of upland and riparian native vegetation occur in the western portion of the site. Patches of upland native vegetation also occur in the eastern portion of the site and have been subject to historical disturbance in the form of grazing.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of 17 threatened and 58 priority flora species occurring or potentially occurring within a 10-20 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, seven threatened flora species and 29 priority flora species were identified as potentially occurring within the site as shown in **Table 4**.

Table 4: Conservation significant flora species with 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			
Caladenia procera	CR	CR	PG	Rich clay loam, alluvial loamy flats with jarrah/marri/peppermint woodland, dense heath, sedges.	Sep-Oct
Gastrolobium argyrotrichum	CR	CR	P	Slopes and valleys. Dark grey sandy clay over granite or laterite.	Jul-Oct
Grevillea brachystylis subsp. *grandis*	CR	CR	P	Sand and loam with lateritic gravel.	Sep-Dec
Caladenia viridescens	CR	E	PG	Well-drained lateritic sandy loam soils in marri and peppermint woodlands or coastal heath.	Sep-Oct
Verticordia plumosa var. *ananeotes*	CR	E	P	Sand in open jarrah woodland or sandy/clay soils with marri.	Nov-Dec
Banksia squarrosa subsp. *argillacea*	VU	VU	P	White/grey sand, gravelly clay or loam predominantly in winter-wet areas over ironstone in open to tall shrubland.	Jun-Nov
Daviesia elongata	T	-	P	Sand, laterite.	Sep/Dec-Jan/Feb

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

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Schoenus sp. Jindong (R.D. Royce 2485)	P1	-	P	Red loamy soils on stream banks.	Undocumented (likely Aug-Nov)
Tetraria sp. Nannup (P.A. Jurjevich 1133)	P1	-	P	Sand and clay loam in valley flats and creeks	Undocumented (likely Mar-Nov)
Amperea micrantha	P2	-	P	Sandy soils.	Oct-Nov
Andersonia sp. Echidna (A.R. Annels ARA 5500)	P2	-	P	Brown laterite and sandy loam on slopes and flats.	Nov-Dec
Boronia sp. Leeuwin (J. Scott 235)	P2	-	P	Sand and peat with gravelly laterite in winter-wet depressions, swamps and watercourses.	Aug-Dec
Hybanthus volubilis	P2	-	P	Clay or sandy clay on river banks.	Sep-Dec
Acacia inops	P3	-	P	Black peaty sand, clay. Swamps, creeks.	Sep-early Nov
Acacia lateriticola var. Glabrous variant (B.R.Maslin 6765)	P3	-	P	Lateritic soils	Aug or Oct
Boronia capitata subsp. *gracilis*	P3	-	P	White/grey or black sand in winter-wet swamps, hillslopes.	Jun-Nov
Boronia tetragona	P3	-	P	Black/white sand, laterite, brown sandy loam in winter-wet flats, swamps, open woodland.	Oct-Dec
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan
Gastrolobium formosum	P3	-	P	Clay loam. Along river banks or in swamps.	Nov
Grevillea bronwenae	P3	-	P	Grey sand over laterite, lateritic loam on hillslopes.	Jun-Dec
Juncus meianthus	P3	-	P	Black sand, sandy clay. Creeks, seepage areas.	Nov-Dec/Jan
Lasiopetalum laxiflorum	P3	-	P	Sand and/or clay with laterite.	Sep-Dec
Olearia strigosa	P3	-	P	Sandy loam in open forest.	Dec/Jan-May
Pimelea ciliata subsp. *longituba*	P3	-	P	Grey sand over clay, loam.	Oct-Dec
Pultenaea pinifolia	P3	-	P	Loam or clay. Floodplains, swampy areas.	Oct-Nov
Synaphea decumbens	P3	-	P	Sand over laterite.	Sep-Oct
Synaphea hians	P3	-	P	Sandy soils on rises.	Jul-Nov

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

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Acacia flagelliformis	P4	-	P	Sandy soils in winter-wet areas.	May-Sep
Acacia semitrullata	P4	-	P	White/grey sand, sometimes over laterite, clay sometimes in sandplains, swampy areas.	May-Oct
Acacia tayloriana	P4	-	P	Grey or yellow/orange sandy soils, lateritic gravel, clay loam. Winter-wet areas.	Jan
Calothamnus quadrifidus subsp. teretifolius	P4	-	P	Sand, loam or clay with laterite.	Oct-Dec
Chamelaucium erythrochlorum	P4	-	P	Clay, loam and sandy soils in creeklines, slopes and ridges	Nov-Feb

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

4.2.2 Species inventory

A total of 135 native and 19 non-native (weed) species were recorded within the site during the field survey, representing 46 families. The dominant families containing native taxa were Fabaceae (14 native taxa), Cyperaceae (11 native taxa), Orchidaceae (11 native taxa and one weed taxon) and Proteaceae (nine native taxa). Of the species recorded 101 were recorded in sample locations and 53 were recorded opportunistically.

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

4.2.3 Threatened and priority flora

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

One priority flora species, *Chordifex gracilior* (P3), was recorded within the western portion of the site as shown in **Figure 3**. This species was recorded at one location where it was abundant. The number of individuals was unable to be determined due to the rhizomatous nature of *C. gracilior.*

The threatened and priority flora species identified in the desktop assessment as potentially occurring 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.

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

One species, **Zantedeschia aethiopica* (arum lily) listed as a declared pest (C3) pursuant to the BAM Act, was recorded within the site. Arum lily individuals were scattered throughout the site, particularly in low-lying areas.

No weeds of national significance (WoNS) were recorded.

4.3 Vegetation

4.3.1 Desktop assessment

The database search results identified two 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

The following five native plant communities and one non-native plant community were identified in the site:

- **CcAfB** exists as small patches around a dam in the centre of the site.
- **CcAfL** is associated with the creekline and is located in the central and western portions of the site.
- **CcAfTl** exists on the southern boundary of the dam in the south-western portion of the site.
- **CcEm** exists as two patches in the eastern portion of the site.
- **CcEmHeHh** exists as multiple patches in the western portion of the site.
- **Non-native** plant community occurs across the remainder of the site and includes vineyards, pasture and buildings.

A small portion (0.83 ha) of the site supports dams which were not mapped as vegetation. 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 6**. The location of each plant community is shown in **Figure 3**. Raw sample data is provided in **Appendix E**.

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

Plant community	Description	Area (ha)
CcAfB	Woodland *Corymbia calophylla* over tall shrubland *Agonis flexuosa* over sedgeland *Baumea articulata* and *Baumea juncea* with non-native grassland in more disturbed areas (**Plate 1**).	0.16
CcAfL	Open forest *Corymbia calophylla* over low closed forest *Agonis flexuosa* with scattered **Sphaeropteris cooperi* and closed sedgeland *Lepidosperma tetraquetrum* in waterway (where present) and closed sedgeland *Lepidosperma* spp. on banks (**Plate 2**).	2.61
CcAfTlCa	Woodland *Corymbia calophylla* over low closed forest *Agonis flexuosa* over tall closed shrubland *Taxandria linearifolia* over mixed native sedeland over herbland *Centella asiatica* (**Plate 3**).	0.08
CcEm	Open forest *Corymbia calophylla* and *Eucalyptus marginata* over sparse native shrubland over sparse native and non-native forbland over non-native grassland (**Plate 4**).	7.08
CcEmHeHh	Open forest *Corymbia calophylla* and *Eucalyptus marginata* over scattered low trees *Banksia grandis* over shrubland *Hovea elliptica* and *Xanthorrhoea preissii* over low shrubland *Hibbertia hypericoides* over mixed native herbland (**Plate 5)**.	8.99
Non-native	Heavily disturbed areas dominated by non-native grasses and herbs and planted vegetation with occasional native trees, shrubs and herbs (**Plate 6**).	20.31

*Plate 1: Plant community **CcAfB** in 'good – degraded' condition*

*Plate 2: Plant community **CcAfL** in 'very good' condition*

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

*Plate 4: Plant community **CcEm** in 'good' condition*

*Plate 5: Plant community **CcEmHeHh** in 'very good' condition*

Plate 6: Non-native vegetation in 'completely degraded' condition

4.3.3 Vegetation condition

Most of the patches of plant communities **CcEmHeHh**, **CcAfTlCa** and **CcAfL** in the western portion of the site were mapped as being in 'very good' condition. This vegetation supported a high diversity of native species, low non-native species and a mostly intact structure. However, some alterations to the structure were present, with evidence of historic logging.

