Detailed Flora and Vegetation Assessment

Stock Road Corridor, Bullsbrook

Project No: EP20-089(02)

Prepared for Department of Planning, Lands and Heritage
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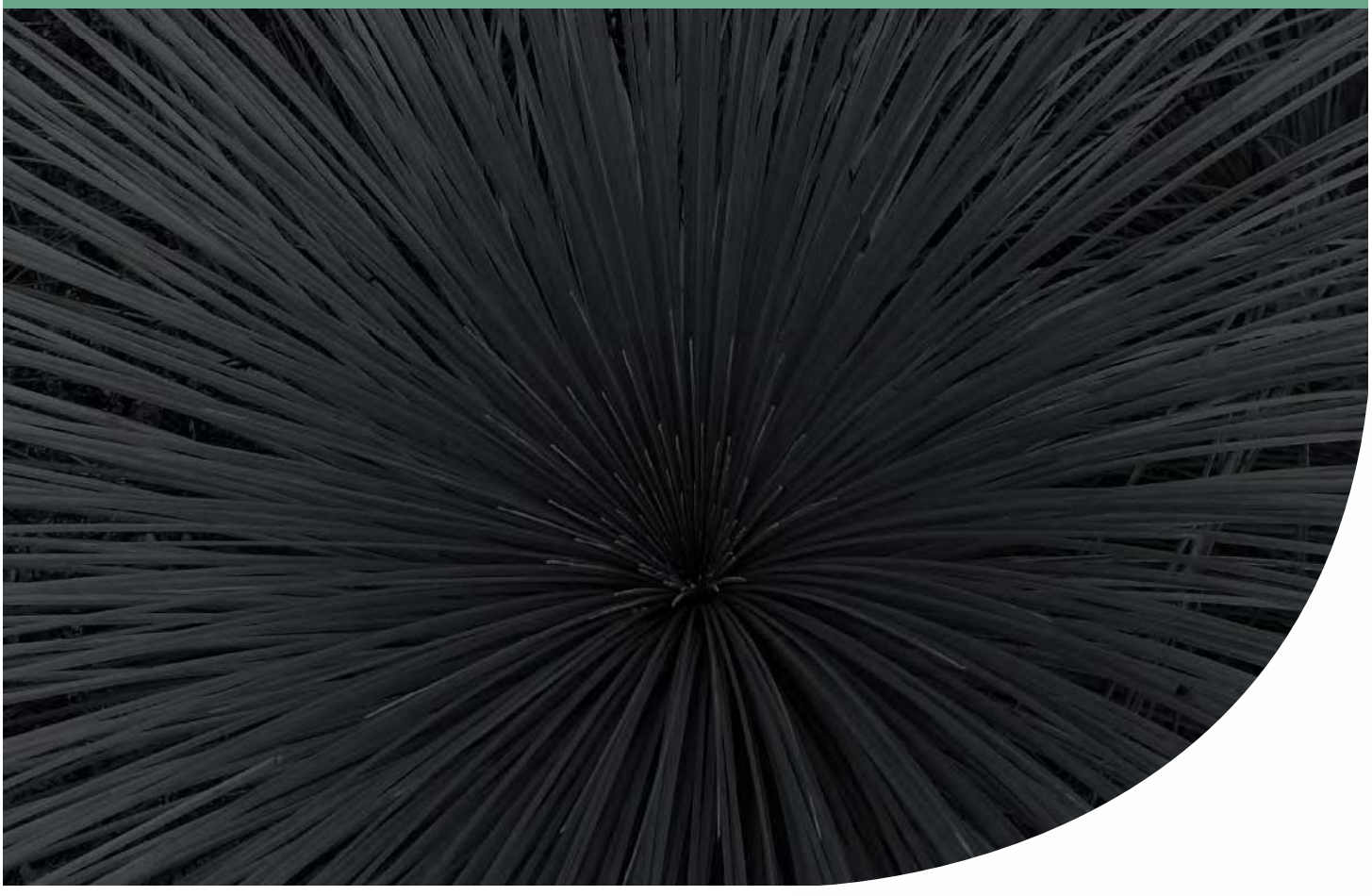

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Executive Summary

The Department of Planning, Lands and Heritage (DPLH) engaged Emerge Associates to undertake a detailed flora and vegetation survey along a section of Stock Road between Tonkin Highway and Great Northern Highway in Bullsbrook (the 'site').

As part of the assessment a desktop review of relevant background information was completed and a field survey was undertaken on multiple dates between August and November 2020. During the field survey an assessment was made on the type, condition and values of vegetation across the site.

Outcomes of the survey include the following:

- The site has been subject to intensive historical disturbance.
- A total of 70 native and 51 non-native (weed) species were recorded in the site.
- No threatened or priority flora species were recorded within the site or are considered likely to occur.
- One flora species identified in *Bush Forever* documentation as 'significant flora of the foothills and Pinjarra plain', *Grevillea obtusifolia*, was recorded within the site.
- The vegetation within the site was classified into the following 12 plant communities: **As**, **AsGoAc**, **Bj**, **Cc**, **CcM, Co**, **EcTaCa**, **ErMr**, **Ew**, **M**, **mixed** and **non-native**.
- The majority of the site supports non-native vegetation and was mapped as being in 'completely degraded' condition (49.50 ha/88% of the site).
- A large portion of the site supports native vegetation in 'degraded' condition (6.98 ha/12% of the site).
- The most intact vegetation occurs as small patches within the rail reserve in the western portion of the site that were mapped as being in 'good' and 'very good' condition (0.08 ha/<1% of the site).
- A 0.08 ha patch of the 'shrublands and woodlands on Muchea limestone of the Swan Coastal Plain' TEC occurs in the rail reserve in the western portion of the site). This TEC is listed as 'endangered' under the *Environment Protection and Biodiversity Conservation Act 1999* and in WA.
- Native and non-native trees within the site have the potential to provide foraging, roosting and nesting habitat for threatened species of black cockatoo, along with other ecological services.
- Wetland feature ID 12433, currently mapped within the site as a 'conservation' category wetland, was determined to have values representative of a 'resource enhancement' category wetland.

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Table of Contents

List of Tables

List of Plates

Figures

Appendices

Appendix A

Additional Information

Appendix B

Conservation Significant Flora Species and Likelihood of Occurrence Assessment

Appendix C

Conservation Significant Communities and Likelihood of Occurrence Assessment

Appendix D

Species List

Appendix E

Species x Plant Community Matrix

Appendix F

Sample Data

Appendix G

Cluster Dendrograms

Appendix H

Wetland Evaluation Documentation – UFI 12433

Abbreviation Tables

Table A1: Abbreviations – Organisations

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

Table A2: Abbreviations – General terms

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

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

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1 Introduction

1.1 Project background

The Department of Planning, Lands and Heritage (DPLH) are undertaking a range of investigations with respect to the potential widening of a portion of Stock Road in Bullsbrook, approximately between Tonkin Highway and Great Northern Highway. The area being investigated comprises the Stock Road reserve and portions of adjacent private properties (an area referred to herein as the 'site'). The site is approximately 56.56 hectares (ha) in size and is shown in **Figure 1**.

The site is located approximately 31 kilometres (km) north east of the Perth Central Business District and comprises multiple different zones and reserves under the *Metropolitan Region Scheme*, including 'rural', 'primary regional roads', 'other regional roads', 'railways' and 'industrial'. Similarly, the site is zoned a combination of 'general rural' and 'landscape' and reserved for 'regional reserve - other regional road' and 'regional reserve – railway' under the City of Swan *Local Planning Scheme 17*.

1.2 Purpose and scope of work

Emerge Associates (Emerge) were engaged by DPLH to undertake a flora and vegetation assessment within the site 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 652.1 millimetres (mm) of rainfall is recorded annually from the Pearce RAAF weather station, which is the closest weather station, located approximately 3.5 km north of the site. The majority of this rainfall is received between the months of May and September. Mean maximum temperatures at the Pearce RAAF station range from 17.9°C in July to 33.5°C in January, while mean minimum temperatures range from 8.2°C in August to 17.6°C in February (BoM 2021).

A total of 417.6 mm of rain was recorded from May to November 2020 prior to the survey, which is approximately 72% of the mean of 578.6 mm for this period (BoM 2021). No rainfall records for October and November 2020 were available. Although lower than the mean this amount of rainfall was considered to have been sufficient to promote the flowering and emergence of native flora.

2.2 Geomorphology and soils

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

The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly the Swan Coastal Plain consists of two sedimentary belts of different origin. Its eastern side has formed from the deposition of alluvial material washed down from the Darling Scarp, while its western side is comprised of three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004).

The site lies on the eastern side of the Swan Coastal Plain and mapping of physiographic regions by Gozzard (2011) places the eastern portion of the site within the Piedmont Zone, which comprises a series of spurs and colluvial slopes that form the foothills of the Darling Scarp.

Examination of soil mapping places the majority of the site within the 'Beermullah' soil association, which is described as 'poorly drained plain; saline and solonetzic soils, bog iron ore and some shallow

sands over bog iron' (Churchward and McArthur 1980). The western portion of the site lies within the 'Yanga' soil association, which is described as a 'poorly drained plain with grey sandy benches and intervening swamps; also areas of bog iron ore, marl' (Churchward and McArthur 1980). The eastern portion of the site lies within the 'Guildford' soil association, which is described as a 'flat plain with medium textured deposits; yellow duplex soils' (Churchward and McArthur 1980). The soil associations mapped within the site by Churchward and McArthur (1980) are shown in **Figure 2**.

The Muchea limestone formation comprises a thin shallow deposit of limestone sandy and marly limestone on the central and eastern portion of the Swan Coastal Plain (DoW 2017). Due to the site's location there is potential for Muchea limestone to occur. Soil landscape mapping also indicates that the central western portion, between the railway and Ellen Brook, supports the 'Yanga 7x Phase' which states that 'marl may be at the surface or deeply buried' (DPIRD 2018).

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

2.3 Topography

The elevation of the site ranges from 35 m in relation to the Australian height datum (mAHD) on the western side of the site to 41 mAHD on the eastern side of the site, with the central portion of the site being the lowest at 26 mAHD near Ellen Brook (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 2017b)
- *A Directory of Important Wetlands in Australia* (DBCA 2018a).

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

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2018) shows the following three wetland or water related features in the site that are associated with Ellen Brook, as shown in **Figure 3**:

- watercourse - major, non-perennial
- watercourse - minor, non-perennial
- drain – major.

On the Swan Coastal Plain the Department of Biodiversity, Conservation and Attractions (DBCA) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and

Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period) (DBCA 2017a). DBCA maintains the *Geomorphic Wetlands of the Swan Coastal Plain* dataset, which further categorises geomorphic wetland features into specific management categories to guide land use and conservation (DBCA 2020). Note that as this dataset was drafted at a regional scale the boundaries of mapped wetland features are often inconsistent with physical wetland boundaries. Further information on geomorphic wetland types and their management categories is provided in **Appendix A**.

A review of the *Geomorphic Wetlands, Swan Coastal Plain* dataset (DBCA 2018b) indicated that the following wetland features occur within the site:

- Two large 'multiple use' category wetland (MUW) features (15282 and 15732) classified as palusplain wetlands occur across the majority of the site. MUW 15282 occurs in the eastern portion of the site and extends beyond the site to the north, east and south. MUW 15732, named 'Ellen Brook Floodplain', occurs in the western portion of the site and extends beyond the site to the north, west and south.
- One 'conservation' category wetland (CCW) feature (15734) lies between MUWs 15282 and 15732 in the central portion of the site and extends beyond the site to the north and south. This feature is named 'Ellen Brook Floodplain' and generally aligns with the Ellen Brook watercourse. A small portion of another 'conservation' category wetland feature (12433) lies in the south eastern portion of the site. Both of these features are classified as palusplain wetlands.

The locations of the geomorphic wetlands in the site are shown in **Figure 3**.

2.5 Regional vegetation

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

Vegetation complex mapping by Heddle *et al.* (1980) shows the site as occurring within three complexes:

- The majority of the site lies within the 'Beermullah' complex which is described as a 'mixture of low open forest of *Casuarina obesa* and open woodland of *C. calophylla - Eucalyptus wandoo - Eucalyptus marginata*. Components include closed scrub of *Melaleuca* spp. Minor components include closed scrub of *Melaleuca* spp. and occurrence of *Actinostrobus pyramidalis* (now *Callitris pyramidalis*)' (Heddle *et al.* 1980).
- The far western portion of the site is mapped as the 'Yanga' complex which is described as 'low open forest of *Casuarina obesa* with patches of *Actinostrobus pyramidalis* and *Melaleuca* spp. on

low lying flats. Mixture of low open forest of *Banksia* spp. - *Eucalyptus todtiana* and open woodland of *Corymbia calophylla* - *Banksia* spp.' (Heddle *et al.* 1980).

- The eastern portion of the site is mapped as the 'Guildford' complex which is described as 'a mixture of open forest to tall open forest of *Corymbia calophylla* - *Eucalyptus wandoo* - *Eucalyptus marginata* and woodland of *Eucalyptus wandoo* (with rare occurrences of *Eucalyptus lane-poolei*). Minor components include *Eucalyptus rudis* - *Melaleuca rhaphiophylla'* (Heddle *et al.* 1980).

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 (Environment Australia 2001) established an objective of retaining 30% of the original extent of each vegetation complex. However, a lower objective of 10% is applied in 'constrained urban areas' such as the Swan Coastal Plain (Ministry for Planning 1995).

The 'Beermullah' complex has 6.6% of its pre-European extent remaining with 2.13% protected for conservation purposes. The 'Yanga' complex has 16.31% of its pre-European extent remaining with 1.86% protected for conservation purposes. The 'Guildford' complex has 5.09% of its pre-European extent remaining with 0.33% protected for conservation purposes (Government of Western Australia 2019). Therefore, the percentage protected for conservation of the above complexes fall below both the 30% and 10% retention objectives.

2.6 Historic land use

Review of historical images available from 1965 onwards shows that the portion of Stock Road within the site was present as a dirt track from at least 1965 and was later sealed in parts (WALIA 2021). The majority of the site was cleared of native vegetation prior to 1965 and vegetation clearing since then appears to have been minor. Vegetation in the western portion of the site within the rail reserve appears to have been subject to disturbance since 1965 and intensive vegetation clearing is visible in the image from 2000 when the railway crossing was bituminised. Revegetation (or natural regeneration) is visible along the railway reserve in the image from 2004.

2.7 Significant flora and vegetation

2.7.1 Threatened and priority flora

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

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

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

2.7.2 Threatened and priority ecological communities

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

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

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

A plant community that is under consideration for listing as a TEC in Western Australia, but does not yet meet survey criteria or has not been adequately defined, may be listed as a 'priority ecological community' (PEC). Listing as a PEC is similarly considered during State approval processes. Further information on categories of TECs and PECs is provided in **Appendix A**.

2.7.3 Local and regional significance

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

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

- The vegetation is associated with Ellen Brook, which is listed as a 'protection' category 'potential local natural area' within the City of Swan (City of Swan 2015) (see **Section 2.10**).
- The vegetation within the site has potential value as habitat for threatened or priority fauna species including threatened species of black cockatoo.
- Flora taxon is listed in *Bush Forever* 'significant flora' list for the Pinjarra Plain.

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 weed species are expected to be present at the site.