The **CcEm** vegetation in the eastern portion of the site was mapped as being in 'good' condition. This vegetation consists of native canopy trees but the understorey is altered with reduced diversity and cover. The structural changes appear to be due to historical disturbance in the form of grazing and logging.

Parts of plant community **CcAfB** were mapped as being in 'good – degraded' condition where they supported moderate cover of native species with low diversity and moderate cover of weeds. This vegetation showed signs of disturbance such as an altered structure.

Areas of vegetation with native canopy trees but very low native understorey diversity and cover were mapped as being in 'degraded' condition. Often, these areas also supported high cover of non-native species.

The remainder of the site was mapped as being in 'completely degraded' condition as it was dominated by non-native species such as pasture grasses and herbs and planted trees and shrubs including grapevines. Scattered native plants also occur within this area. Tracks, bare ground and buildings were included in this category.

The 0.83 ha of water associated with the dams were not assigned a condition category.

The extent of vegetation by condition category is detailed in **Table 6** and shown in **Figure 4**.

Table 6: Extent of vegetation condition categories within the site

Condition category (Keighery 1994)	Size (ha)
Pristine	0
Excellent	0
Very good	9.87
Good	7.53
Good – degraded	0.13
Degraded	1.39
Completely degraded	20.31

4.3.4 Threatened and priority ecological communities

The vegetation within the site does not represent a TEC or PEC.

4.3.5 Locally and regionally significant vegetation

The site supports vegetation which has the potential to provide habitat for threatened fauna, including threatened black cockatoos and western ringtail possum. In particular, numerous mature eucalypt trees (diameter at breast height larger than 500 mm) including *Corymbia calophylla* (marri) and *Eucalyptus marginata* (jarrah) are present in the site, which have the potential to provide nesting habitat for black cockatoos. Incidental foraging evidence of black cockatoos was also observed within the site. A separate fauna assessment was undertaken concurrently with this flora and vegetation assessment (Emerge Associates 2020).

The native vegetation in the site, particularly that in the western portion, is contiguous with extensive areas of intact native vegetation outside of the site and would contribute to ecological linkages.

4.4 Species richness and sampling adequacy

A total of 101 species were recorded from six samples. A species accumulation curve derived from sample data is presented in **Plate 7**. After six 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 150 (Jacknife1) and 163 (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 53 additional species recorded opportunistically, a total of 154 species was recorded in the site. This indicates that between 94% and 103% of the estimated 150-163 species in the site were recorded. Therefore, the survey effort was considered to be adequate to prepare a comprehensive species inventory.

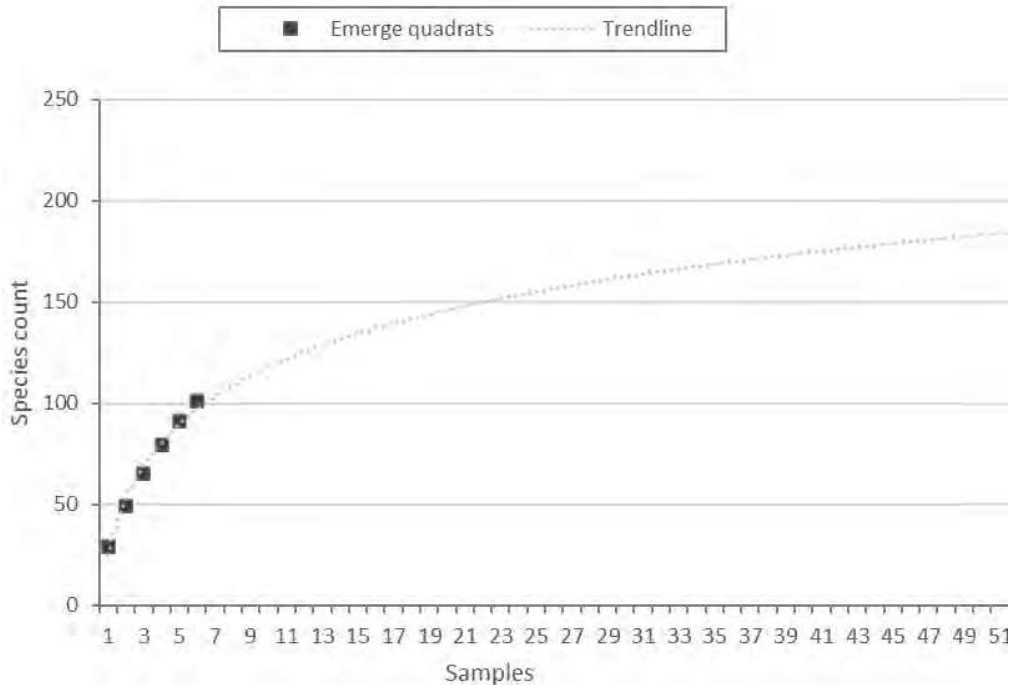

Plate 7: Species accumulation curve derived from sample data (y =40.509ln(x) + 24.73, R^2 = 0.9835)

5 Discussion

Approximately half of the site has been subject to historical disturbance and does not currently support native vegetation. The most intact native vegetation exists within plant communities **CcEmHeHh**, **CcAfTlCa** and **CcAfL** in the western portion of the site. These communities are contiguous with extensive areas of native vegetation outside of the site. While not mapped as formal ecological linkages, this vegetation contributes to the value of vegetation within the region. The eastern portion of the site supports patches of native vegetation with lower values due to historical disturbance.

5.1 Threatened and priority flora

No threatened flora species were recorded within the site.

One priority flora species, *Chordifex gracilior* (P3), was recorded within one location in the site. This species was not considered likely to occur in the site during the desktop assessment due to its listed habitat as 'peaty sand in swamps' (Western Australian Herbarium 2020). Soil mapping and the field survey confirmed that peaty swamps do not occur in the site. However, a specimen of *C. gracilior* was collected during the field survey and a specialist taxonomist confirmed that its features matched that of *C. gracilior.* A total of 31 records of *C. gracilior* exist on DBCA's *Florabase* database and some occur on sandy and clay soils such as that within the site. This species appeared to be abundant in the location where it was recorded during the survey but was not recorded elsewhere.

Prior to the survey, based on background information, seven threatened and 29 priority flora species were considered to potentially occur within the site. The field surveys in August and October were considered sufficient to determine that these species are unlikely to occur. This is because either suitable habitat does not occur or the species were not recorded during traverses within potentially suitable habitat. The timing of the surveys coincided with the main flowering period of the majority of the conservation significant flora identified in the desktop assessment and therefore they should have been visible, if present. The species with flowering periods outside of August and October are perennials and would be visible throughout the year. Since no unidentified specimens which had potential to comprise conservation significant species were collected, the survey effort is also considered sufficient to confirm the absence of these species.