2.8 Bush Forever

The Government of Western Australia's *Bush Forever* policy is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of *Bush Forever* is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10% of each vegetation complex for protection (Government of WA 2000a). *Bush Forever* sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity.

Bush Forever Site 296 (Ellen Brook, Upper Swan) lies within the central portion of the site and generally aligns with the Ellen Brook watercourse. This linear site extends beyond to the north and south, connecting to other *Bush Forever* sites. The location of the part of Bush Forever Site 296 associated with the site is shown in **Figure 3**.

2.9 Environmentally sensitive areas

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

Two ESAs are located within the eastern portion of the site. One is a circular shape and extends to the south of the site, appearing to be associated with UFI 12433 (refer **Section 2.4**). The other occurs as a linear shape in the site and appears to be associated with the Ellen Brook watercourse, and also extends north and south of the site. The locations of these ESAs in relation to the site are shown in **Figure 3**.

2.10 Local natural areas

The City of Swan's *Local Biodiversity Strategy* includes mapping of 'potentially significant local natural areas' (PSLNAs) which were determined using various environmental factors and 'ecological criteria' (City of Swan 2015). PSLNAs have been classified into proposed protection categories of 'conservation', 'protection', 'retention', 'limited protection' and 'to be determined/negotiated'.

PSLNAs will be considered to be a 'significant local natural area' (SLNA) following a suitable flora and vegetation survey and if that survey determines the vegetation is in 'good' or better condition. *Local Biodiversity Strategy* states that SLNAs should be 'retained and where possible, protected and their biodiversity values managed for the future' (City of Swan 2015).

Ellen Brook is mapped as a PSLNA, and the portion that traverses the site meets '9-11 prioritisation criteria' (City of Swan 2015). This PSLNA has been assigned a 'protection' biodiversity protection level.

2.11 Ecological linkages

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

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

One mapped ecological linkage (No. 27) occurs within the site. This linkage is associated with Ellen Brook watercourse and extends beyond the site to the north and south, connecting to other linkages. The location of this linkage is shown in **Figure 3**.

2.12 Previous surveys

Emerge previously undertook a 'reconnaissance' level flora and vegetation assessment of a portion of the site in 2019, on behalf of the City of Swan (Emerge Associates 2019b). The site boundary for the previous survey encompassed the central portion of the current site boundary. During the previous assessment a field survey was undertaken during February and September 2019 and nine plant communities were identified, of which eight were dominated by native vegetation. The vegetation was mapped as being in 'degraded' and 'completely degraded' condition using the Keighery (1994) scale. No conservation significant flora or vegetation was recorded during the previous survey.

Emerge Associates (2019b) also assessed the general characteristics of each mapped geomorphic wetland within the site and compared them to the management category assigned to the wetland. A detailed wetland evaluation using the DBCA (2017a) methodology was not undertaken. The assessment indicated that three of the mapped wetlands which intersect with the site appear to support values that align with their current management categories and that one wetland feature currently mapped as a CCW (UFI 12433) may support values indicative of a lower management category.

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 2021), *NatureMap* (DBCA 2021) and DBCA's threatened and priority flora database (reference no. 17-0221FL_TPFL).

A search was also conducted for TECs and PECs that may occur or have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DAWE 2020a), the *weed and native flora dataset* (Keighery *et al.* 2012) and DBCA's threatened and priority ecological communities' databases (reference no. reference no. 21-0219EC).

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 to conduct the flora and vegetation field survey on the following dates in 2020:

- 18 August
- 30 September
- 9 October
- 10 November.

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 non-permanent relevés. The relevés were completed over an approximate 10 x 10 m area without the use of physical markers and were used to provide a rapid sample of patches of vegetation in poorer condition and/or of smaller size. The position of each relevé was recorded with a hand-held GPS unit.

The data recorded within each sample included:

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

The characteristics of each mapped geomorphic wetland within the site was assessed during the survey (refer **Section 2.4**). Notes were taken on aspects such as hydrology, vegetation and landform.

The appropriate management category of each wetland feature was determined using the DBCA document *A methodology for the evaluation of specific wetland types on the Swan Coastal Plain, Western Australia* (DBCA 2017a).

3.4 Mapping and data analysis

3.4.1 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.

3.4.2 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.

3.4.3 Floristic community type assignment

The identified plant communities were then compared to the regional 'floristic community type' (FCT) dataset *A floristic survey of the southern Swan Coastal Plain* by Gibson *et al.* (1994). The sample data (presence/absence) was reconciled with Gibson *et al*. (1994) by standardising the names of taxa with those used in the earlier study. This was necessary due to changes in nomenclature in the intervening period. Taxa that were only identified to genus level were excluded, while some infra-species that have been identified since 1994 were reduced to species level. The combined dataset was then imported into the statistical analysis package PRIMER v6 (Clarke and Gorley 2006). As data from a localised survey is often spatially correlated, data for each sample was compared to Gibson *et al.* (1994) separately. This removed the influence of spatial correlation when assigning a FCT. Classification was then undertaken using a group-average hierarchical clustering technique using the Bray-Curtis distance measure (as described above for plant community determination).

Where the sample tended to cluster with a grouping of different FCTs, samples were assessed separately to differentiate between FCTs. Ultimately the cluster analysis, as well as contextual information relating to the soils, landforms and known locations of FCTs within the region, was considered in the final determination of an FCT for vegetation within the site.

FCT analysis was not undertaken for samples located within disturbed vegetation with low native species diversity as the vegetation was considered unlikely to currently represent an FCT.

3.4.4 Threatened and priority ecological communities

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

3.4.5 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.

3.5 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.
		The previous survey was reviewed prior to the survey and during documentation of this report (refer **Section 2.12**).
	No limitation	Regarding assignment of FCTs, the authoritative Gibson *et al.* (1994) dataset was derived from a necessarily limited sample of vegetation from largely publicly owned land which is now more than 20 years out of date. Consequently, it is unknown to what degree official FCTs are appropriate reference to biodiverse vegetation across the Swan Coastal Plain. Furthermore, Gibson *et al.* (1994) collected data in the spring main flowering period and in many cases sampled plots multiple times to provide a complete species list. The survey was undertaken during spring but analysis of samples against the Gibson *et al.* (1994) dataset did not indicate resemblance to any FCTs. This is likely due to the reduced and altered native species diversity due to intensive historical disturbance
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.

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

Constraint	Degree of limitation	Details
Suitability of timing	No limitation	The survey was conducted in spring and thus within the main flowering season. Relatively high rainfall was recorded in the months prior to 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 degraded nature of much of the site limits the potential habitat for native geophytic plants such as orchids. 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 multiple times between August and November 2020. The range of survey dates provided an insight into the vegetation condition and composition across and outside of 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. Part of Lot 1361 could not be accessed but this was not considered to be a limitation.
	No limitation	The EPA (2016) guidance indicated that surveys for linear infrastructure should incorporate characterisation of vegetation within the infrastructure corridor and a 500 m to 1000 m area on both sides. Detailed survey to this extent beyond the site boundary was not undertaken for the current assessment. The vegetation surrounding most of the site was observed to be consistent with that in the site, being subject to historical disturbance and currently used for farming purposes. As noted in this assessment, the highest quality vegetation in the site, which lies in the railway corridor and along Ellen Brook, extends beyond the site. Therefore, the current survey area was considered sufficient to characterise the vegetation within the sight in detail and gain an insight into that adjacent to the site.
Sampling intensity	No limitation	A total of 121 species were recorded, of which 63 were recorded from four sample locations and 51 were recorded opportunistically. Minimum species richness within site is estimated at between 96 (Jacknife1) and 119 (Chao2) species (refer **Section 4.4**). The number of species recorded in the site is greater than the estimates and, combined with the degraded nature of the majority of the site, demonstrates that survey effort was adequate to prepare a comprehensive species inventory for the site.
Influence of disturbance	Minor limitation	Time since fire is greater than 60 years as interpreted from aerial imagery and therefore short lived species more common after fire may not have been visible.
	No limitation	Historical ground disturbance was evident in parts of the site and some native vegetation in the site is regrowth with minimal non-native species present. 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 is located on a flat to gently sloping plain. The Ellen Brook watercourse flows through the centre of the site in a north-south direction. Soils range from grey sand approximately west of the Ellen Brook channel to red/brown sand/clay to the east. Outcropping limestone was recorded between the railway and Ellen Brook and is suspected to be present at depth in the central and western portions of the site, to unknown extent. This limestone is considered likely to be representative of the 'Muchea limestone' geological formation due to its geographic location.

All roads within the site are bituminised, excepting the central portion of Stock Road which is a sand track. A single-track railway line with level bitumen crossing is present in the western portion of the site, adjacent to Railway Parade. The remainder of the site comprises road reserve and portions of private properties. The private properties are currently used for agricultural purposes such as stock grazing.

The road reserve, rail reserve and private properties in the site support a combination of native and non-native vegetation. The majority of the site comprises agricultural land with occasional native trees and shrubs over non-native pasture grasses. Many of the patches of native vegetation in the site are isolated and support a high cover of non-native grasses. Vegetation along Ellen Brook comprises native trees over a predominantly non-native understorey that are part of a larger patch of riparian vegetation that extends beyond the site. Vegetation in the rail reserve extends beyond the site and mainly comprises native shrubs and occasional trees over non-native vegetation. Native shrubland exists in a small portion of the rail reserve within the site and extends beyond the site to the north.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of 25 threatened and 38 priority flora species occurring or potentially occurring within a 10 km radius of the site. Information on these species including their habitat preferences and flowering period is provided in **Appendix B**.

Based on background information available for the site, suitable habitat was considered to potentially occur within the site for eight threatened flora species and 15 priority flora species as shown in **Table 4**.

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

Species	Level of significance		Life strategy	Habitat	Flowering period
	State	EPBC Act			
Grevillea althoferorum subsp. *fragilis*	CR	CR	P	Greyish-yellow colluvial sand at the base of the Darling Scarp.	Sep-Nov
Darwinia foetida	EN	EN	P	Grey-white sand on swampy, seasonally wet sites	Oct-Nov
Diuris purdiei	EN	EN	PG	Sand to sandy clay soils in areas subject to winter inundation.	Sep-Oct, after a fire
Grevillea curviloba subsp. *incurva*	EN	EN	P	Sand, sandy loam. Winter-wet heath.	Aug-Sep
Acacia anomala	VU	VU	P	Shallow sand,loam,clay or gravel	Aug-Sep
Anigozanthos viridis subsp. *terraspectans*	VU	VU	P	Grey sand, clay loam. Winter-wet depressions.	Aug-Sep
Chamelaucium lullfitzii	VU	VU	P	White yellow sand in low woodland.	Sep-Dec
Eleocharis keigheryi	VU	VU	P	Clay or sandy loam in freshwater creeks and seasonally wet clay pans.	Aug-Dec
Hydrocotyle striata	P1	-	A	Sand and clay in springs and creeklines.	Nov
Calectasia elegans	P2	-	P	Grey yellow sand on plains.	Sep-Oct
Poranthera moorokatta	P2	-	A	Sandy or clay soils. Dampland or low sandy dunes.	Oct or Feb
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	P3	-	P	Grey brown sand or clay in winter wet flats.	Sep-Nov
Guichenotia tuberculata	P3	-	P	Sand clay over laterite, sand	Aug-Oct
Haemodorum loratum	P3	-	P	Grey or yellow sand, gravel.	Nov
Persoonia rudis	P3	-	P	White, grey or yellow sand, often over laterite.	Dec-Jan
Platysace ramosissima	P3	-	P	Sandy soils.	Oct-Nov
Schoenus sp. Waroona (G.J. Keighery 12235)	P3	-	A	Clay or sandy clay. Winter-wet flats.	Oct-Nov
Stylidium aceratum	P3	-	A	Sandy soils in swamp heathland.	Oct-Nov
Styphelia filifolia	P3	-	P	Brown over pale yellow sand.	Feb-Apr
Verticordia serrata var. *linearis*	P3	-	P	White sand, gravel.	Sep-Oct
Hypolaena robusta	P4	-	P	White sand. Sandplains.	Sep-Oct
Schoenus natans	P4	-	A	Aquatic, in winter-wet depressions.	Oct

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

4.2.2 Species inventory

A total of 70 native and 51 non-native (weed) species were recorded within the site during the field survey, representing 38 families. The dominant families containing native taxa were Myrtaceae (13 native taxa and 3 non-native/planted taxa) and Cyperaceae (ten native taxa only). Of the species recorded 63 were recorded in sample locations and 51 were recorded opportunistically.

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

4.2.3 Threatened and priority flora

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

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

4.2.4 Locally and regionally significant flora

One species recorded in the site, *Grevillea obtusifolia*, is identified in *Bush Forever* as significant flora of the foothills and Pinjarra plain as it is considered to have significant populations and is endemic (Government of WA 2000b). *G. obtusifolia* was recorded within plant community **AsGoAc** in the rail reserve in the western portion of the site.

Grevillea thelemanniana, which is listed as 'critically endangered' under the EPBC Act and 'threatened' the BC Act, and is also listed as significant flora of the foothills and Pinjarra plain, was recorded in the eastern portion of the site along Great Northern Highway. However, the individual/s in the site are cultivars and located within other planted non-native vegetation which was likely installed during previous works associated with the Great Northern Highway. Therefore, the individual/s recorded within the site do not represent the threatened form of *G. thelemanniana* and are not considered significant flora. This was confirmed by a representative from DBCA (A. Jones 2019, pers. comm., 2 July).

4.2.5 Declared pests

Two species listed as a declared pest (C3) pursuant to the BAM Act, **Moraea flaccida* (one-leaf cape tulip) and **Zantedeschia aethiopica* (arum lily), were recorded within the site. Scattered individuals of these species were recorded throughout the site.

No weeds of national significance (WoNS) were recorded.

4.3 Vegetation

4.3.1 Desktop assessment

The database search results identified 12 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, three TECs and one PEC were considered to have potential to occur in the site:

- *'Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain' TEC which is listed as 'critically endangered' under the EPBC Act and 'endangered' in WA.
- 'Shrublands and woodlands on Muchea limestone of the Swan Coastal Plain' TEC which is listed as 'endangered' under the EPBC Act and in WA.
- 'Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' TEC which is listed as which is listed as 'critically endangered' under the EPBC Act. This community also represents a PEC (P3) in WA.

4.3.2 Plant communities

Four locations were sampled as shown in **Figure 4**.

A total of 12 plant communities were identified within the site. The majority of the site supports **non-native** vegetation which includes bitumised road surface, tracks and non-native species currently used for pasture. The other plant communities occur as small scattered patches within the road reserve, rail reserve and private properties.

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 12**. The location of each plant community is shown in **Figure 4**. A matrix of species recorded within each plant community is provided in **Appendix E** and raw sample data in **Appendix F**.

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

Plant community	Description	Area (ha)
As	Tall shrubland *Acacia saligna* over open forbland *Dianella revoluta* over closed non-native grassland	0.37
AsGoAc	Tall shrubland *Acacia saligna* over shrubland to closed shrubland *Grevillea obtusifolia*, *Banksia telmatiaea*, *Regelia ciliata* and *Stylobasium australe* over herbland *Acanthocarpus canaliculatus* and *Scaevola lanceolata* over grassland to open grassland **Ehrharta calycina* and **Eragrostis curvula*	0.08
Bj	Scattered *Acacia saligna* over closed sedgeland *Baumea juncea* with scattered *Caustis dioica* over open grassland **Cynodon dactylon* and scattered non-native herbs	0.01
Cc	Forest *Corymbia calophylla* over non-native grassland	0.59
CcM	Occasional *Corymbia calophylla* over tall shrubland *Melaleuca huegelii* over closed non-native grassland over occasional *Baumea juncea*	0.26
Co	Open forest *Casuarina obesa* over non-native grassland/herbland	3.32
EcTaCa	Scattered *Leptocarpus canus* over grassland **Eragrostis curvula* over herbland *Tribonanthes australis* and *Centrolepis aristata*	0.01
ErMr	Open forest *Eucalyptus rudis* and *Melaleuca rhaphiophylla* over sparse herbland *Lobelia anceps* over open non-native grassland	0.58
Ew	Woodland *Eucalyptus wandoo* over occasional native species such as *Hypocalymma* sp. (or absent) over non-native grassland	0.42

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

Plant community	Description	Area (ha)
M	Shrubland *Melaleuca viminea/M. rhaphiophylla/M. preissiana* over non-native grassland	0.68
Mixed	Occasional native species such as *Corymbia calophylla* and *Eucalyptus rudis* over planted native and non-native shrubs over non-native grassland	0.74
Non-native	Non-native and planted vegetation with occasional native plants	49.5

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

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

*Plate 3: Plant community **Bj** in 'good' condition*

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

*Plate 5: Plant community **CcM** in 'degraded' condition*

*Plate 6: Plant community **Co** in 'degraded' condition*

*Plate 7: Plant community **EcTaCa** in 'degraded' condition*

*Plate 8: Plant community **ErMr** in 'degraded' condition*

*Plate 9: Plant community **Ew** in 'degraded' condition*

*Plate 10: Plant community **M** in 'degraded' condition*

*Plate 11: Plant community **Mixed** in 'degraded' condition*

*Plate 12: Plant community **non-native** in 'completely degraded' condition*

4.3.3 Vegetation condition

The most intact vegetation occurs within plant community **AsGoAc** in the rail reserve in the western portion in the site, which was mapped as being in 'very good' and 'good' condition. This vegetation has been subject to historical disturbance of varying intensity but still retains moderate native species diversity and high cover of native species in parts.

Plant community **Bj** in the north western portion of the rail reserve was mapped as being in 'good' condition. This vegetation has been subject to historical disturbance and is dominated by one native species, *Baumea juncea*.

The other native plant communities in the site were mapped as being in 'degraded' condition as their composition and structure has been altered by intensive historical and ongoing disturbance.

The **non-native** plant community was mapped as being in 'completely degraded' condition as it consists of areas dominated by weeds and non-vegetated areas.

The extent of vegetation by condition category is detailed in **Table 6** and shown in **Figure 5**.

Table 6: Extent of vegetation condition categories within the site

Condition category (Keighery 1994)	Size (ha)
Pristine	0
Excellent	0
Very good	0.05
Good	0.03
Degraded	6.98
Completely degraded	49.5

4.3.4 Floristic community types

The vegetation within the site was considered too degraded to assign to an FCT.

The two samples within plant community **AsGoAc**, R1 and R2, were compared to the Gibson *et al.* (1994) dataset but did not group with any FCTs conclusively. The relevant portions of the cluster dendrograms showing R1 and R2 are provided in **Appendix G**.

4.3.5 Threatened and priority ecological communities

The outcropping limestone observed within the site indicates the potential for the 'shrublands and woodlands on Muchea limestone of the Swan Coastal Plain' TEC to be present. The **AsGoAc** vegetation comprises a small area of intact native vegetation and includes some species listed by DoEE (2017) as occurring within this TEC, such as *Acacia saligna*, *Scaevola lanceolata* and *Stylobasium australe*. Although no outcropping limestone was observed within this vegetation, it is considered to represent the TEC as it is probable that there is underlying limestone based on the nearby outcropping observed.

Plant communities **As**, **Cc**, **CcM**, **Co**, **ErMr** and **M** contain a range of shrub or overstorey species that are listed as being associated with this TEC including *Casuarina obesa*, *Eucalyptus rudis, Melaleuca huegelii*, *Melaleuca rhaphiophylla*, *Melaleuca viminea*, *Stylobasium australe* and *Xanthorrhoea preissii*. These species are generally common and widespread, and only associated with the TEC where they occur in geographic areas influenced by Muchea limestone. Due the fact that these plant communities are highly disturbed, lacking native understory species and with extremely low native species diversity they were not considered to represent the TEC.

Therefore, a total of 0.08 ha of this TEC occurs within the site, as shown in **Figure 6**.

Plant communities in the site that include marri trees were not considered to represent the SCP3a or SCP3c TECs due to the lack of native understorey species.

Some tuart trees exist in the western portion of the site but are not considered to represent the 'tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain' TEC/PEC as they are planted.

No other TECs or PECs occur within the site. The likelihood of occurrence assessment is provided in **Appendix C**.

4.3.6 Locally and regionally significant vegetation

Stands of mature eucalypt trees are present in the site. These trees have the potential to provide foraging, roosting and nesting habitat for threatened species of black cockatoo, along with other ecological services. Some of the planted non-native eucalypt trees in the site may also provide foraging and roosting habitat for black cockatoos.

The portion of the mapped PSLNA within the site (associated with Ellen Brook) supports native vegetation in 'degraded' condition and therefore does not represent a SLNA. However, this PSLNA extends beyond the site and the remaining portion may be in 'good' or better condition and may represent a SLNA.

4.4 Species richness and sampling adequacy

A total of 63 species were recorded from four samples. A species accumulation curve derived from sample data is presented in **Plate 13**. After four samples the curve is still increasing and has not reached its asymptote. This indicates that a proportion of species likely remain undetected by sampling.

Species richness was estimated in PRIMER v6 to be between 96 (Jacknife1) and 119 (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 51 additional species recorded opportunistically, a total of 121 species was recorded in the site. This indicates that more than the estimated 96-119 species in the site were recorded. This result, and the degraded nature of the majority of the site and the time spent sampling and searching the vegetation indicates that the survey effort is adequate to prepare a comprehensive species inventory.

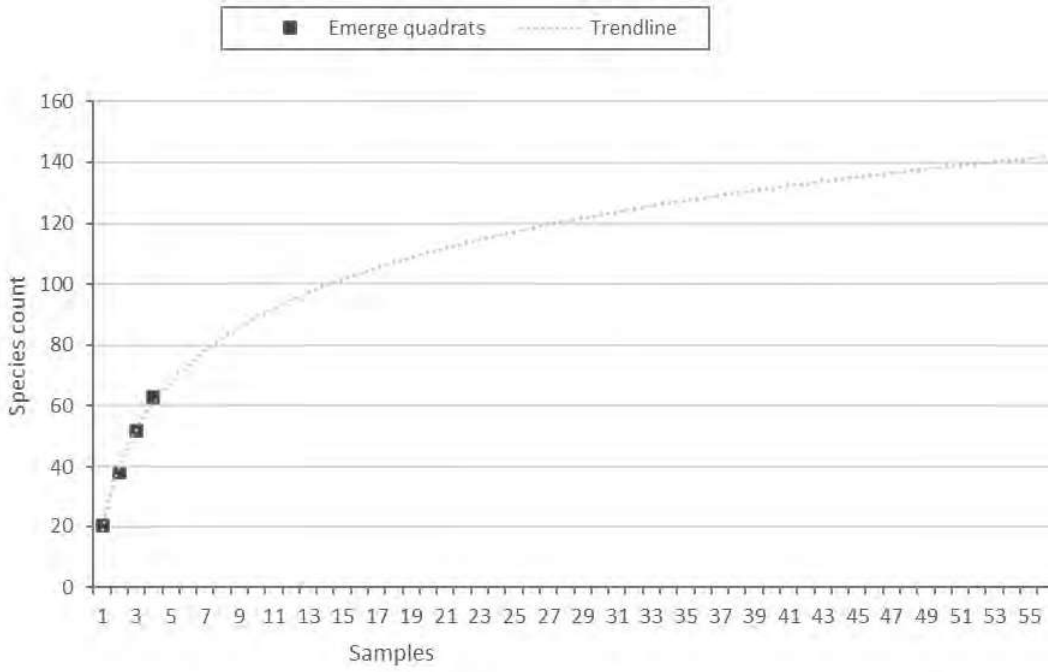

Plate 13: Species accumulation curve derived from sample data (y =30.556ln(x) + 18.848, R^2 = 0.9883)

4.5 Wetlands

The portions of the two MUWs (UFIs 15282 and 15732) in the site support predominantly non-native vegetation and are considered to be consistent with their current 'multiple use' management category.

The portion of the CCW associated with Ellen Brook (UFI 15734) in the site supports native vegetation in 'degraded' condition. This CCW is considered to align with its current 'conservation' management category due to factors such as its association with Ellen Brook and ecological linkage function.

The other CCW (UFI 12433) in the site supports a patch of plant community **Co** in 'degraded' condition. A small portion of this feature extends beyond the site and was also determined to be in 'degraded' condition. When assessed using (DBCA 2017a), UFI 12433 was determined to represent a 'resource enhancement' wetland (REW). This is primarily due to geomorphology attributes and the presence of flora and fauna habitat. The wetland evaluation documentation is provided in **Appendix H**.

5 Discussion

The site has been subject to long-term disturbance and as such is dominated by non-native vegetation. The native vegetation in the site occurs primarily as isolated patches with low species diversity.

5.1 Threatened and priority flora

The potential habitat for any threatened or priority flora species is extremely limited in the site due to historic disturbance and subsequent lack of native understory vegetation. The most intact native vegetation exists within plant community **AsGoAc** . Thorough searches in this vegetation over multiple dates did not record any threatened or priority flora species. Therefore, it is considered unlikely that any threatened or priority flora species occur in the site.

5.2 Vegetation condition

Classifying the condition of vegetation within the site was relatively straightforward. Most of the plant communities have been severely modified by historic disturbances and retain few native species. Due to the presence of native canopy or shrub species these patches were still recognisable as woodland or shrubland vegetation and so were classed as being in 'degraded' condition. Some patches of vegetation included native regrowth and planted species, particularly in the eastern portion of the site along Great Northern Highway. The 'degraded' category was considered suitable to assign to these patches as none were considered to be intact and they have a significantly altered vegetation structure with understorey species lacking or present at low cover and diversity.

Plant community **AsGoAc** in the rail reserve represents a small patch of native vegetation, which extends beyond the site to the north where it is appears more intact. The **AsGoAc** vegetation decreases in condition as the size of the patch reduces and disturbance increases, resulting in higher grassy weed cover and lower native species diversity.

Plant community **Bj** comprises a small patch of vegetation (0.01 ha) that would not usually be separated at the scale of mapping used for a site of this size. However, the **Bj** vegetation was mapped as being in 'good' condition to acknowledge the presence of native *Baumea juncea* understorey. A higher condition category was not assigned as few other native species were present and the vegetation is regrowth following to historical disturbance, likely due to its location within a narrow strip of vegetation and adjacent to a road.

5.3 Floristic community type assignment

The most intact vegetation within the site, plant community **AsGoAc**, was not considered to currently represent an FCT.

The number of native species recorded within samples in this vegetation was insufficient to group with Gibson *et al.* (1994) sites, likely due to historical disturbance. The **AsGoAc** vegetation showed low similarity to FCT 6 'weed dominated wetlands on heavy soils'. This FCT is characterised by a high

proportion of non-native species which is likely why the **AsGoAc** vegetation showed some similarity. Nevertheless, the amount of similarity was so low that this vegetation is not considered to currently represent an FCT. The more intact native vegetation to the north of **AsGoAc** provides a reference of what **AsGoAc** within the site may have once been like.

Floristic analysis of the other plant communities in the site, including the **Bj** vegetation, was not undertaken due to the low native species diversity recorded.

5.4 Threatened and priority ecological communities

The 'shrublands and woodlands on Muchea limestone of the Swan Coastal Plain' TEC (Muchea limestone TEC) is not linked to a specific FCT and the conservation advice identifies a variety of different forms which are due to the landform and level of limestone outcropping (DoEE 2017). Six forms are identified, comprising:

- *'Melaleuca huegelii* heath or shrubland over *Grevillea evanescens* and *Xanthorrhoea preissii'* (on rises with outcropping limestone)
- 'scattered *Casuarina obesa* over *Melaleuca lateriflora*, *Grevillea evanescens* and *Melaleuca viminea* shrubland and herbs' (on wet flats)
- *'Melaleuca huegelii*, *Grevillea evanescens* and *Melaleuca* species shrubland and herbs' (on wet flats)
- *'Casuarina obesa* open woodland over *Poa* grassland and herbs' (on wet flats)
- *'Eucalyptus rudis* open forest over *Melaleuca rhaphiophylla* open low forest over shrubland over tall sedgeland and grassland' (in creeklines)
- 'Open marri woodland over mixed shrublands usually containing (on damper sands over limestone where the limestone appears to be at greater depth, is more remote or the limestone area is geographically isolated from other limestone areas) (DoEE 2017).

Some of the plant communities recorded in the site include species outlined in the forms described above, indicating that they may be associated with Muchea limestone. Given the sites location near Muchea and presence of outcropping limestone in part of the site, this is not unexpected. However, the vegetation within the site is highly disturbed and the majority at the lowest end of 'degraded' condition, lacking in understorey and with significantly reduced native species diversity.

The DoEE does not recommend size or condition thresholds are applied when identifying the Muchea limestone TEC (DoEE 2017). Rather, DoEE (2017) suggests that the community can be defined by the presence of a limestone influenced substrate. Under this guidance the Muchea limestone TEC would be considered to be present in all areas with a Muchea limestone influenced substrate, irrespective of whether native vegetation is present, which could potentially result in the perverse outcome of cleared pasture being mapped as the TEC.

The DoEE describes the Muchea limestone TEC as supporting 'a rich layer of herbaceous annuals under a dense, diverse shrub layer' (DoEE 2019b). The 'degraded' condition vegetation within the site lacks native understorey and as such, does not align with this description and it was considered inappropriate to conclude such vegetation represents the TEC. Similarly, the **Bj** vegetation does not meet this description and is also not considered to represent the TEC.

The **AsGoAc** vegetation comprises a native shrubland over annuals but the species diversity is moderately low due to historical disturbance. No outcropping limestone was observed within the **AsGoAc** vegetation but limestone may be underlying due to the proximity of outcropping observed nearby. Due to the potential for underlying limestone to be present and the presence of understory species listed as occurring within the TEC, such as *Scaevola lanceolata* and *Stylobasium australe*, the **AsGoAc** vegetation is considered to be a remnant of the Muchea limestone TEC.

5.5 Local and regional significance

Plant community **ErMr** associated with Ellen Brook is part of a contiguous patch of native vegetation that provides an ecological linkage and is part of a *Bush Forever* site and a 'conservation' category wetland feature. However, the **ErMr** vegetation in the site supports low native species diversity and non-native grasses dominate the ground layer. Ongoing disturbance appears to be occurring to the **ErMr** vegetation in the site due to stock access.

The potential for trees in the site to provide habitat for threatened species of black cockatoo was characterised in a separate fauna assessment completed by Emerge Associates (2019a).