5.2 Vegetation condition

Assigning vegetation condition categories to the vegetation was relatively straightforward. The higher condition of the **CcEmHeHh**, **CcAfTlCa** and **CcAfL** vegetation in the western portion of the site was clearly discernible from other vegetation due to the high cover and diversity of native flora. This vegetation is tending towards the 'excellent' condition category but was determined to be in 'very good' condition due to the presence of alterations to the vegetation structure, primarily the lack of large old trees due to historical logging.

The **CcEm** vegetation in the eastern portion of the site was mapped as being in 'good' condition due to the reduced native understorey that was present during the field survey, likely due to historic disturbance such as grazing. However, a considerable diversity of native species, including orchids which are often impacted by disturbance events, were recorded in this vegetation. If undisturbed in the future, it is likely that the structure of the **CcEm** vegetation in 'good' condition will regenerate, though it is unlikely to improve to the condition of the **CcEmHeHh**, **CcAfTlCa** and **CcAfL** vegetation in the western portion of the site.

5.3 Threatened and priority ecological communities

The TECs and PECs identified in the desktop assessment are associated with banksia woodland vegetation, the Gracetown soil-landscape system, wetlands, rimstone pools and caves. The vegetation and landforms within the site do not meet any of these criteria. Therefore, no TECs or PECs occur within the site.

5.4 Local and regional significance

The native vegetation, particularly that in 'very good' condition, is contiguous with extensive areas of vegetation outside of the site and contributes to ecological linkages. Habitat for conservation significant fauna species exists within the site, particularly for threatened black cockatoos and western ringtail possum.

6 Conclusions

No threatened flora species were recorded in the site. One priority flora species, *Chordifex gracilior* (P3), was recorded within the western portion of the site. No threatened or other priority flora species were recorded or considered likely to occur in the site.

The vegetation within the site was classified into six plant communities:

- Plant community **CcEmHeHh** comprises intact native vegetation and extends over 8.99 ha (22.44% of the site).
- Plant community **CcAfL** comprises intact native vegetation associated with creeklines and extends over 2.61 ha (6.52% of the site).
- Plant community **CcAfTlCa** comprises a small patch of intact native vegetation that extends over 0.08 ha (0.20% of the site).
- Plant community **CcEm** has been subject to disturbance and exists as two patches in the eastern portion of the site which extend over 7.08 ha (17.67% of the site).
- Plant community **CcAfB** exists as small patches around a dam and extends over 0.16 ha (0.40% of the site).
- **Non-native** plant community occurs within the remainder of the site and includes vineyards, pasture and buildings (20.31 ha/50.70% of the site).

Half of the site was mapped as being in 'completely degraded condition' (20.31 ha/50.70% of the site). The remainder was mapped as 'very good' (9.87 ha/24.64% of the site), 'good' (7.53 ha/18.80% of the site), 'good – degraded' (0.13 ha/0.32% of the site) and 'degraded' (1.39 ha/3.47% of the site) condition.

No TECs or PECs occur within the site.

The site supports vegetation that may provide habitat for threatened fauna species such as three species of black cockatoo and western ringtail possum. The native vegetation in the site, particularly that in the western portion, is contiguous with extensive areas of intact native vegetation outside of the site and would contribute to ecological linkages.

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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.

Clarke, K. R. and Gorley, R. N. 2006, *PRIMER v6: User Manual/Tutorial*, PRIMER-E, Plymouth.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017a, *DBCA - Legislated Lands and Waters (DBCA-011)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017b, *Lands of Interest (DBCA-012)*.

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

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

Department of Biodiversity, Conservation and Attractions (DBCA) 2018b, *Geomorphic Wetlands Leeuwin Naturaliste Ridge and Donnybrook to Nannup - Unreviewed (DBCA-043)*.

Department of Biodiversity Conservation and Attractions (DBCA) 2019, *Vegetation Complexes - South West forest region of Western Australia (DBCA-047)*, Kensington.

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

Department of Primary Industries and Regional Development (DPIRD) 2018, *Soil Landscape Mapping - Best Available (DPIRD-027)*, Perth.

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

Emerge Associates 2020, *Basic Fauna and Targeted Black Cockatoo Assessment - Lot 32 (No.325) Tom Cullity Drive, Wilyabrup*, EP20-088(02)--004 MS, Version 1.

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.

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

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.

Gotelli, N. J. and Colwell, R. K. 2011, *Estimating species richness*, Oxford University Press, Oxford.

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

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

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.

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 1 December , <http://www.bom.gov.au/climate/data/>.

Department of Biodiversity, Conservation and Attractions (DBCA) 2020, *NatureMap,* viewed 3 August 2020 <https://naturemap.dbca.wa.gov.au/>.

Department of Agriculture, Water and the Environment (DAWE) 2020a, *Protected Matters Search Tool*, viewed 3 August 2020, <https://www.environment.gov.au/epbc/protected-matters-search-tool>.

Department of Agriculture, Water and the Environment (DAWE) 2020b, *Threatened Ecological Communities*, viewed 20 June 2020, <http://www.environment.gov.au/biodiversity/threatened/communities/about>.

Department of Agriculture, Water and the Environment (DAWE) 2020c, *Weeds of National Significance*, viewed 12 July 2020, <http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>.

West Australian Land Information Authority (WALIA) 2020, *Landgate Map Viewer*, viewed 3 August 2020, <http://landgate.wa.gov.au>.

Western Australian Herbarium 2020, *FloraBase – the Western Australian Flora*, Department of Biodiversity, Conservation and Attractions (DBCA), viewed 3 December 2020 <https://florabase.dpaw.wa.gov.au/>.

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Figures

Figure 1: Site Location

Project: Detailed Flora and Vegetation Survey
Lot 32 (No.235) Tom Cullity Drive, Wilyabrup
Client: Montague VY No. 1 Pty Ltd ATF Montague Trust