Vegetation must be in 'good' or better condition for a PSLNA to be considered a SLNA (City of Swan 2015). The area of the PSLNA in the site is only a small portion of the larger feature. Therefore, although the portion within the site does not meet the SLNA criteria, there is potential for the vegetation within the remainder of the PSLNA and outside of the site to be in 'good' condition and meet the SLNA criteria.

5.6 Wetlands

The wetland evaluation indicated that wetland feature CCW 12433 has values that are representative of a resource enhancement category wetland, as it is 'partly modified but still supporting substantial functions and attributes'. Wetland features often require re-evaluation as they may not have been physically inspected when first entered into the *Geomorphic Wetlands, Swan Coastal Plain* dataset (DBCA 2018b). The result for CCW 12433 is not surprising as this wetland feature has been subject to historical and ongoing disturbance from agricultural land use. A wetland reclassification request would need to be submitted to DBCA to alter the management category within the dataset.

6 Conclusions

The site is highly modified and disturbed, with 49.50 ha (88% of the site) supporting non-native vegetation in 'completely degraded' condition. Most native vegetation in the site is present in 'degraded' condition (6.98 ha/12% of the site). The most intact vegetation occurs as small patches within the rail reserve in the western portion of the site that are present in 'good' and 'very good' condition (0.08 ha/<1% of the site).

No threatened or priority flora species were recorded within the site and none are considered likely to occur.

Plant community **AsGoAc** represents a 0.08 ha patch of the 'shrublands and woodlands on Muchea limestone of the Swan Coastal Plain' TEC which is listed as 'endangered' under the EPBC Act and in WA. No other TECs or PECs occur within the site.

One flora species listed as 'significant flora of the foothills and Pinjarra plain', *Grevillea obtusifolia*, was recorded within the site. Native and non-native trees within the site have the potential to provide foraging, roosting and nesting habitat for threatened species of black cockatoo, along with other ecological services.

Wetland feature CCW 12433 within the site has values that are representative of an REW.

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Figures

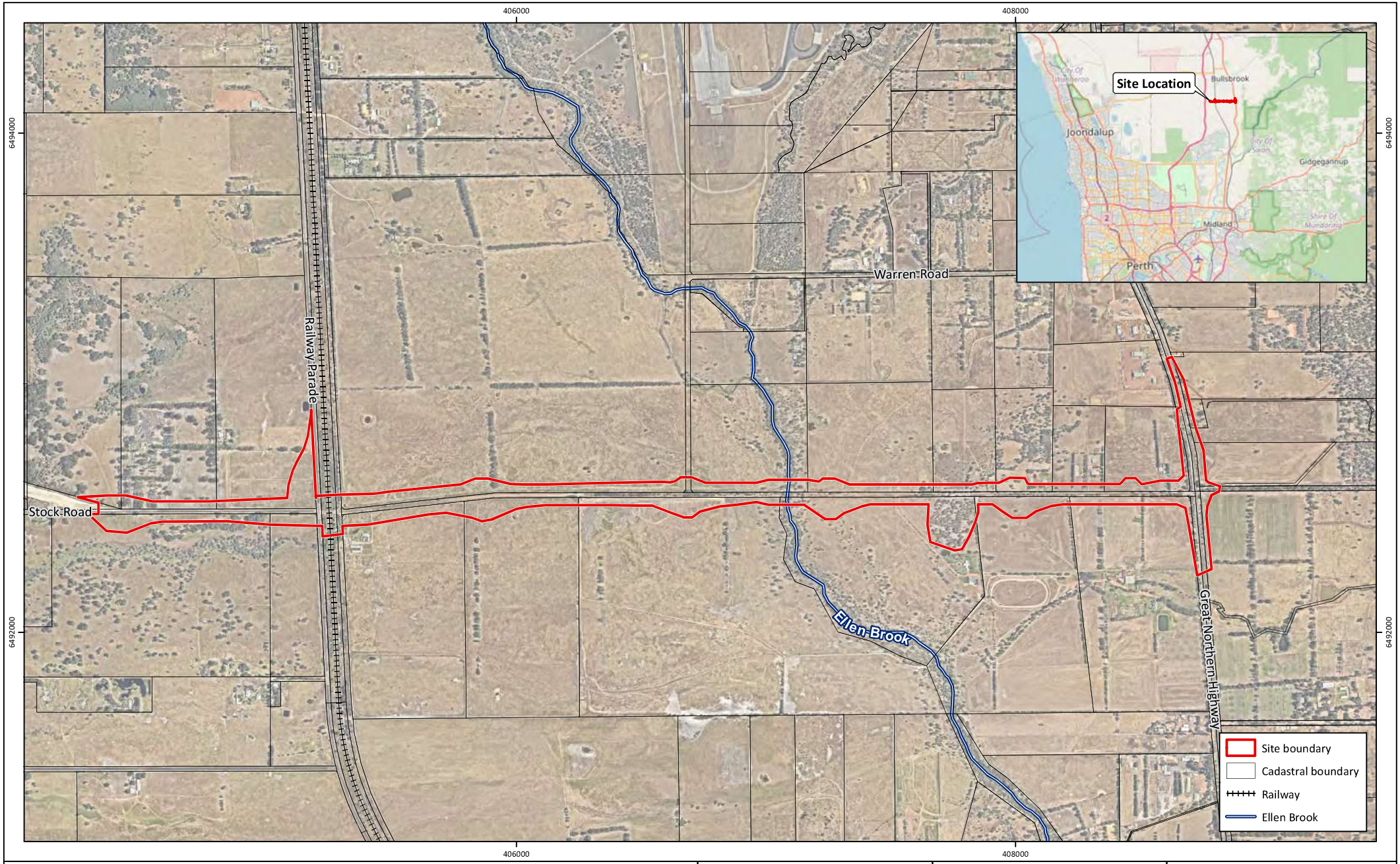

Figure 1: Site Location

Project:	Detailed Flora and Vegetation Assessment Stock Road Corridor, Bullsbrook
Client:	Department of Planning, Lands and Heritage

Plan Number:
EP20-089(02)--F13a

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

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Scale: 1:20,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

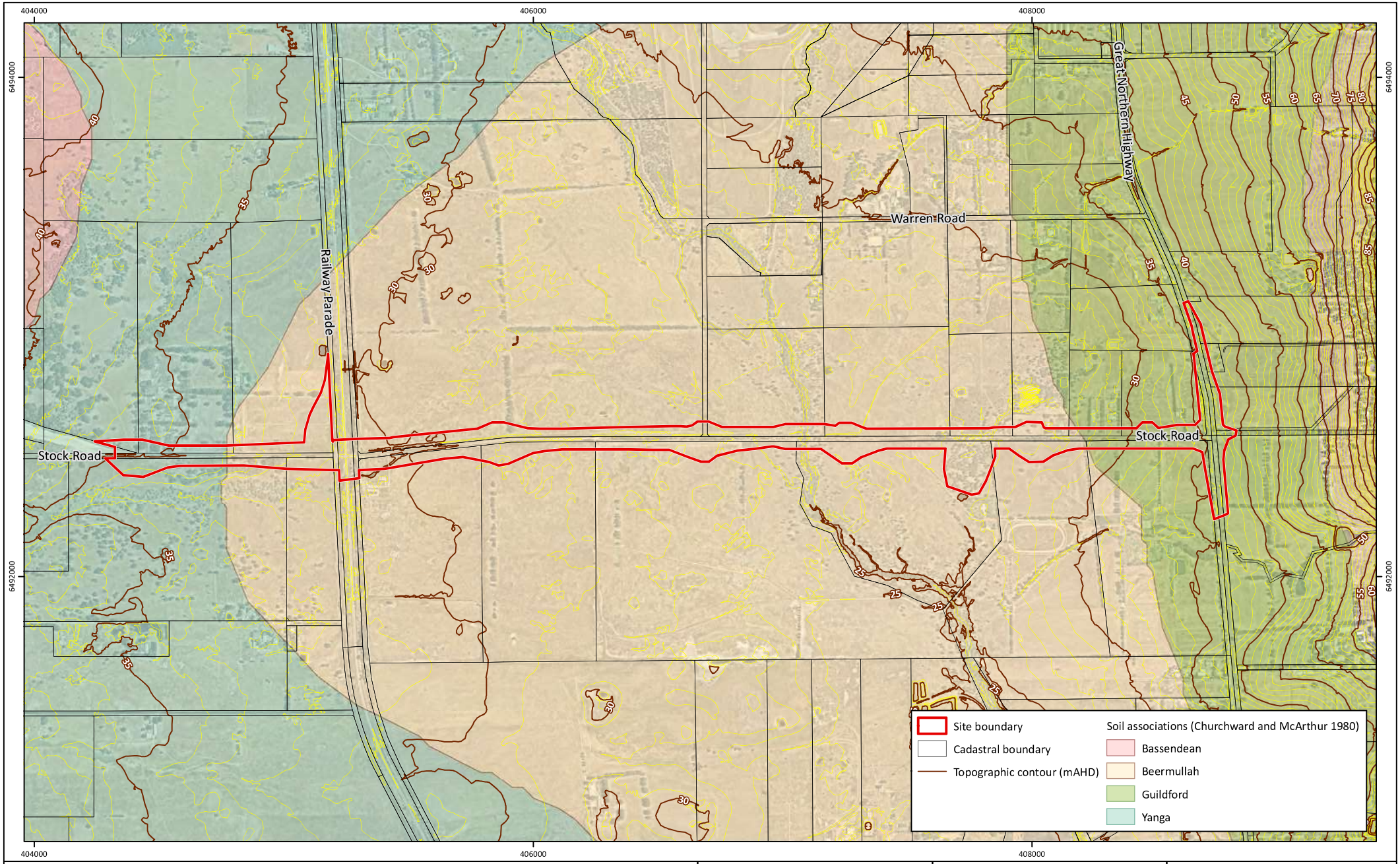

Figure 2: Soils and Topography

Project: Detailed Flora and Vegetation Assessment
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Client: Department of Planning, Lands and Heritage

Plan Number:
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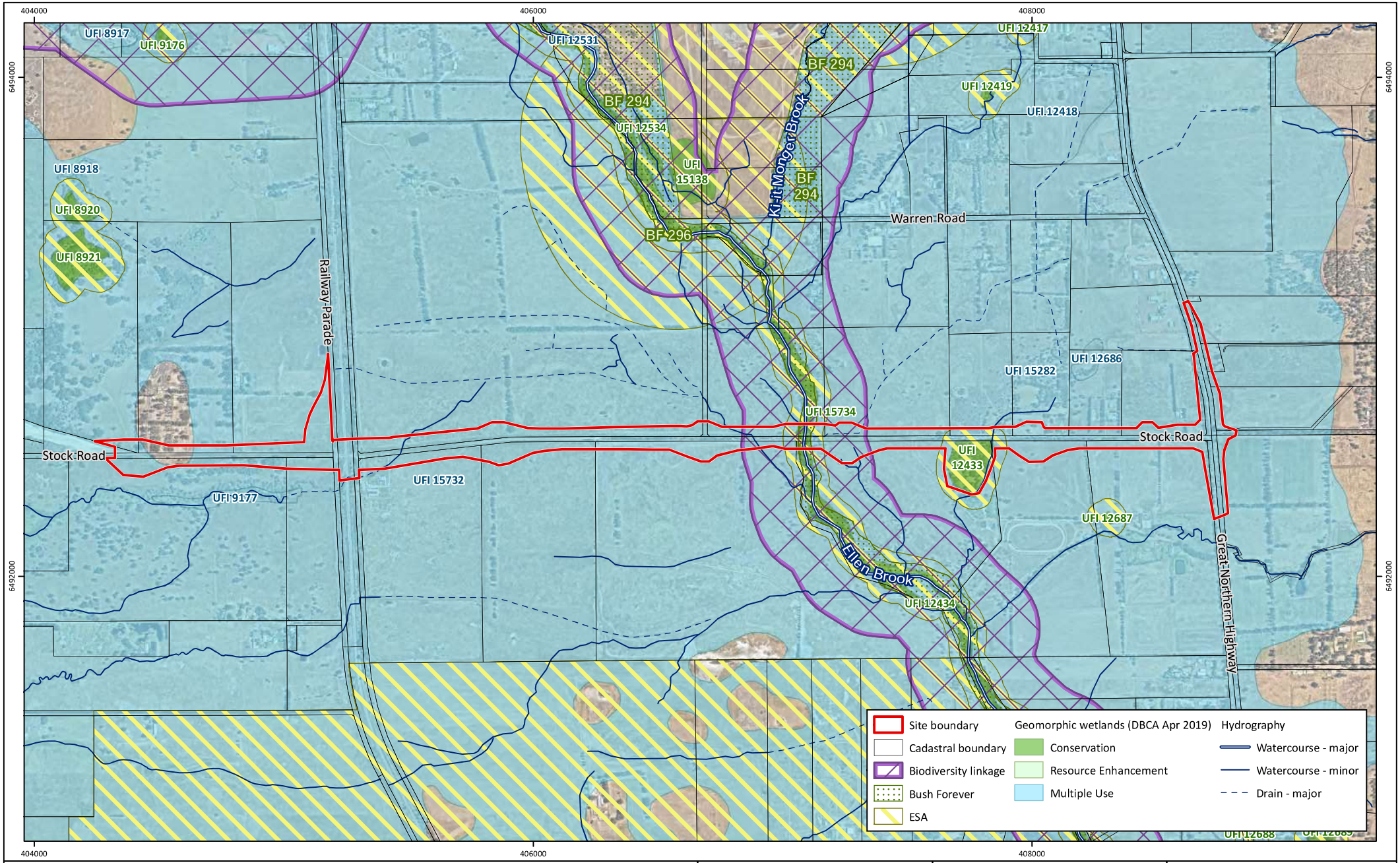

Figure 3: Environmental Features

Project: Detailed Flora and Vegetation Assessment
Stock Road Corridor, Bullsbrook
Client: Department of Planning, Lands and Heritage