Plan Number:
EP20-088(01)--F17

Drawn:	GAR
Date:	01/10/2020
Checked:	RAW
Approved:	KK
Date:	16/12/2020

N

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Metres

Scale: 1:10,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

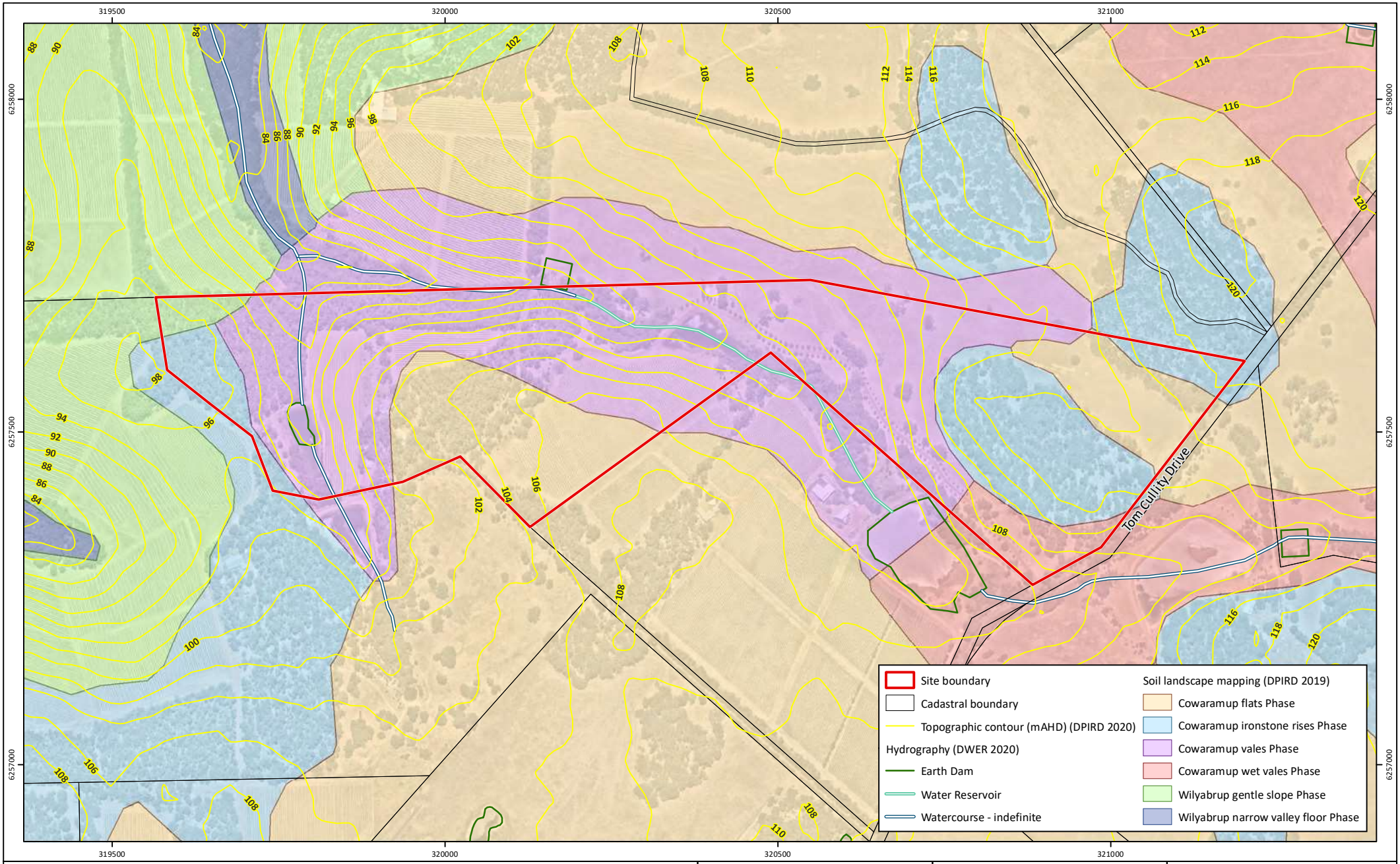

Figure 2: Hydrography, Soils, and Topography

Project: Detailed Flora and Vegetation Survey
Lot 32 (No.235) Tom Cullity Drive, Wilyabrup
Client: Montague VY No. 1 Pty Ltd ATF Montague Trust

Plan Number:
EP20-088(01)--F18

Drawn:	GAR
Date:	01/10/2020
Checked:	RAW
Approved:	KK
Date:	16/12/2020

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

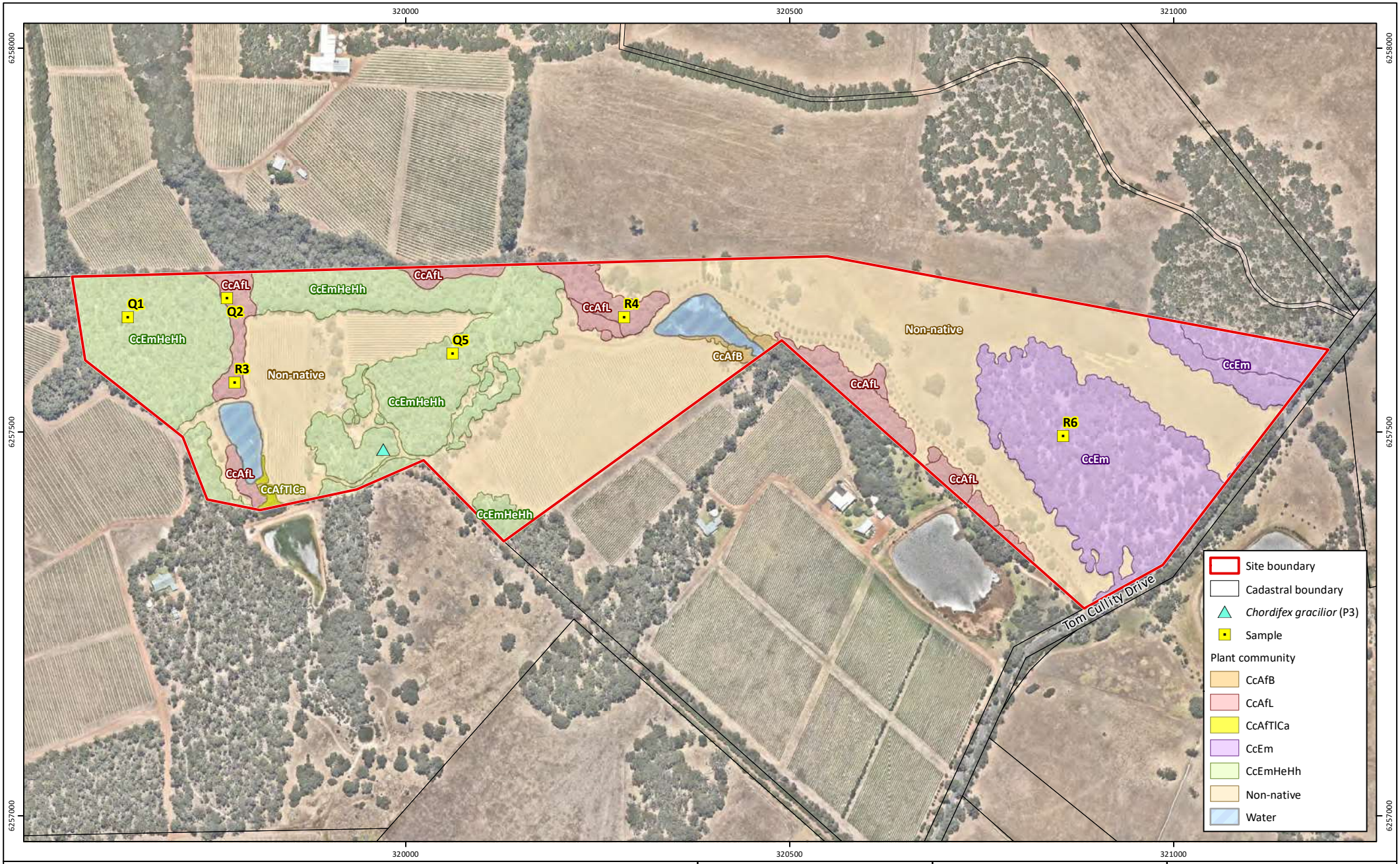

Figure 3: Plant Communities and Priority Flora

Project: Detailed Flora and Vegetation Survey
Lot 32 (No.325) Tom Cullity Drive, Wilyabrup
Client: Montague VY No. 1 Pty Ltd ATF Montague Trust

Plan Number:
EP20-088(01)--F19
Drawn: GAR
Date: 01/10/2020
Checked: RAW
Approved: KK
Date: 16/12/2020