Plan Number:
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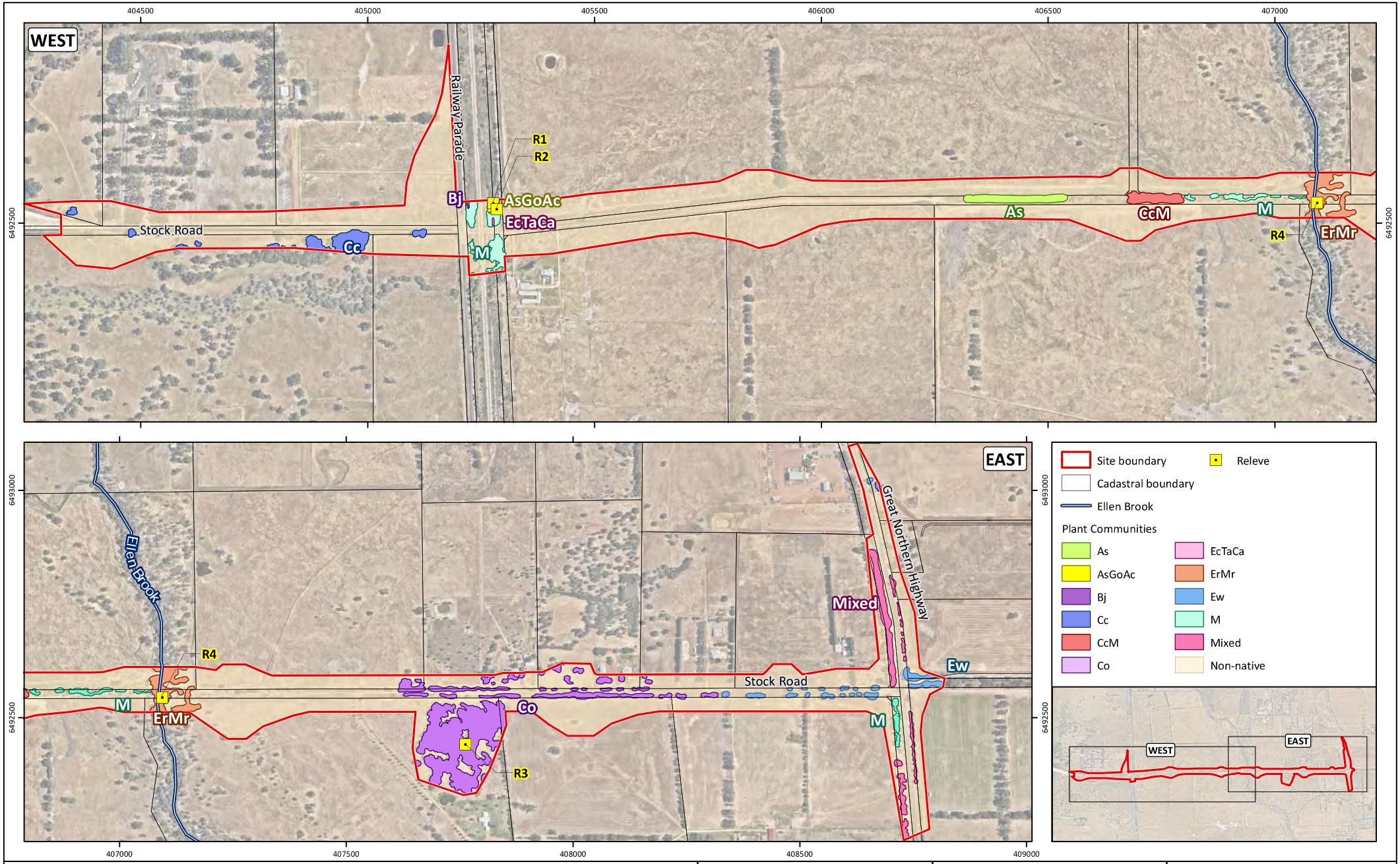

Figure 4: Plant Communities

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Client:	Department of Planning, Lands and Heritage

Plan Number:
EP20-089(02)--F16a

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emerge ASSOCIATES

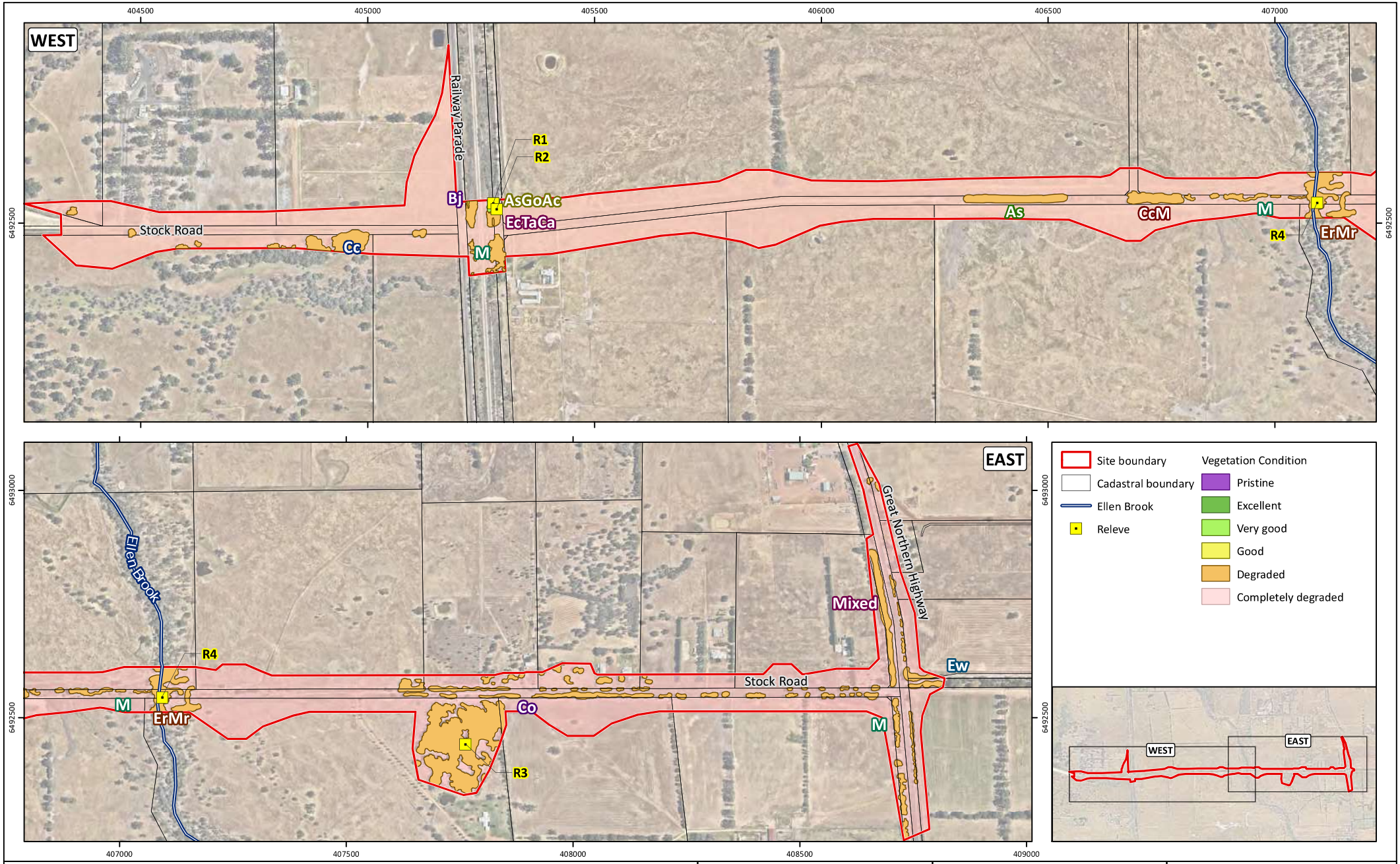

Figure 5: Vegetation Condition

Project: Detailed Flora and Vegetation Assessment
Stock Road Corridor, Bullsbrook
Client: Department of Planning, Lands and Heritage

Plan Number:
EP20-089(02)--F17a
Drawn: GAR
Date: 12/03/2021
Checked: RAW
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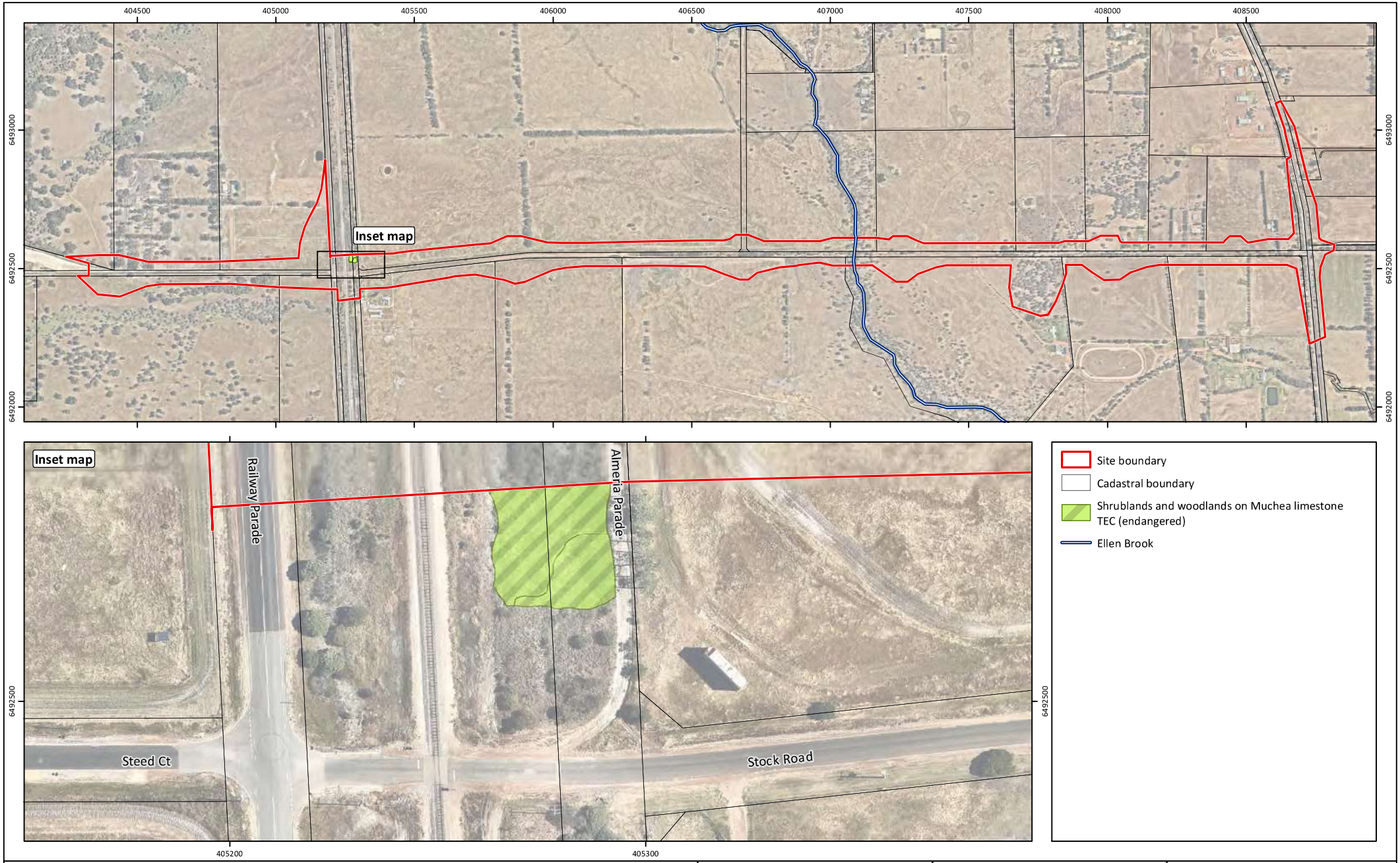

Figure 6: Conservation Significant Vegetation

Project: Detailed Flora and Vegetation Assessment
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Client: Department of Planning, Lands and Heritage

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

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Metres
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GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix A

Additional Information

Conservation Significant Flora and Vegetation

Threatened and priority flora

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

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

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

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

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

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

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

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

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

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

Threatened and priority ecological communities

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

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

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

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

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

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

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

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

Weeds

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

Declared Pests

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

Under the BAM Act, all declared pests are assigned a legal status, as described in **Table 7**. Species assigned to the 'declared pest, prohibited - s12' category are placed in one of three control categories, as described in **Table 8**.

The *Biosecurity and Agriculture Management Regulations 2013* specify keeping categories for species assigned to the 'declared pest - s22(2)' category, which relate to the purposes of which species can be kept, as well as the entities that can keep them. The categories are described in **Table 9**.

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

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

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

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

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

Category	Description
	Established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

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

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

Wetland Habitat

Geomorphic wetland types

On the Swan Coastal Plain DBCA (2017a) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period) as outlined in **Table 10**.

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

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

Wetland management categories

DBCA maintains the *Geomorphic Wetland of the Swan Coastal Plain* dataset (DBCA 2018a), which also categorises individual wetlands into specific management categories as described in **Table 11**.

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

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

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

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

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

Wetland reclassification

DBCA have a protocol for proposing changes to the wetland boundaries and management categories of the existing geomorphic wetland dataset (DEC 2007). The procedure involves a wetland desktop evaluation and site assessment which culminates in a recommended management category. Relevant information should be obtained in the optimal season for vegetation condition and water levels, which is usually spring (DEC 2007). In the case of larger wetlands that have undergone a degree of disturbance, a separate management category may be assigned to parts of the wetland in order to reflect the current values.