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

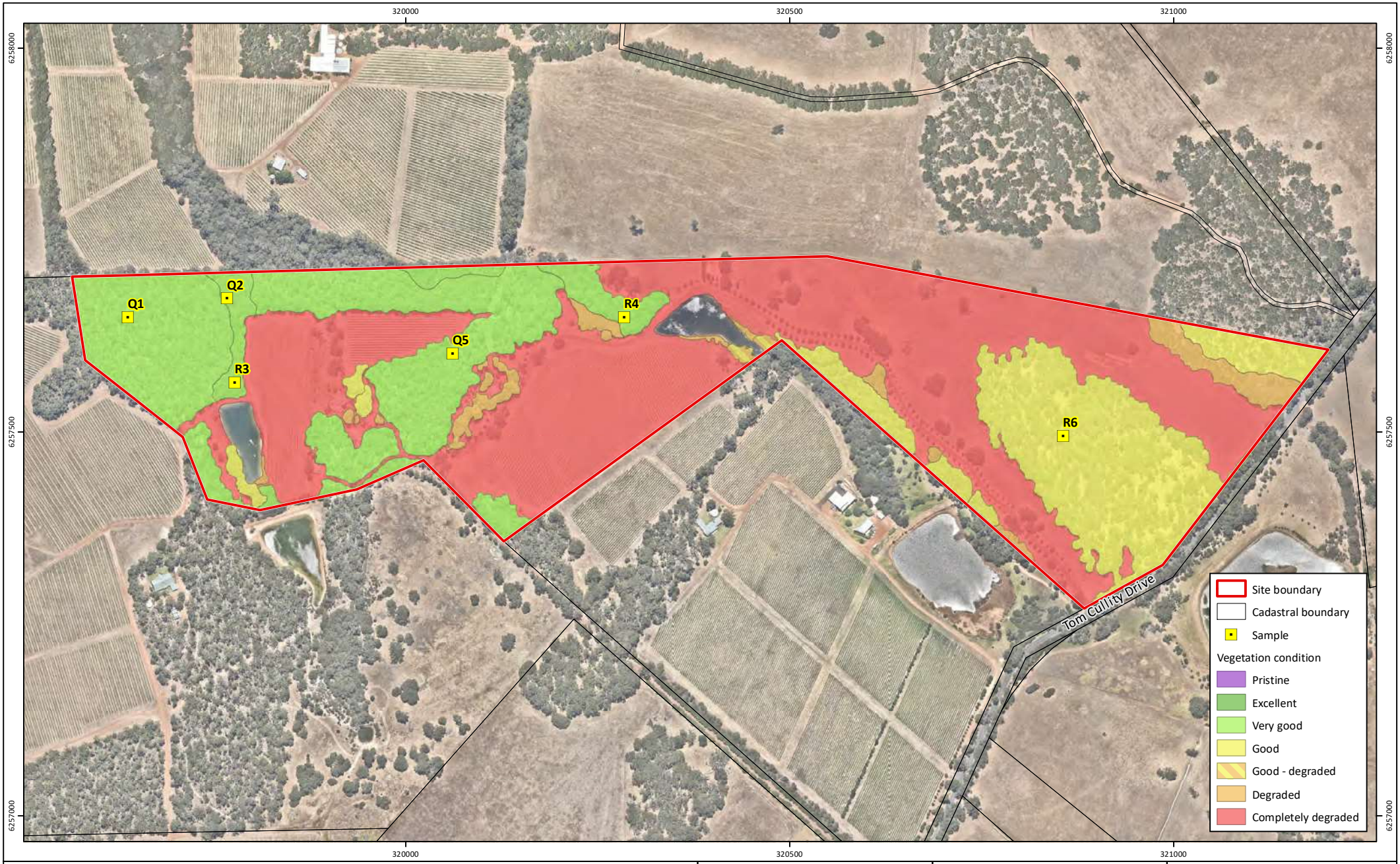

Figure 4: Vegetation Condition

Project: Detailed Flora and Vegetation Survey
Lot 32 (No.325) Tom Cullity Drive, Wilyabrup
Client: Montague VY No. 1 Pty Ltd ATF Montague Trust

Plan Number:
EP20-088(01)--F20

Drawn:	GAR
Date:	01/10/2020
Checked:	RAW
Approved:	KK
Date:	16/12/2020

N

0 80 160 240
Metres

Scale: 1:6,500@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.

References

General references

Department of Biodiversity Conservation and Attractions (DBCA) 2017, *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, *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment*, Perth.

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

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				
Caladenia lodgeana	CR	CR	PG	Seasonally moist to wet clay/sand soils on the margins of either low granite outcrops or ephemeral wetlands	Oct	Unlikely
Caladenia procera	CR	CR	PG	Rich clay loam, alluvial loamy flats with jarrah/marri/peppermint woodland, dense heath, sedges.	Sep-Oct	Unlikely
Gastrolobium argyrotrichum	CR	CR	P	Slopes and valleys. Dark grey sandy clay over granite or laterite.	Jul-Oct	Unlikely
Grevillea brachystylis subsp. grandis	CR	CR	P	Sand and loam with lateritic gravel.	Sep-Dec	Unlikely
Banksia nivea subsp. uliginosa	EN	EN	P	Clay over laterite in thick scrub, in winter wet ironstones.	Aug-Sep	Unlikely
Caladenia busselliana	CR	EN	PG	Sandy loam and winter-wet	Sep-Oct	Unlikely
Caladenia excelsa	EN	EN	PG	Hilltops, slopes, swales and low	Sep-Oct	Unlikely
Caladenia huegelii	CR	EN	PG	Well-drained, deep sandy soils	Sep-early	Unlikely
Caladenia viridescens	CR	EN	PG	Well-drained lateritic sandy loam soils in marri and peppermint woodlands or coastal heath.	Sep-Oct	Unlikely
Eucalyptus x phylacis	CR	EN	P	Laterite, loam over granite in	May	Unlikely
Gastrolobium papilio	CR	EN	P	Sandy clay over ironstone and laterite. Flat plains.	Oct-Dec	Unlikely
Sphenotoma drummondii	EN	EN	P	Stony or shallow soils over granite or quartzite on steep rocky slopes, crevices of rocks.	Sep-Dec	Unlikely
Verticordia plumosa var. ananeotes	CR	EN	P	Sand in open jarrah woodland or sandy/clay soils with marri.	Nov-Dec	Unlikely
Drakaea micrantha	EN	VU	PG	Open sandy patches often adjacent to winter-wet swamps.	Sept- early Oct	Unlikely
Banksia squarrosa subsp. argillacea	VU	VU	P	White/grey sand, gravelly clay or loam predominantly in winter-wet areas over ironstone in open to tall shrubland.	Jun-Nov	Unlikely
Daviesia elongata	T	-	P	Sand, laterite.	Sep/Dec-Jan/Feb	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Chamelaucium roycei	T	-	P	Sandy clay or sandy loam with laterite on flat low-lying areas.	Sep-Dec	Unlikely
Schoenus sp. Jindong (R.D. Royce 2485)	P1	-	P	Red loamy soils on stream banks.	Undocumented (likely Aug-Nov)	Unlikely
Tetraria sp. Nannup (P.A. Jurjevich 1133)	P1	-	P	Sand and clay loam in valley flats and creeks	Undocumented (likely Mar-Nov)	Unlikely
Amperea micrantha	P2	-	P	Sandy soils.	Oct-Nov	Unlikely
Andersonia sp. Echidna (A.R. Annels ARA 5500)	P2	-	P	Brown laterite and sandy loam on slopes and flats.	Nov-Dec	Unlikely
Boronia sp. Leeuwin (J. Scott 235)	P2	-	P	Sand and peat with gravelly laterite in winter-wet depressions, swamps and watercourses.	Aug-Dec	Unlikely
Hybanthus volubilis	P2	-	P	Clay or sandy clay on river banks.	Sep-Dec	Unlikely
Acacia inops	P3	-	P	Black peaty sand, clay. Swamps, creeks.	Sep-early Nov	Unlikely
Acacia lateriticola var. Glabrous variant (B.R.Maslin 6765)	P3	-	P	Lateritic soils	Aug or Oct	Unlikely
Boronia capitata subsp. gracilis	P3	-	P	White/grey or black sand in winter-wet swamps, hillslopes.	Jun-Nov	Unlikely
Boronia tetragona	P3	-	P	Black/white sand, laterite, brown sandy loam in winter-wet flats, swamps, open woodland.	Oct-Dec	Unlikely
Chordifex gracilior	P3	-	P	Peaty sand in swamps.	Sep-Dec	Recorded
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan	Unlikely
Gastrolobium formosum	P3	-	P	Clay loam. Along river banks or in swamps.	Nov	Unlikely
Grevillea bronwenae	P3	-	P	Grey sand over laterite, lateritic loam on hillslopes.	Jun-Dec	Unlikely
Juncus meianthus	P3	-	P	Black sand, sandy clay. Creeks, seepage areas.	Nov-Dec/Jan	Unlikely
Lasiopetalum laxiflorum	P3	-	P	Sand and/or clay with laterite.	Sep-Dec	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Olearia strigosa	P3	-	P	Sandy loam in open forest.	Dec/Jan-May	Unlikely
Pimelea ciliata subsp. longituba	P3	-	P	Grey sand over clay, loam.	Oct-Dec	Unlikely
Pultenaea pinifolia	P3	-	P	Loam or clay. Floodplains, swampy areas.	Oct-Nov	Unlikely
Synaphea decumbens	P3	-	P	Sand over laterite.	Sep-Oct	Unlikely
Synaphea hians	P3	-	P	Sandy soils on rises.	Jul-Nov	Unlikely
Acacia flagelliformis	P4	-	P	Sandy soils in winter-wet areas.	May-Sep	Unlikely
Acacia semitrullata	P4	-	P	White/grey sand, sometimes over laterite, clay sometimes in sandplains, swampy areas.	May-Oct	Unlikely
Acacia tayloriana	P4	-	P	Grey or yellow/orange sandy soils, lateritic gravel, clay loam. Winter-wet areas.	Jan	Unlikely
Calothamnus quadrifidus subsp. teretifolius	P4	-	P	Sand, loam or clay with laterite.	Oct-Dec	Unlikely
Chamelaucium erythrochlorum	P4	-	P	Clay, loam and sandy soils in creeklines, slopes and ridges	Nov-Feb	Unlikely
Eucalyptus rudis subsp. cratyantha	P4	-	P	Loam on flats and hillsides.	Jul-Sep	Unlikely
Gahnia sclerioides	P4	-	P	Loam, sandy soils. Moist shaded situations.	Feb, Apr, Jun, Aug or Nov	Unlikely
Lambertia rariflora subsp. rariflora	P4	-	P	Red-brown clay soils, black organic loam, laterite near intermittent streams.	Feb-Mar or May	Unlikely
Thysanotus glaucus	P4	-	P	White, grey or yellow sand, sandy gravel.	Oct-Mar	Unlikely
Actinotus whicheranus	P2	-	P	White sand pockets over laterite.	Dec or Jan-Mar	Unlikely
Caladenia nivalis	P2	-	PG	Sand, loam, granite on coastal	Sep-Oct	Unlikely
Gastrolobium whicherense	P2	-	P	Red-grey sandy clay over quartzite on steep westerly slopes.	Oct	Unlikely
Thysanotus sp.	P2	-	P	Grey sand with lateritic gravel.	Dec	Unlikely
Xyris maxima	P2	-	P	Black peaty sand on drainage flats.	Nov-Dec/Jan	Unlikely
Caladenia abbreviata	P3	-	PG	Sand dunes.	Nov-Dec	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Chamaescilla gibsonii	P3	-	P	Clay to sandy clay in winter-wet	Sep	Unlikely
Dampiera heteroptera	P3	-	P	Sandy soils, swampy areas.	Sep-Oct	Unlikely
Grevillea brachystylis subsp. brachystylis	P3	-	P	Black sand, sandy clay in swampy situations.	Aug-Nov	Unlikely
Grevillea manglesioides subsp. ferricola	P3	-	P	Red sandy clay over ironstone on winter wet flats.	Oct	Unlikely
Johnsonia inconspicua	P3	-	P	White-grey or black sand. Low dunes, winter-wet flats.	Oct-Nov	Unlikely
Lepyrodia heleocharoides	P3	-	P	Moist peaty sand. Dry or seasonally inundated heath or woodland, swamps.	Dec	Unlikely
Stylidium lowrieanum	P3	-	P	Sand or sandy loam over limestone. Eucalypt or Agonis woodland, forest.	Oct-Nov	Unlikely
Banksia sessilis var. cordata	P4	-	P	White/grey sand. Coastal limestone.	Jul-Oct	Unlikely
Franklandia triaristata	P4	-	P	White or grey sand.	Aug-Oct	Unlikely
Thysanotus isantherus	P4	-	P	Hillsides, sand over granite.	Nov-Dec	Unlikely
Andersonia ferricola	P1	-	P	White sand or red-brown loam over ironstone on seasonally wet flats.	Oct	Unlikely
Leptomeria furtiva	P2	-	P	Grey or black peaty sand in winter-wet flats.	Aug-Oct	Unlikely
Boronia anceps	P3	-	P	White sand, gravelly laterite in seasonally swampy heaths.	Sep-Dec/Jan	Unlikely
Calothamnus lateralis var. crassus	P3	-	P	Sand, clay or peat in swamps and winter-wet depressions.	Aug-Dec	Unlikely
Chordifex gracilior	P3	-	P	Peaty sand in swamps.	Sep-Dec	Unlikely
Hakea oldfieldii	P3	-	P	Red clay or sand over laterite on seasonally wet flats.	Aug-Oct	Unlikely
Isopogon formosus subsp. dasylepis	P3	-	P	Sand, sandy clay, gravelly sandy soils over laterite, often in swampy areas.	Jun-Dec	Unlikely
Loxocarya magna	P3	-	P	Sand, loam, clay, ironstone in seasonally inundated or damp habitats.	Sep or Nov	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Synaphea petiolaris subsp. simplex	P3	-	P	Sandy soils on flats and in winter-wet areas.	Sep-Oct	Unlikely
Drosera fimbriata	P4	-	P	White sand, granite.	Sep-Oct	Unlikely
Gonocarpus pusillus	P4	-	A	Grey sandy clay in winter-wet swamps.	Nov-Dec	Unlikely
Stylidium leeuwinense	P4	-	P	Grey to black peaty sand in winter-wet habitats and depressions. Shrubland, heath, sedgeland or low woodland.	Feb-May	Unlikely
Verticordia lehmannii	P4	-	P	Sandy clay in winter-wet flats.	Jan/Apr-Jun or Aug-Dec	Unlikely

Note: T=threatened, CE=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	
			State	EPBC Act
Banksia WL SCP	Banksia Dominated Woodlands of the Swan Coastal Plain IBRA Region	TEC/ PEC	P3	Endangered (Banksia woodlands of the Swan Coastal Plain TEC)
Augusta-microbial	Rimstone Pools and Cave Structures Formed by Microbial Activity on Marine Shorelines (Augusta microbialites)	TEC	Endangered	-
Whicher Scarp G2	Shrublands of near permanent wetlands in creeklines of the Whicher Scarp (Whicher Scarp community G2)	PEC	P1	-
Whicher Scarp B2	West Whicher Scarp *Banksia attenuata* woodland (Swan Coastal Plain centred woodlands of grey/white sands community B2)	PEC	P1	-
Low shrublands (Gracetown)	Low shrublands on acidic grey-brown sands of the Gracetown soil-landscape system	PEC	P2	-

Note: TEC=threatened ecological community, PEC=priority ecological community, CR=critically endange
EN=endangered, VU=vulnerable, P3=priority 3. Communities considered to potentially occur within the
shaded green.