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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				
Acacia anomala	VU	VU	P	Shallow sand,loam,clay or gravel	Aug-Sep	Unlikely
Anigozanthos viridis subsp. terraspectans	VU	VU	P	Grey sand, clay loam. Winter-wet depressions.	Aug-Sep	Unlikely
Chamelaucium lullfitzii	VU	VU	P	White yellow sand in low woodland.	Sep-Dec	Unlikely
Eleocharis keigheryi	VU	VU	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	Unlikely
Anthocercis gracilis	VU	VU	P	Steep granite slopes along the Darling Scarp in shallow, humis-rich sandy or loamy soils.	Sep-Oct, Ap	Unlikely
Diuris micrantha	VU	VU	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep- ea	Unlikely
Darwinia foetida	EN	EN	P	Grey-white sand on swampy, seasonally wet sites	Oct-Nov	Unlikely
Diuris purdiei	EN	EN	PG	Sand to sandy clay soils in areas subject to winter inundation.	late Septem	Unlikely
Grevillea curviloba subsp. incurva	EN	EN	P	Sand, sandy loam. Winter-wet heath.	Aug-Sep	Unlikely
Andersonia gracilis	VU	EN	P	Seasonally damp, black sandy clay flats near or on the margins of swamps.	Sep-Nov	Unlikely
Caladenia huegelii	CR	EN	PG	Well-drained, deep sandy soils in lush undergrowth in a variety of moisture levels.	Sep-early N	Unlikely
Conospermum densiflorum subsp. unicephalatum	EN	EN	P	Clay in low lying areas.	Sep-Nov	Unlikely
Diplolaena andrewsii	EN	EN	P	Granite outcrops & hillsides.	Jul-Oct	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Drakaea elastica	CR	EN	PG	Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps. Typically in banksia woodland or thickets of Kunzea glabrescens.	late Sep-Oct	Unlikely
Eucalyptus leprophloia	EN	EN	P	White or grey sand over laterite. Valley slopes.	Aug-Oct	Unlikely
Eucalyptus x balanites	CR	EN	P	Light coloured sandy soils over laterite. Habitat consists of gently sloping heathlands; open mallee woodland over shrubland (Population 2) or heathland with emergent mallees (population 1)	Oct - Feb	Unlikely
Grevillea christineae	EN	EN	P	Clay loam, sandy clay, often moist.	Aug-Sep	Unlikely
Grevillea corrugata	VU	EN	P	Gravelly loam. Roadsides.	Aug-Sep	Unlikely
Grevillea curviloba subsp. curviloba	CR	EN	P	Winter wet, deep peaty grey sands over limestone at depth.	Sep-Oct	Unlikely
Thelymitra dedmaniarum	CR	EN	PG	Red brown sandy loam with dolerite and granite outcrops.	Oct-Nov	Unlikely
Thelymitra stellata	EN	EN	PG	Sandy loam, clay or gravel over laterite or gravel.	Sep-Nov	Unlikely
Trithuria occidentalis	CR	EN	A	Partly submerged on the edge of shallow winter-wet clay pans in very open shrubland.	Oct-Nov	Unlikely
Grevillea althoferorum subsp. fragilis	CR	CR	P	Greyish-yellow colluvial sand at the base of the Darling Scarp.	Sep-Nov	Unlikely
Calectasia cyanea	CR	CR	P	Heathland on white sand or laterite gravel over laterite. Known only from one population near Albany.	Jun-Oct	Unlikely
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	CR	P	Low woodland on grey, clayey sand with lateritic pebbles (Pinjarra Plain) near winter wet flats.	Sep-Nov	Unlikely
Hydrocotyle striata	P1	-	A	Sand and clay in springs and creeklines.	Nov	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Calectasia elegans	P2	-	P	Grey yellow sand on plains.	Sep-Oct	Unlikely
Poranthera moorokatta	P2	-	A	Sandy or clay soils. Dampland or low sandy dunes.	Oct or Feb	Unlikely
Cyathochaeta teretifolia	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan	Unlikely
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	P3	-	P	Grey brown sand or clay in winter wet flats.	Sep-Nov	Unlikely
Guichenotia tuberculata	P3	-	P	Sand clay over laterite, sand	Aug-Oct	Unlikely
Haemodorum loratum	P3	-	P	Grey or yellow sand, gravel.	Nov	Unlikely
Persoonia rudis	P3	-	P	White, grey or yellow sand, often over laterite.	Dec-Jan	Unlikely
Platysace ramosissima	P3	-	P	Sandy soils.	Oct-Nov	Unlikely
Schoenus sp. Waroona (G.J. Keighery 12235)	P3	-	A	Clay or sandy clay. Winter-wet flats.	Oct-Nov	Unlikely
Stylidium aceratum	P3	-	A	Sandy soils in swamp heathland.	Oct-Nov	Unlikely
Styphelia filifolia	P3	-	P	Brown over pale yellow sand.	Feb-Apr	Unlikely
Verticordia serrata var. linearis	P3	-	P	White sand, gravel.	Sep-Oct	Unlikely
Hypolaena robusta	P4	-	P	White sand. Sandplains.	Sep-Oct	Unlikely
Schoenus natans	P4	-	A	Aquatic, in winter-wet	Oct	Unlikely
Acacia oncinophylla	P3	-	P	Granitic soils	Aug-Oct	Unlikely
Adenanthos cygnorum	P3	-	P	Grey sand, lateritic gravel.	Jul or Sep to	Unlikely
Beaufortia purpurea	P3	-	P	Lateritic or granitic soils on rocky slopes.	Oct-Feb	Unlikely
Chamaescilla gibsonii	P3	-	P	Clay to sandy clay in winter-wet	Sep	Unlikely
Cyanicula ixioides subsp. ixioides	P4	-	P	Laterite, gravel.	Aug-Oct	Unlikely
Darwinia pimelioides	P4	-	P	Loam, sandy loam on granite	Sep-Oct	Unlikely
Drosera occidentalis	P4	-	P	Flat, brown/white/yellow moist sand/clay/peat, often near swamps.	Oct-Dec/Jan	Unlikely
Halgania corymbosa	P3	-	P	Gravelly soils, soils over granite.	Aug-Nov	Unlikely
Hydrocotyle lemnoides	P4	-	A	Floating in swamps.	Aug-Oct	Unlikely

Species name	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	WA	EPBC Act				
Lasiopetalum glutinosum subsp. glutinosum	P3	-	P	Brown clay loam on slopes	Sep-Dec	Unlikely
Meionectes tenuifolia	P3	-	P	Clay loam in seasonally wet	Oct-Dec	Unlikely
Millotia tenuifolia var. laevis	P2	-	A	Granite or lateritic soils.	Sep-Oct	Unlikely
Oxymyrrhine coronata	P4	-	P	Brown loam/laterite on slopes.	Oct-Dec	Unlikely
Persoonia sulcata	P4	-	P	Lateritic or granitic soils.	Sep-Nov	Unlikely
Phlebocarya pilosissima subsp. pilosissima	P3	-	P	White or grey sand, lateritic gravel.	Aug-Oct	Unlikely
Schoenus capillifolius	P3	-	A	Brown mud in claypans	Oct-Nov	Unlikely
Schoenus sp. Bullsbrook (J.J. Alford 915)	P2	-	P	Grey peaty sand. Low-lying flats	Oct	Unlikely
Stylidium longitubum	P4	-	A	Sandy clay, clay. Seasonal wetlands.	Oct-Dec	Unlikely
Stylidium paludicola	P3	-	P	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland	Oct-Dec	Unlikely
Stylidium squamellosum	P2	-	P	Brown to red-brown clay loam in winter-wet habitats and depressions.	Oct-Nov	Unlikely
Stylidium trudgenii	P3	-	P	Grey sand, dark grey to black sandy peat. Margins of winter-wet swamps, depressions	Sep-Jan	Unlikely
Tetraria sp. Chandala (G.J. Keighery 17055)	P2	-	P	Black peat in swamps.	Sep-Feb	Unlikely
Tetratheca pilifera	P3	-	P	Gravelly soils.	Aug-Oct	Unlikely

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

Appendix C

Conservation Significant Communities and Likelihood of Occurrence Assessment

Code	Community name	TEC/ PEC	Level of significance		Likelihood of occurrence
			State	EPBC Act	
Mound Springs SCP	Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	TEC	CR	EN	Does not occur
SCP3a	*Corymbia calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain	TEC	CR	EN	Does not occur
SCP3c	*Corymbia calophylla - Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain	TEC	CR	EN	Does not occur
MUCHEA LIMESTONE	Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain	TEC	EN	EN	Likely
SCP07	Herb rich saline shrublands in clay pans	TEC	VU	Critically endangered (Clay Pans of the Swan Coastal	Does not occur
SCP08	Herb rich shrublands in clay pans	TEC	VU		Does not occur
SCP22	*Banksia ilicifolia* woodlands	TEC/ PEC	P3	Endangered (Banksia Woodlands of the Swan Coastal Plain)	Does not occur
SCP21c	Low lying *Banksia attenuata* woodlands or shrublands	TEC/ PEC	P3		Does not occur
SCP23b	Swan Coastal Plain *Banksia attenuata - Banksia menziesii* woodlands	TEC/ PEC	P3		Does not occur
SCP15	Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain	TEC	VU	-	Does not occur
SCP18	Shrublands on calcareous silts of the Swan Coastal Plain	TEC	VU	-	Does not occur
	Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain	TEC/ PEC	P3	CR	Does not occur

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

Appendix D

Species List

Family	Status	Species
Anarthriaceae		
		Lyginia barbata
Anacardiaceae		
	*	*Schinus terebinthifolia*
Araceae		
		Lemna sp.
	*DP	*Zantedeschia aethiopica*
Asparagaceae		
		Acanthocarpus canaliculatus
		Laxmannia squarrosa
		Sowerbaea laxiflora
		Thysanotus arenarius
		Thysanotus manglesianus
Asteraceae		
	*	*Arctotheca calendula*
	*	*Cotula coronopifolia*
	*	*Erigeron bonariensis*
	*	*Hypochaeris radicata*
	*	*Lactuca serriola*
		Siloxerus humifusus
	*	*Sonchus oleraceus*
	*	*Symphyotrichum squamatum*
	*	*Ursinia anthemoides*
Campanulaceae		
		Lobelia anceps
Casuarinaceae		
		Allocasuarina fraseriana
		Casuarina obesa
Centrolepidaceae		
		Aphelia cyperoides
		Centrolepis aristata
Chenopodiaceae		
	*	*Atriplex prostrata*
Colchicaceae		
		Burchardia multiflora
Cyperaceae		
		Baumea juncea
		Caustis dioica
		Cyathochaeta avenacea
		Bolboschoenus caldwellii
		Cyperus congestus
		Cyperus tenuiflorus
		Eleocharis acuta
		Isolepis cernua
		Isolepis marginata
		Schoenus grammatophyllus
Droseraceae		
		Drosera ?glanduligera

Family	Status	Species
		Drosera menziesii
Euphorbiaceae		
	*	*Euphorbia peplus*
Fabaceae		
		Acacia pulchella var. pulchella
		Acacia saligna
		Jacksonia sternbergiana
		Labichea punctata
	*	*Lotus angustissimus*
	*	*Lotus subbiflorus*
	*	*Trifolium arvense*
		Viminaria juncea
	*	*Vitis sp.*
Geraniaceae		
	*	*Pelargonium capitatum*
Goodeniaceae		
		Dampiera linearis
		Scaevola lanceolata
Haemodoraceae		
		Anigozanthos viridis
		Conostylis aculeata
		Tribonanthes australis
Hemerocallidaceae		
		Caesia micrantha
		Corynotheca micrantha
		Dianella revoluta var. divaricata
		Tricoryne elatior
Iridaceae		
	*	*Hesperantha falcata*
	*DP	*Moraea flaccida*
	*	*Romulea rosea*
	*	*Sparaxis bulbifera*
	*	*Watsonia meriana var. bulbillifera*
Juncaceae		
		Juncus pallidus
		Juncus kraussii subsp. australiensis
Lauraceae		
		Cassytha sp.
Lythraceae		
	*	*Lythrum hyssopifolia*
Myrtaceae		
	*Pl	*Callistemon sp.*
		Calothamnus quadrifidus
		Corymbia calophylla
		Eremaea pauciflora
	*Pl	*Eucalyptus gomphocephala*
	*Pl	*Eucalyptus leucoxylon rosea*
		Eucalyptus rudis

Family	Status	Species
		Eucalyptus wandoo
		Hypocalymma sp.
		Melaleuca huegelii
		Melaleuca lateritia
		Melaleuca preissiana
		Melaleuca rhaphiophylla
		Melaleuca viminea
		Regelia ciliata
		Verticordia sp.
Nyctaginaceae		
	*	*Bougainvillea sp.*
Oleaceae		
	*	*Olea europaea*
Orchidaceae		
		Microtis media
Oxalidaceae		
	*	*Oxalis purpurea*
Papaveraceae		
	*	*Fumaria capreolata*
Plantaginaceae		
	*	*Misopates orontium*
Poaceae		
		Amphibromus nervosus
		Austrostipa sp.
	*	*Avena barbata*
	*	*Briza maxima*
	*	*Bromus diandrus*
	*	*Bromus hordeaceus*
	*	*Cenchrus clandestinus*
	*	*Chloris gayana*
	*	*Cynodon dactylon*
	*	*Ehrharta calycina*
	*	*Ehrharta longiflora*
	*	*Eragrostis curvula*
	*	*Hyparrhenia hirta*
	*	*Lolium rigidum*
	*	*Paspalum sp.*
	*	*Phalaris sp.*
	*	*Polypogon monspeliensis*
Polygonaceae		
	*	*Rumex crispus*
Proteaceae		
		Banksia dallanneyi
		Banksia telmatiaea
	*Pl	*Grevillea crithmifolia*
		Grevillea obtusifolia
	*Pl	*Grevillea olivacea*
	Pl	*Grevillea thelemanniana*

Family	Status	Species
		Petrophile ?media
		Stirlingia latifolia
Restionaceae		
		Desmocladus flexuosus
		Leptocarpus canus
Rubiaceae		
		Opercularia vaginata
Scrophulariaceae		
		Eremophila glabra
Solanaceae		
	*	*Solanum nigrum*
Surianaceae		
		Stylobasium australe
Xanthorrhoeaceae		
		Xanthorrhoea preissii

*=non-native, Pl=planted, DP=declared pest under the BAM Act

Appendix E

Species x Plant Community Matrix

		Plant community											
Status	**Species name**	**As**	**AsGoAc**	**Bj**	**Cc**	**CcM**	**Co**	**EcTaCa**	**ErMr**	**Ew**	**M**	**Mixed**	**Non-native**
	Acacia pulchella var. pulchella												X
	Acacia saligna	X	X	X									
	Acanthocarpus canaliculatus		X										
	Allocasuarina fraseriana												X
	Amphibromus nervosus												X
	Anigozanthos viridis		X										
	Aphelia cyperoides		X										
*	*Arctotheca calendula*				X		X						X
*	*Atriplex prostrata*								X				X
	Austrostipa sp.												X
*	*Avena barbata*												X
	Banksia dallanneyi		X										
	Banksia telmatiaea		X										
	Baumea juncea			X		X							
	Bolboschoenus caldwellii												X
*	*Bougainvillea sp.*												X
*	*Briza maxima*												X
*	*Bromus diandrus*	X				X					X	X	X
*	*Bromus hordeaceus*												X
	Burchardia multiflora		X										
	Caesia micrantha		X										
Pl*	*Callistemon sp.*											X	
	Calothamnus quadrifidus											X	
	Cassytha sp.		X										
	Casuarina obesa						X						X
	Caustis dioica		X	X									
*	*Cenchrus clandestinus*												X
	Centrolepis aristata							X					
*	*Chloris gayana*												X
	Conostylis aculeata		X										
*	*Conyza bonariensis*												X
	Corymbia calophylla				X	X						X	
	Corynotheca micrantha		X										
*	*Cotula coronopifolia*						X						X
	Cyathochaeta avenacea		X										
*	*Cynodon dactylon*			X	X			X	X				X
*	*Cyperus congestus*								X				
*	*Cyperus tenuiflorus*												X
	Dampiera linearis		X										
	Desmocladus flexuosus		X										
	Dianella revoluta var. divaricata	X	X										
	Drosera menziesii							X					

		Plant community											
Status	**Species name**	**As**	**AsGoAc**	**Bj**	**Cc**	**CcM**	**Co**	**EcTaCa**	**ErMr**	**Ew**	**M**	**Mixed**	**Non-native**
	Drosera ?glanduligera		X										
	Drosera menziesii		X										
*	*Ehrharta calycina*	X	X									X	X
*	*Ehrharta longiflora*						X						X
	Eleocharis acuta												X
*	*Eragrostis curvula*		X					X			X	X	X
	Eremaea pauciflora		X										
Pl*	*Eremophila glabra*											X	
Pl*	*Eucalyptus gomphocephala*												X
Pl*	*Eucalyptus leucoxylon rosea*											X	
	Eucalyptus rudis								X			X	X
	Eucalyptus wandoo									X			
*	*Euphorbia peplus*												X
*	*Fumaria capreolata*												X
Pl	*Grevillea crithmifolia*											X	
	Grevillea obtusifolia		X										
Pl*	*Grevillea olivacea*											X	
Pl	*Grevillea thelemanniana*											X	
*	*Hesperantha falcata*												X
*	*Hyparrhenia hirta*												X
	Hypocalymma sp.									X			
*	*Hypochaeris radicata*		X										
	Isolepis cernua						X						
	Isolepis marginata												X
	Jacksonia sternbergiana		X										X
	Juncus pallidus								X				X
	Juncus kraussii subsp. austr aliensis												X
	Labichea punctata										X		
*	*Lactuca serriola*												X
	Laxmannia squarrosa		X										
	Lemna sp.												X
	Leptocarpus canus							X					
	Lobelia anceps								X				X
*	*Lolium rigidum*		X				X						
*	*Lotus subbiflorus*						X						
*	*Lotus angustissimus*						X						X
	Lyginia barbata		X										
	Lythrum hyssopifolia						X						
	Melaleuca huegelii					X							
	Melaleuca lateritia										X		
	Melaleuca preissiana										X		
	Melaleuca rhaphiophylla								X		X		
	Melaleuca viminea												X