Appendix D

Species List

Family	Status	Species
Apiaceae		
		Centella asiatica
		Pentapeltis peltigera
		Platysace tenuissima
		Xanthosia candida
Araceae		
	*DP	*Zantedeschia aethiopica*
Araliaceae		
		Trachymene pilosa
Asparagaceae		
		Lomandra hermaphrodita
		Lomandra nigricans
		Lomandra pauciflora
		Lomandra purpurea
		Thysanotus patersonii
		Thysanotus thyrsoideus
Asteraceae		
		Millotia tenuifolia var. tenuifolia
	*	*Arctotheca calendula*
	*	*Cotula turbinata*
		Craspedia variabilis
	*	*Hypochaeris radicata*
		Lagenophora huegelii
		Rhodanthe citrina
		Siloxerus filifolius
		Trichocline spathulata
Campanulaceae		
		Lobelia anceps
Celastraceae		
		Tripterococcus brunonis
Centrolepidaceae		
		Aphelia cyperoides
		Centrolepis aristata
Colchicaceae		
		Burchardia congesta
Cyatheaceae		
	*	*Sphaeropteris cooperi*
Cyperaceae		
		Cyathochaeta ?clandestina
		Baumea articulata
		Carex thecata
		Lepidosperma leptostachyum
		Lepidosperma striatum
		Lepidosperma tetraquetrum
		Schoenus elegans
		Schoenus maschalinus
		Schoenus sp.
		Tetraria octandra

Family	Status	Species
		Baumea sp.
Dasypogonaceae		
		Dasypogon hookeri
Dennstaedtiaceae		
		Pteridium esculentum
Dilleniaceae		
		Hibbertia amplexicaulis
		Hibbertia commutata
		Hibbertia cuneiformis
		Hibbertia hypericoides
Droseraceae		
		Drosera erythrorhiza
		Drosera pallida
		Drosera platystigma
		Drosera sp.
Elaeocarpaceae		
		Tetratheca hirsuta
		Tremandra diffusa
		Tremandra stelligera
Ericaceae		
		Acrotriche cordata
		Leucopogon capitellatus
		Leucopogon verticillatus
Fabaceae		
		Acacia pulchella var. pulchella
		Acacia browniana var. browniana
		Bossiaea aquifolium subsp. aquifolium
		Acacia alata var. alata
		Acacia saligna
		Bossiaea linophylla
		Bossiaea ornata
		Chorizema nanum
		Chorizema rhombeum
		Hovea elliptica
		Lotus subbiflorus
		Mirbelia dilatata
		Sphaerolobium medium
		Viminaria juncea
Goodeniaceae		
		Dampiera hederacea
		Dampiera linearis
		Goodenia trinervis
		Lechenaultia biloba
		Scaevola calliptera
		Scaevola microphylla
Haemodoraceae		
		Haemodorum sp.
		Agrostocrinum hirsutum

Family	Status	Species
		Caesia micrantha
		Johnsonia lupulina
Iridaceae		
		Patersonia umbrosa var. xanthina
	*	*Freesia alba × leichtlinii*
		Patersonia babianoides
	*	*Romulea rosea*
Juncaceae		
		Luzula meridionalis
Lauraceae		
		Cassytha racemosa forma pilosa
Lindsaeaceae		
		Lindsaea linearis
Loganiaceae		
		Orianthera serpyllifolia subsp. serpyllifolia
		Logania vaginalis
Myrtaceae		
		Agonis flexuosa
		Corymbia calophylla
		Eucalyptus marginata
		Eucalyptus patens
		Hypocalymma angustifolia
	*Pl	*Melaleuca nesophila*
		Melaleuca sp.
		Taxandria linearifolia
Oleaceae		
	*	*Olea europaea*
Orchidaceae		
		Caladenia flava subsp. flava
		Caladenia attigens subsp. attigens
		Caladenia pectinata
	*	*Disa bracteata*
		Diuris longifolia
		Drakaea sp.
		Eriochilus sp.
		Lyperanthus serratus
		Pterostylis crispula
		Pterostylis vittata
		Thelymitra graminea
		Thelymitra macrophylla
Orobanchaceae		
	*	*Orobanche minor*
Oxalidaceae		
	*	*Oxalis pes-caprae*
Pittosporaceae		
		Billardiera ?fusiformis
Poaceae		
		Austrostipa ?campylachne

Family	Status	Species
		Amphipogon amphipogonoides
		Anthoxanthum odoratum
	*	*Briza maxima*
	*	*Briza minor*
	*	*Cenchrus clandestinus*
	*	*Holcus lanatus*
	*	*Lolium rigidum*
		Microlaena stipoides
		Neurachne alopecuroidea
	*	*Paspalum dilatatum*
		Rytidosperma occidentale
		Tetrarrhena laevis
Podocarpaceae		
		Podocarpus drouynianus
Polygalaceae		
		Comesperma confertum
Proteaceae		
		Banksia dallanneyi subsp. dallanneyi var. mellicula
		Adenanthos barbiger
		Banksia bipinnatifida
		Banksia grandis
		Hakea amplexicaulis
		Hakea ruscifolia
		Hakea trifurcata
		Persoonia longifolia
		Synaphea petiolaris
Ranunculaceae		
		Clematis pubescens
Restionaceae		
	P3	*Chordifex gracilior*
		Desmocladus fasicularis
Rhamnaceae		
		Trymalium ledifolium var. rosmarinifolium
Rubiaceae		
	*	*Galium murale*
		Opercularia hispidula
Rutaceae		
		Philotheca spicata
Santalaceae		
		Leptomeria squarrosa
Stylidiaceae		
		Levenhookia pusilla
		Stylidium amoenum
		Stylidium calcaratum
		Stylidium fasciculatum
		Stylidium schoenoides
Thymelaeaceae		
		Pimelea sp.

Family	Status	Species
Violaceae		
		Hybanthus calycinus
Xanthorrhoeaceae		
		Chamaescilla corymbosa var. corymbosa
		Xanthorrhoea gracilis
		Xanthorrhoea preissii
Zamiaceae		
		Macrozamia riedlei

Note: * denotes introduced weed species, Pl = planted, DP=declared pest under the BAM Act

Appendix E

Sample Data

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: Q1

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020 **Status** Non-permanent
Author: RAW, Q1: Page 2 of 3

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	319638	NW corner northing:	6257649
Altitude (m):	96	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	slightly damp	Landform:	upper slope
Time since fire:	no evidence	Disturbance:	low -
Soil type/texture	sand/loam with organic layer	Bare ground (%):	1
Rocks (%) and type:	10%, laterite	Soil colour:	brown/
Litter:	15% (leaves,twigs,logs)	Vegetation condition:	very good

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: Q1

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020 **Status** Non-permanent
Author: RAW, Q1: Page 2 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia pulchella var. pulchella	1
	Acrotriche cordata	<1
	Agrostocrinum hirsutum	<1
	Banksia dallanneyi subsp. dallanneyi var. mellicula	<1
	Banksia grandis	opp
	Burchardia congesta	<1
	Caesia micrantha	<1
	Caladenia flava subsp. flava	<1
	Corymbia calophylla	10
	Dampiera linearis	<1
	Drosera erythrorhiza	<1
	Eucalyptus marginata	15
	Goodenia trinervis	<1
	Hakea trifurcata	<1
	Hibbertia commutata	<1
	Hibbertia hypericoides	30
	Hovea elliptica	5
	Hybanthus calycinus	<1
	Hypocalymma angustifolia	<1
	Lagenophora huegelii	<1
	Lepidosperma leptostachyum	5
	Leucopogon capitellatus	<1
	Lomandra nigricans	<1
	Lomandra purpurea	<1
	Macrozamia riedlei	opp
	Mirbelia dilatata	opp
	Opercularia hispidula	5
	Orianthera serpyllifolia subsp. serpyllifolia	<1
*	*Orobanche minor*	<1
	Patersonia umbrosa var. xanthina	15
	Philotheca spicata	opp
	Platysace tenuissima	<1
	Scaevola calliptera	1
	Stylidium fasciculatum	<1
	Synaphea petiolaris	<1
	Tetraria octandra	1

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: Q1

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020 **Status** Non-permanent
Author: RAW, Q1: Page 3 of 3

Tetrarrhena laevis	<1
Tetratheca hirsuta	<1
Thelymitra graminea	<1
Thysanotus patersonii	<1
Tripterococcus brunonis	<1
Xanthorrhoea gracilis	<1
Xanthosia candida	5

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: Q2

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020 **Status** Non-permanent
Author: RAW, Q2: Page 2 of 2

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	0	NW corner northing:	0
Altitude (m):	87	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	near saturated	Landform:	waterway
Time since fire:	no evidence	Disturbance:	low -
Soil type/texture	sand/clay	Bare ground (%):	15
Rocks (%) and type:	No rocks	Soil colour:	brown/
Litter:	10% (leaves,logs,)	Vegetation condition:	very good

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: Q2

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020 **Status** Non-permanent
Author: RAW, Q2: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia saligna	5
	Agonis flexuosa	40
	Baumea articulata	<1
	Caesia micrantha	<1
	Cassytha racemosa forma pilosa	<1
	Clematis pubescens	<1
	Corymbia calophylla	10
	Eriochilus sp.	<1
	Hibbertia amplexicaulis	<1
	Hovea elliptica	5
	Lagenophora huegelii	<1
	Lepidosperma leptostachyum	2
	Lepidosperma tetraquetrum	60
	Lobelia anceps	opp
	Patersonia umbrosa var. xanthina	3
	Pentapeltis peltigera	<1
	Pteridium esculentum	1
	Schoenus elegans	<1
	Schoenus maschalinus	<1
*	*Sphaeropteris cooperi*	15
	Taxandria linearifolia	1
	Tetrarrhena laevis	15
	Thelymitra graminea	<1
	Tremandra stelligera	<1
	Xanthosia candida	1

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: R3

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020
Author: RAW,

Status Non-permanent
R3: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	0	NW corner northing:	0
Altitude (m):	-	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	near saturated	Landform:	waterway
Time since fire:	no evidence	Disturbance:	low -
Soil type/texture	sand/clay	Bare ground (%):	15
Rocks (%) and type:	No rocks	Soil colour:	brown/
Litter:	30% (leaves,logs,)	Vegetation condition:	very good

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: R3

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020 **Status** Non-permanent
Author: RAW, R3: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name
	Agonis flexuosa
	Baumea articulata
	Bossiaea linophylla
	Caesia micrantha
	Clematis pubescens
	Corymbia calophylla
	Dampiera hederacea
	Lepidosperma leptostachyum
	Lepidosperma tetraquetrum
	Lobelia anceps
	Schoenus maschalinus
*	*Sphaeropteris cooperi*
	Taxandria linearifolia
	Lepidosperma striatum
	Tetrarrhena laevis
	Xanthosia candida

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: R4

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020
Author: RAW,

Status Non-permanent
R4: Page 2 of 2

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	0	NW corner northing:	0
Altitude (m):	100	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	damp	Landform:	lower slope
Time since fire:	no evidence	Disturbance:	low -
Soil type/texture	sand/clay with organic layer	Bare ground (%):	0
Rocks (%) and type:	No rocks	Soil colour:	brown/
Litter:	40% (leaves,,)	Vegetation condition:	very good

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: R4

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020 **Status** Non-permanent
Author: RAW, R4: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name
	Agonis flexuosa
	Baumea sp.
	Corymbia calophylla
	Eucalyptus patens
	Hovea elliptica
	Lepidosperma leptostachyum
	Lindsaea linearis
	Microlaena stipoides
	Schoenus sp.
	Tetrarrhena laevis
*	*Zantedeschia aethiopica*

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: Q5

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020 **Status** Non-permanent
Author: RAW, Q5: Page 2 of 2

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	0	NW corner northing:	0
Altitude (m):	110	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	damp	Landform:	upper slope
Time since fire:	no evidence	Disturbance:	low -
Soil type/texture	sand/clay with organic layer	Bare ground (%):	0
Rocks (%) and type:	No rocks	Soil colour:	brown/
Litter:	15% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: Q5

Project no.: EP20-088
Date: 12/08/2020, 26/10/2020 **Status** Non-permanent
Author: RAW, Q5: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Adenanthos barbiger	<1
	Billardiera ?fusiformis	<1
	Bossiaea ornata	2
	Burchardia congesta	<1
	Caesia micrantha	<1
	Cassytha racemosa forma pilosa	<1
	Chamaescilla corymbosa var. corymbosa	<1
	Chorizema rhombeum	<1
	Comesperma confertum	opp
	Corymbia calophylla	25
	Dampiera linearis	<1
	Diuris longifolia	<1
	Drosera pallida	<1
	Eucalyptus marginata	15
	Hakea trifurcata	1
	Hibbertia hypericoides	40
	Hovea elliptica	20
	Lagenophora huegelii	<1
	Lechenaultia biloba	<1
	Lepidosperma leptostachyum	2
	Leucopogon capitellatus	2
	Leucopogon verticillatus	<1
	Lyperanthus serratus	<1
	Macrozamia riedlei	1
	Patersonia umbrosa var. xanthina	20
	Pentapeltis peltigera	<1
	Persoonia longifolia	1
	Philotheca spicata	<1
	Scaevola calliptera	opp
	Sphaerolobium medium	opp
	Tetraria octandra	10
	Tetrarrhena laevis	5
	Tetratheca hirsuta	<1
	Tripterococcus brunonis	<1
	Xanthorrhoea preissii	15
	Xanthosia candida	30

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: R6

Project no.: EP20-088
Date: 26/10/2020 **Status** Non-permanent
Author: RAW, R6: Page 2 of 3

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	0	NW corner northing:	0
Altitude (m):	118	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	mid-slope
Time since fire:	> 5 yrs	Disturbance:	moderate - stock grazing
Soil type/texture	clay/sand	Bare ground (%):	5
Rocks (%) and type:	20%, laterite	Soil colour:	brown/
Litter:	60% (leaves,twigs,logs)	Vegetation condition:	very good

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: R6

Project no.: EP20-088
Date: 26/10/2020 **Status** Non-permanent
Author: RAW, R6: Page 2 of 3

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia pulchella var. pulchella
	Agrostocrinum hirsutum
*	*Anthoxanthum odoratum*
	Banksia grandis
	Bossiaea aquifolium subsp. aquifolium
*	*Briza maxima*
*	*Briza minor*
	Caesia micrantha
	Caladenia flava subsp. flava
	Chorizema nanum
	Chorizema rhombeum
	Corymbia calophylla
*	*Cotula turbinata*
	Eucalyptus marginata
	Goodenia trinervis
	Haemodorum sp.
	Hakea amplexicaulis
	Hibbertia hypericoides
*	*Hypochaeris radicata*
	Lagenophora huegelii
	Lepidosperma leptostachyum
	Lolium rigidum
	Lomandra purpurea
*	*Lotus subbiflorus*
	Opercularia hispidula
	Patersonia umbrosa var. xanthina
	Pentapeltis peltigera
	Podocarpus drouynianus
*	*Romulea rosea*
	Rytidosperma occidentale
	Stylidium amoenum
	Tetrarrhena laevis
	Tetratheca hirsuta
	Thelymitra graminea
	Thelymitra macrophylla
	Thysanotus patersonii

Vegetation Sample Data

Lot 32 (No.325) Tom Cullity Drive Wilyabrup

Sample Name: R6

Project no.: EP20-088
Date: 26/10/2020 **Status** Non-permanent
Author: RAW, R6: Page 3 of 3

Thysanotus thyrsoideus
Trachymene pilosa
Trichocline spathulata
Xanthorrhoea gracilis
Xanthorrhoea preissii