		Plant community											
Status	**Species name**	**As**	**AsGoAc**	**Bj**	**Cc**	**CcM**	**Co**	**EcTaCa**	**ErMr**	**Ew**	**M**	**Mixed**	**Non-native**
	Microtis media		X										
*	*Misopates orontium*												X
*DP	*Moraea flaccida*						X		X				X
*	*Olea europaea*											X	
	Opercularia vaginata		X										
*	*Oxalis purpurea*						X						
*	*Paspalum sp.*												X
*	*Pelargonium capitatum*												X
	Petrophile ?media		X										
*	*Phalaris sp.*												X
*	*Polypogon monspeliensis*						X						
	Regelia ciliata		X										
*	*Romulea rosea*												X
*	*Rumex crispus*						X		X				X
	Scaevola lanceolata		X										
*	*Schinus terebinthifolia*											X	
	Schoenus grammatophyllus		X										
	Siloxerus humifusus		X										
*	*Solanum nigrum*												X
*	*Sonchus oleraceus*												X
	Sowerbaea laxiflora		X										
*	*Sparaxis bulbifera*												X
	Stirlingia latifolia		X										
	Stylobasium australe		X										
*	*Symphyotrichum squamatum*								X				X
	Thysanotus arenarius		X										
	Thysanotus manglesianus		X										
	Tribonanthes australis							X					
	Tricoryne elatior		X										
*	*Trifolium arvense*												X
*	*Ursinia anthemoides*		X										X
	Verticordia sp.		X										
	Viminaria juncea										X		
*	*Vitis sp.*												X
*	*Watsonia meriana var. bulbillifera*		X										X
	Xanthorrhoea preissii		X										X
*DP	*Zantedeschia aethiopica*						X				X		

*=non-native, Pl=planted, DP=declared pest under the BAM Act

Appendix F

Sample Data

Vegetation Sample Data

Stock Road and Adjacent Lots, Bullsbrook

Sample Name: R1

Project no.: EP20-089
Date: 18/08/2020, 30/09/2020, 9/10/2020, 10/11/2020
Author: RAW
Status Non-permanent

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	405277.02	NW corner northing:	6492543.6
Altitude (m):	0	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	damp	Landform:	flat
Time since fire:	no evidence	Disturbance:	low - Weeds
Soil type/texture	sand	Bare ground (%):	1
Rocks (%) and type:	No rocks	Soil colour:	white/grey
Litter:	15% (leaves,twigs,)	Vegetation condition:	very good

Vegetation Sample Data

Stock Road and Adjacent Lots, Bullsbrook

Sample Name: R1

Project no.: EP20-089
Date: 18/08/2020, 30/09/2020, 9/10/2020, 10/11/2020
Status Non-permanent
Author: RAW

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia saligna
	Acanthocarpus canaliculatus
	Banksia telmatiaea
	Caesia micrantha
	Cassytha sp.
	Caustis dioica
	Conostylis aculeata
	Corynotheca micrantha
	Cyathochaeta avenacea
	Dianella revoluta var. divaricata
*	*Ehrharta calycina*
*	*Eragrostis curvula*
	Eremaea pauciflora
	Grevillea obtusifolia
*	*Hypochaeris radicata*
	Jacksonia sternbergiana
	Lyginia barbata
	Microtis media
	Opercularia vaginata
	Regelia ciliata
	Scaevola lanceolata
	Siloxerus humifusus
	Sowerbaea laxiflora
	Stylobasium australe
	Thysanotus manglesianus
	Tricoryne elatior
	Verticordia sp.
	Watsonia meriana var. bulbillifera
	Xanthorrhoea preissii

Vegetation Sample Data

Stock Road and Adjacent Lots, Bullsbrook

Sample Name: R2

Project no.: EP20-089
Date: 18/08/2020, 30/09/2020, 9/10/2020, 10/11/2020
Author: RAW
Status Non-permanent

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	405284.48	NW corner northing:	6492531.29
Altitude (m):	0	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	damp	Landform:	flat
Time since fire:	no evidence	Disturbance:	moderate - Weeds
Soil type/texture	sand	Bare ground (%):	5
Rocks (%) and type:	No rocks	Soil colour:	white/grey
Litter:	20% (leaves,,)	Vegetation condition:	good

Vegetation Sample Data

Stock Road and Adjacent Lots, Bullsbrook

Sample Name: R2

Project no.: EP20-089
Date: 18/08/2020, 30/09/2020, 9/10/2020, 10/11/2020
Status Non-permanent
Author: RAW

Species Data

* denotes non-native species

Status	Confirmed name
	Acacia saligna
	Acanthocarpus canaliculatus
	Anigozanthos viridis
	Burchardia multiflora
	Conostylis aculeata
	Corynotheca micrantha
	Dampiera linearis
	Dianella revoluta var. divaricata
	Drosera menziesii
*	*Ehrharta calycina*
*	*Eragrostis curvula*
	Eremaea pauciflora
	Grevillea obtusifolia
*	*Hypochaeris radicata*
	Laxmannia squarrosa
	Leptocarpus canus
*	*Lolium rigidum*
	Lyginia barbata
	Petrophile ?media
	Scaevola lanceolata
	Schoenus grammatophyllus
	Stirlingia latifolia
	Thysanotus arenarius
	Thysanotus manglesianus
	Tribonanthes australis
*	*Ursinia anthemoides*
	Watsonia meriana var. bulbillifera
	Xanthorrhoea preissii

Vegetation Sample Data

Stock Road and Adjacent Lots, Bullsbrook

Sample Name: R3

Project no.: EP20-089

Date: 9/10/2020 **Status** Non-permanent

Author: RAW

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	407762.38	NW corner northing:	6492441.36
Altitude (m):	0	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	damp	Landform:	flat
Time since fire:	> 5 yrs	Disturbance:	high - Grazing, clearing, weeds
Soil type/texture	clay/sand	Bare ground (%):	1
Rocks (%) and type:	No rocks	Soil colour:	brown
Litter:	5% (leaves,,)	Vegetation condition:	degraded

Vegetation Sample Data

Stock Road and Adjacent Lots, Bullsbrook

Sample Name: R3

Project no.: EP20-089

Date: 9/10/2020 **Status** Non-permanent

Author: RAW

Species Data

* denotes non-native species

Status	Confirmed name
*	*Arctotheca calendula*
	Casuarina obesa
*	*Cotula coronopifolia*
*	*Ehrharta longiflora*
	Isolepis cernua
*	*Lolium rigidum*
*	*Lotus subbiflorus*
*	*Lotus angustissimus*
	Lythrum hyssopifolia
*DP	*Moraea flaccida*
*	*Oxalis purpurea*
*	*Polypogon monspeliensis*
*	*Rumex crispus*
*DP	*Zantedeschia aethiopica*

Vegetation Sample Data

Stock Road and Adjacent Lots, Bullsbrook

Sample Name: R4

Project no.: EP20-089

Date: 9/10/2020 **Status** Non-permanent

Author: RAW

Quadrat and landform details

Sample type:	releve	Size:	other
NW corner easting:	407093.82	NW corner northing:	6492544.88
Altitude (m):	0	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	saturated	Landform:	waterway
Time since fire:	no evidence	Disturbance:	moderate - Grazing, clearing, weeds
Soil type/texture	sand	Bare ground (%):	60
Rocks (%) and type:	No rocks	Soil colour:	white/grey
Litter:	20% (leaves,branches,bark)	Vegetation condition:	degraded

Vegetation Sample Data

Stock Road and Adjacent Lots, Bullsbrook

Sample Name: R4

Project no.: EP20-089

Date: 9/10/2020 **Status** Non-permanent

Author: RAW

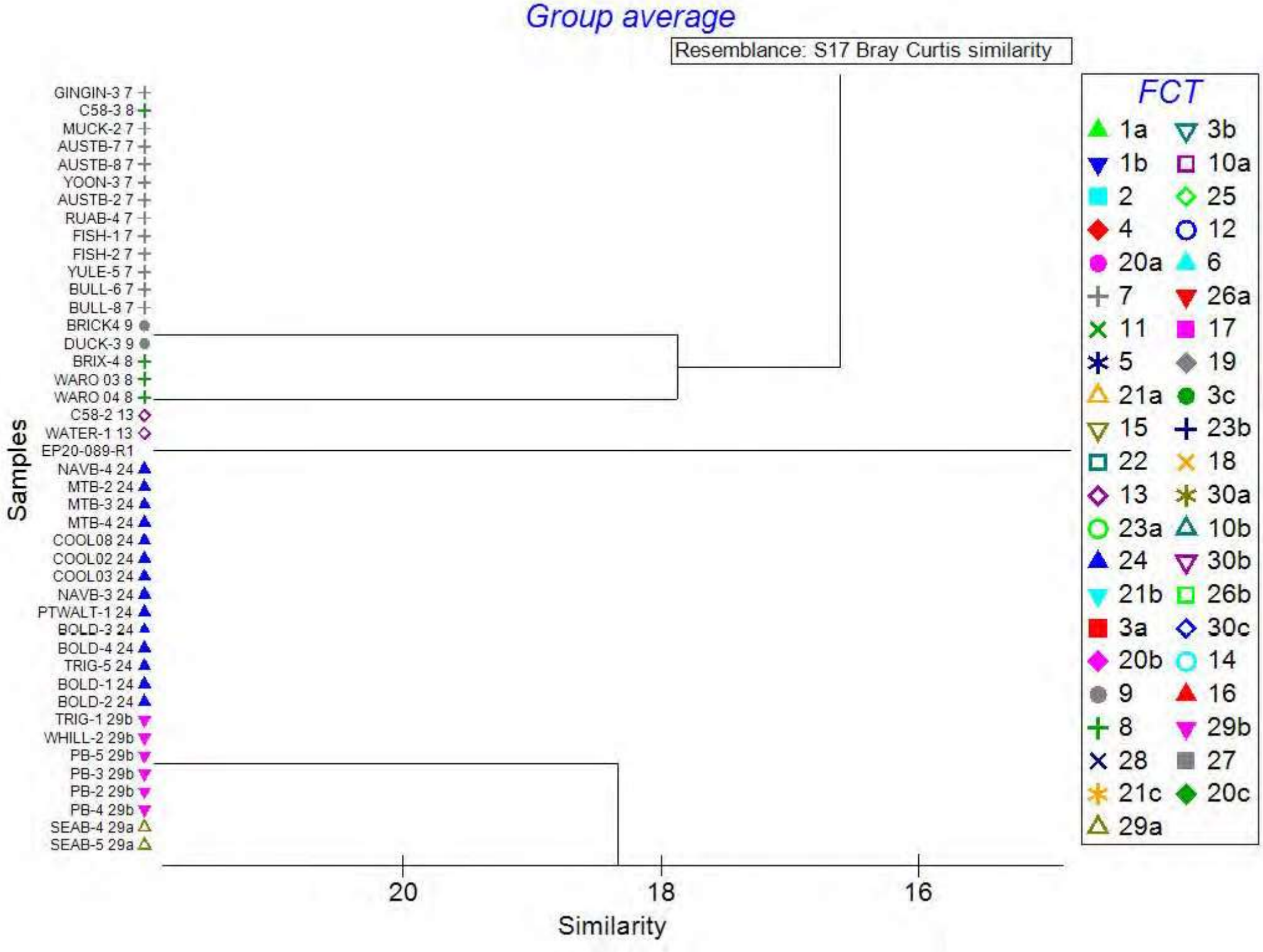
Species Data

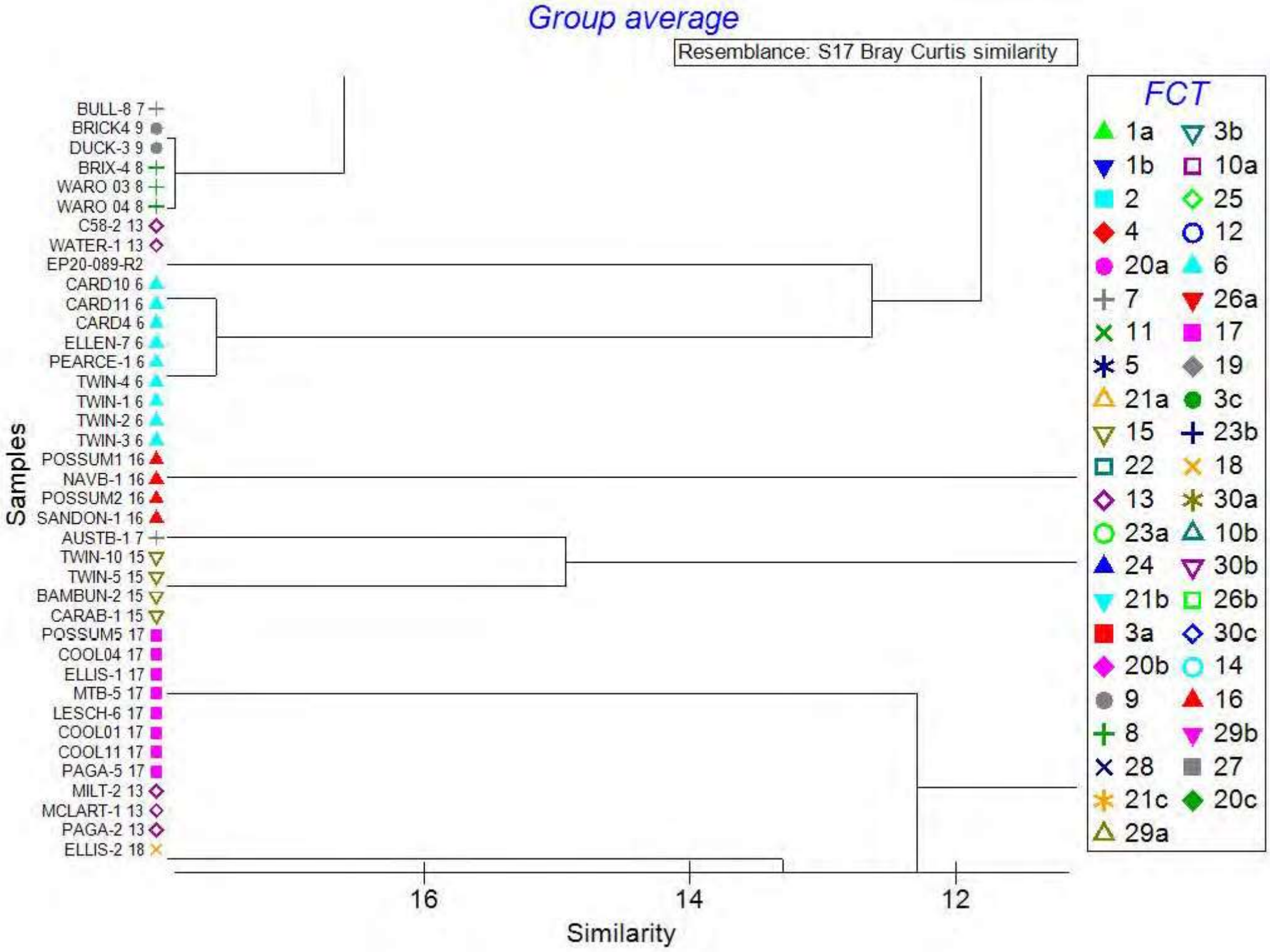
* denotes non-native species

Status	Confirmed name
*	*Atriplex prostrata*
*	*Cynodon dactylon*
*	*Cyperus congestus*
	Eucalyptus rudis
	Juncus pallidus
	Lobelia anceps
	Melaleuca rhaphiophylla
*DP	*Moraea flaccida*
*	*Rumex crispus*
*	*Symphyotrichum squamatum*

Appendix G

Cluster Dendrograms


Group average
Resemblance: S17 Bray Curtis similarity
GINGIN-3 7
C58-3 8
MUCK-2 7
AUSTB-7 7
AUSTB-8 7
YOON-3 7
AUSTB-2 7
RUAB-4 7
FISH-1 7
FISH-2 7
YULE-5 7
BULL-6 7
BULL-8 7
BRICK4 9
DUCK-3 9
BRIX-4 8
WARO 03 8
WARO 04 8
C58-2 13
WATER-1 13
EP20-089-R1
NAVB-4 24
MTB-2 24
MTB-3 24
MTB-4 24
COOL08 24
COOL02 24
COOL03 24
NAVB-3 24
PTWALT-1 24
BOLD-3 24
BOLD-4 24
TRIG-5 24
BOLD-1 24
BOLD-2 24
TRIG-1 29b
WHILL-2 29b
PB-5 29b
PB-3 29b
PB-2 29b
PB-4 29b
SEAB-4 29a
SEAB-5 29a
Samples
20
18
16
Similarity
FCT
1a
3b
1b
10a
2
25
4
12
20a
6
7
26a
11
17
5
19
21a
3c
15
23b
22
18
13
30a
23a
10b
24
30b
21b
26b
3a
30c
20b
14
9
16
8
29b
28
27
21c
20c
29a


Group average
Resemblance: S17 Bray Curtis similarity
BULL-8 7
BRICK4 9
DUCK-3 9
BRIX-4 8
WARO 03 8
WARO 04 8
C58-2 13
WATER-1 13
EP20-089-R2
CARD10 6
CARD11 6
CARD4 6
ELLEN-7 6
PEARCE-1 6
TWIN-4 6
TWIN-1 6
TWIN-2 6
TWIN-3 6
POSSUM1 16
NAVB-1 16
POSSUM2 16
SANDON-1 16
AUSTB-1 7
TWIN-10 15
TWIN-5 15
BAMBUN-2 15
CARAB-1 15
POSSUM5 17
COOL04 17
ELLIS-1 17
MTB-5 17
LESCH-6 17
COOL01 17
COOL11 17
PAGA-5 17
MILT-2 13
MCLART-1 13
PAGA-2 13
ELLIS-2 18
Samples
16
14
12
Similarity
FCT
1a
3b
1b
10a
2
25
4
12
20a
6
7
26a
11
17
5
19
21a
3c
15
23b
22
18
13
30a
23a
10b
24
30b
21b
26b
3a
30c
20b
14
9
16
8
29b
28
27
21c
20c
29a

Appendix H

Wetland Evaluation Documentation – UFI 12433

PRELIMINARY EVALUATION CRITERIA

CCW UFI No. 12433

No.	Criteria	Y/N
1	The wetland is currently recognised as internationally or nationally significant for its natural values. Lists/registers include:	
	The Ramsar Convention on Wetlands	N
	State government endorsed candidate sites for the Ramsar Convention on Wetlands	N
	Directory of Important Wetlands in Australia	N
	National Heritage List	N
	Or equivalent.	
2	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is identified as significant for its natural values under one or more of the following:	
	Conservation Reserves for Western Australia Systems 1, 2, 3, 5	N
	Conservation Reserves for Western Australia, The Darling System – System 6	N
	A Systematic Overview of Environmental Values of the Wetlands, Rivers and Estuaries of the Busselton – Walpole Region	N
	The Environmental Significance of Wetlands in the Perth to Bunbury Region	N
	Bush Forever, Swan Bioplan (including *Peel Regionally Significant Natural Area* s) or equivalent.	N
3	The wetland supports a breeding, roosting, or refuge site or a critical feeding site for populations of fauna listed by the Australian Government (for example, *Environment Protection and Biodiversity Conservation Act 1999* , migratory bird agreements such as JAMBA, CAMBA and RoKAMBA) or the State (for example, threatened and specially protected fauna listed under the *Wildlife Conservation Act 1950*).	N
4	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and supports one or more of the following:	
	An occurrence of a Threatened Ecological Community	N
	A confirmed occurrence of a Priority 1 or Priority 2 Ecological Community	N
	A confirmed occurrence of a Declared Rare (Threatened) flora species.	N
5	Equal to or greater than 90% of the wetland supports vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B.	N
6	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and is known to support internationally, nationally or state-wide scientific values including geoheritage and geoconservation.	N
7	The wetland is spatially dominated by vegetation in a good or better condition using the vegetation condition scale outlined in Appendix B and meets one of the following:	
	≤10% of wetlands of the same type are assigned Conservation management category within the Swan Coastal Plain (by area)	N
	≤10% of all wetlands in the same consanguineous suite are assigned Conservation management category (by area)	N
	≤10% of wetlands of the same type in its consanguineous suite are assigned Conservation management category (by area)	N
	best representative of its type within its consanguineous suite domain.	N

Note: If a wetland does not satisfy any of the above preliminary evaluation criteria or, does satisfy the preliminary evaluation criteria but is not considered to be commensurate with the values of a Conservation management category wetland then a secondary evaluation including a full site assessment is required. Refer to Step 3 and 4 of the evaluation procedure which indicates the process for conducting a secondary evaluation.

Result	**Secondary evaluation required**

DBCA *A methodology for the evaluation of wetlands on the Swan Coastal Plain, WA* (December 2017)

SECONDARY EVALUATION CRITERIA

CCW UFI No. 12433

Attributes/ functions/ values	General criteria	Number	Criteria	Y/N	Score
Geomorphology	Representative-ness	1	≤20% of wetlands of the same type are assigned Conservation on the Swan Coastal Plain by area.	Y	**H**
		2	≤20% of wetlands in the same consanguineous suite are assigned Conservation by area.	Y	**H**
		3	≤20% of wetlands of the same type in the same consanguineous suite are assigned Conservation by area.	Y	**H**
		4	The wetland is outstanding in some geomorphic aspect, for example size, origin, height relative to sea level, depth, age.	N	
	Naturalness	5	Alteration to the wetland's geomorphology by % area: < 25% altered (=H) 25-75% altered (=I) > 75% altered. (=L)	 N Y N	**I**
	Scarcity	6	The wetland exhibits unusual geomorphology or unusual internal geomorphic features compared to other wetlands of the same type in the consanguineous suite.	N	
		7	The wetland is the best example of its type in its consanguineous suite.	N	
Wetland processes	Representative-ness	8	The wetland is an important component of the natural hydrological cycle providing natural functions (e.g. flood protection and recharge/discharge). The wetland's vegetation, geomorphology, hydrology or sediments are modified; however, the wetland is still a component of the hydrological cycle providing natural and artificial functions (e.g. flood remediation, recharge/discharge and hydrological storage). The wetland's vegetation, geomorphology, hydrology or sediments are modified to the extent that the wetlands hydrological functions are artificial such as storage, or the wetland has been disconnected from the natural hydrological cycle and no longer provides natural attributes and functions.	N Y N	**I**
		9	The wetland supports a representative process (e.g. wetland process typical of the wetland's hydrological setting, sediment accretionary process typical of the wetland's geomorphic setting or hydrochemical process typical of the wetland's geological setting).	N	
			The wetland is not subject to altered wetland processes or, is subject to altered wetland processes and the wetland's natural attributes and functions are maintained.	N	

SECONDARY EVALUATION CRITERIA

CCW UFI No. 12433

Attributes/ functions/ values	General criteria	Number	Criteria	Y/N	Score
	Naturalness	10	The wetland is subject to altered wetland processes and the wetland's natural attributes and functions have been changed; however, they have the potential to be rehabilitated. The wetland is subject to altered wetland processes to the extent that the wetland no longer supports natural attributes and functions.	Y N	I
	Scarcity	11	The wetland exhibits unusual processes (e.g. hydrological, sedimentological, chemical, biological) compared to other wetlands of the same type in the consanguineous suite.	N	
Linkages	Representative-ness	12	The wetland is a hydrological link in a larger or more complex and intact system.	N	
	Naturalness	13	The wetland is part of a continuous ecological linkage or wildlife corridor, or a regionally significant ecological linkage or wildlife corridor connecting bushland or wetland areas. The wetland is part of a fragmented ecological linkage or wildlife corridor. The wetland is disturbed and isolated, surrounded by either a built or highly disturbed environment with no nearby native vegetation or waterways to support an intact or fragmented ecological linkage or wildlife corridor.	N Y N	I
	Scarcity	14	The wetland has unusual hydrological, hydrochemical or ecological linkages with adjacent wetland or bushland.	N	
Habitats	Representative-ness	15	The wetland is isolated from other undisturbed wetlands or bushland and as a result, maintains important ecological or genetic fauna or flora diversity within its consanguineous suite domain.	N	
		16	The wetland contains evidence of surface water or groundwater expression that is vital for maintaining regionally significant populations of native aquatic or terrestrial flora or fauna. The wetland contains evidence of surface water or groundwater expression that is important for maintaining populations of native aquatic or terrestrial flora or fauna.	N N	
		17	The wetland provides a nursery for native fauna populations, or maintains fauna populations at a vulnerable stage of their life cycle.	N	
	Naturalness	18	The wetland supports habitats that are unaltered or the wetland has been altered and its natural habitats are maintained. The wetland supports habitats that are altered; however, the habitats are still identifiable and have the potential to be rehabilitated.	N Y	I

SECONDARY EVALUATION CRITERIA

CCW UFI No. 12433

Attributes/ functions/ values	General criteria	Number	Criteria	Y/N	Score
			The wetland is altered and as a result is no longer supporting natural habitats which can be rehabilitated.	N	
	Scarcity	19	The wetland supports habitats that are unusual compared to other wetlands of the same type on the Swan Coastal Plain.	N	
Flora	Representative-ness	20	The wetland's current diversity of native flora is similar to what would be expected in an unaltered state. The wetland supports a reduced diversity of native flora due to human induced disturbances. The wetland supports a significantly reduced diversity of native flora species due to human induced disturbances.	N N Y	L
		21	The wetland is identified in a vegetation complex (Heddle et al. 1980) which is represented by: ≤30% of the pre-European extent 30-50% of the pre-European extent.	Y n	H
	Naturalness	22	Using the vegetation condition scale outlined in Appendix B, the wetland's vegetation condition by area is: ≥ 75% Good, Very Good, Excellent or Pristine 25-75% Good, Very Good, Excellent or Pristine < 25% Good, Very Good, Excellent or Pristine.	N N Y	L
		23	The wetland or ≥ 50% of the wetland boundary is surrounded by land dominated by remnant native vegetation. The wetland or 10-50% of the wetland boundary is surrounded by land dominated by remnant native vegetation. The wetland or < 10% of the wetland boundary is surrounded by land dominated by remnant native vegetation.	N N Y	L
	Scarcity	24	The wetland supports an occurrence of Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora, or an occurrence of 3 or more significant flora taxa.	N	
		25	The wetland is likely to support Declared Rare, Priority 1, Priority 2, Priority 3 or Priority 4 flora; however, the occurrence cannot be located or its habitat has been altered and is no longer in a natural state.	N	
		26	The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	N	
		27	The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community.	N	
			The wetland is an ecological refuge for regionally significant fauna species or fauna assemblages.	N	

SECONDARY EVALUATION CRITERIA

CCW UFI No. 12433

Attributes/ functions/ values	General criteria	Number	Criteria	Y/N	Score
Fauna	Representative-ness	28	The wetland has the potential to be an ecological refuge but is disturbed and its attributes and functions require rehabilitation.	N	
		29	The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regionally significant native fauna.	N	
			The wetland supports a permanent or seasonal feeding, breeding, roosting or watering site for regional or local fauna but only in association with other surrounding natural areas.	Y	I
	Naturalness	30	The wetland's current diversity of native fauna is similar to what would be expected in an unaltered state, or the wetland supports diverse fauna compared to other wetlands of the same type.	N	
			The wetland supports a reduced diversity of fauna compared to other wetlands of the same type.	Y	I
			The wetland supports limited attributes and functions for fauna populations due to human induced disturbances.	N	
	Scarcity	31	The wetland is likely to support a breeding, roosting, refuge or feeding site for populations of fauna listed by the Commonwealth (e.g. EPBC Act 1999, JAMBA, CAMBA, RoKAMBA Agreements) or the State (e.g. Threatened or Specially Protected Fauna listed under the Wildlife Conservation Act 1950).	N	
		32	The wetland supports a breeding, roosting, refuge or feeding site for Priority 1, Priority 2, Priority 3 or Priority 4 fauna.	N	
		33	The wetland supports an occurrence of a Threatened Ecological Community, Priority 1 or Priority 2 ecological community.	N	
		34	The wetland supports an occurrence of a Priority 3 or Priority 4 ecological community or a breeding, roosting, refuge or feeding site for significant fauna.	N	
		35	The wetland or its immediate surrounds is identified for its natural values on a national or State heritage list or the wetland supports other known regional heritage values.	N	
		36	The wetland or its immediate surrounds is identified for its natural values on a municipal heritage list or the wetland supports other known local heritage values.	N	
		37	The wetland or its immediate surrounds is identified on a national, State or local list or register for its Aboriginal cultural value (e.g. Department of Aboriginal Affairs register).	N	

SECONDARY EVALUATION CRITERIA

CCW UFI No. 12433

Attributes/ functions/ values	General criteria	Number	Criteria	Y/N	Score
Cultural	Representative-ness	38	The wetland is important to the local community either nationally or state wide for its natural values.	N	
		39	The wetland is or has the potential to be a site for public or private based recreation.	N	
		40	The wetland is the subject of a recognised ecological restoration / rehabilitation project by a community group, landowner or land manager that aims to improve the wetland's natural, heritage, cultural or social values	N	
			The wetland is likely to support heritage, cultural or social values; however, the value cannot be confirmed or the value has been disturbed and are no longer as important or significant.	N	
			The wetland did support heritage, cultural or social values; however, these have been significantly disturbed and are no longer important or the values have been removed.	N	
Scientific and educational	Representative-ness	41	The wetland supports known important teaching or research characteristics and for this reason is an existing or potential education or research site. Note, the wetland must still support the relevant teaching or research characteristics.	N	
			The wetland has the potential to be used as a study or research site.	N	
			The wetland supports known scientific, geoheritage or geoconservation values.	N	

SECONDARY EVALUATION TALLY

CCW UFI No. 12433

Attributes / functions / values	Scores		
	High	Intermediate	Low
Geomorphology	3	1	0
Wetland processes	0	2	0
Linkages	0	1	0
Habitats	0	1	0
Flora	1	0	3
Fauna	0	2	0
Cultural	0	0	0
Scientific and educational	0	0	0
Max of High + Intermediate	3		
Total score	**4**	**7**	**3**
	7		
Defining attributes/functions/values	Geomorphology		
Applicable management category	**Rehabilitation potential**		

Applicable management category	**Rehabilitation potential**

Apdated from DBCA 2017

A methodology for the evaluation of wetlands on the Swan Coastal Plain, Western Australia