Reconnaissance Flora and Vegetation Assessment

Lot 9766 Sunningdale Road, Yanchep

Project No: EP19-021(01)

Prepared for Department of Finance - Building Management and Works
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Executive Summary

The Department of Finance - Building Management and Works (BMW) engaged Emerge Associates (Emerge) to undertake a flora and vegetation survey within Lot 9766 Sunningdale Road in Yanchep (referred to herein as 'the site'). The site, which is approximately 4.04 hectares (ha) in size and is bound by Sunningdale Road to the east, Moorpark Avenue to the west and north, and an oval and public open space to the south (St Andrews Park). Historic disturbance has occurred across the site including vegetation clearing and planting of native and non-native vegetation.

A botanist and an ecologist from Emerge Associates visited the site on 19 February 2019 and undertook a reconnaissance flora and vegetation survey. During the survey targeted searches were conducted for 'threatened' and 'priority' flora and an assessment was made on the type, condition and values of vegetation across the site.

Outcomes of the survey include the following:

- Non-native vegetation is present across 2.82 ha of the site.
- Remnant native vegetation is present across 1.22 ha of the site in varying levels of condition.
- A total of 36 native and 22 non-native (weed) species were recorded in the site.
- Two species recorded (**Schinus terebinthifolius* and *Macrozamia riedlei*) are listed as poisonous within the Primary School Brief (BMW 2018).
- Two individuals of the priority four species *Conostylis pauciflora* subsp. *pauciflora* were recorded in the northern portion of the site. No other threatened or priority flora species were recorded or are considered likely to occur.
- The native vegetation within the site was classified into two plant communities: **BaXpCq** and **Ll** that are present in 'very good to good', 'good', 'good to degraded' and 'degraded to completely degraded' condition:
    - Plant community **BaXpCq** includes the highest quality vegetation in the site and was most similar to 'floristic community type' (FCT) 24 'Northern Spearwood shrublands and woodlands' and FCT 28 – Spearwood *Banksia attenuata* or *Banksia attenuata – Eucalyptus* woodlands'.
    - Plant community **Ll** is highly disturbed and consists of a closed tall shrubland of **Leptospermum laevigatum* over weeds and scattered native species that is too degraded to assign to an FCT.
- The **BaXpCq** vegetation in good or better condition (0.41 ha) is likely to represent the state listed 'banksia dominated woodlands of the Swan Coastal Plain IBRA region' 'priority ecological community' (PEC).
- On the basis that the vegetation does not meet the minimum size criteria (1 ha), the 0.84 ha of plant community **BaXpCq** is not considered to represent the '*banksia woodlands of the Swan Coastal Plain*' threatened ecological community (TEC), which was recently listed as 'endangered' under the *Environment Protection and Biodiversity Conservation Act 1999*.
- The large trees present within the completely degraded portions of the site may be locally and regionally significant due to their potential as black cockatoo habitat.

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Abbreviation Tables

Table A1: Abbreviations – Organisations

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

Table A2: Abbreviations – General terms

General terms	
ESA	Environmentally sensitive area
FCT	Floristic community type
IBRA	Interim Biogeographic Regionalisation of Australia
NVIS	National Vegetation Inventory System (ESCAVI 2003)
P1	Priority 1
P2	Priority 2
P3	Priority 3
P4	Priority 4
P5	Priority 5
PEC	Priority ecological community
T	Threatened
TEC	Threatened ecological community

Table A3: Abbreviations –Legislation

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

Table A4: Abbreviations – planning

Planning terms	
DPS	District planning scheme
MRS	Metropolitan region scheme

Table A5: Abbreviations – units of measurement

Units of measurement	
cm	Centimetre
ha	Hectare
m	Metre
m^2	Square metre
m AHD	m in relation to the Australian height datum
mm	Millimetre

1 Introduction

1.1 Project background

The Department of Finance - Building Management and Works (BMW) intends to develop Lot 9766 Sunningdale Road in Yanchep as a primary school. This lot (referred to herein as 'the site') is located approximately 58 kilometres (km) north of the Perth Central Business District within the City of Wanneroo and is zoned 'urban' under the *Metropolitan Region Scheme* and 'public use' under the City of Wanneroo *District Planning Scheme (DPS) No. 2.*

The site is approximately 4.04 hectares (ha) in size and is bound by Sunningdale Road to the east, Moorpark Avenue to the west and north, and an oval and public open space to the south (St Andrews Park). The location and extent of the site is shown in **Figure 1**.

1.2 Purpose and scope of work

Emerge Associates (Emerge) were engaged by BMW to provide environmental consultancy services to support the planning process for the site. The purpose of this survey is to provide sufficient information on the flora and vegetation values within the site to inform this process.

The scope of work was specifically to undertake a flora and vegetation assessment to the standard required of a reconnaissance survey in accordance with the Environmental Protection Authority's (EPA's) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (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 and vegetation condition.
- Identification of conservation significant flora and vegetation.
- Documentation of the desktop assessment, survey methodology and results into a report.

2 Background

2.1 Environmental context

2.1.1 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 life-cycle 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 613 millimetres (mm) of rainfall is recorded annually from the Tamala Park (Mindarie) weather station, which is the closest weather station, located approximately 17.7 km from the site. The majority of this rainfall is received between the months of May and August. Mean maximum temperatures at the Gingin Aero research station, which is the nearest temperature recording station approximately 19 km north-west of the site, range from 18.3^{o}C in July to 33.5^{o}C in January and February, while mean minimum temperatures range from 6.4^{o}C in July to 17.0^{o}C in February (BoM 2019).

2.1.2 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). These dune systems, referred to as Quindalup, Spearwood and Bassendean associations, represent a succession of coastal deposition that has occurred since the late Quaternary period (approximately two million years ago) (Kendrick *et al.* 1991) and, as a result, they contain soils at different stages of leaching and formation.

Examination of broad scale soil and landform mapping places the site within the Quindalup dune system (Churchward and McArthur 1980). Finer scale mapping by Gozzard (2011) also places the site

in the Quindalup dunes, with soils consisting of tamala sands. The Quindalup dune system consists of calcareous sands on both beach ridges and parabolic dunes (Churchward and McArthur 1980).

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

2.1.3 Topography

The elevation of the site ranges from 27 m in relation to the Australian height datum (mAHD) at the southern end of the site which contains a turfed oval to 34 mAHD at the northern end of the site (DoW 2008). The eastern and western edges of the site rise to 30 mAHD on either side of the oval (**Figure 2**).

2.1.4 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 2017)
- *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 no wetland or water related features occur in or near the site.

A review of the *Geomorphic Wetlands, Swan Coastal Plain* dataset (DBCA 2018b) indicated that no geomorphic wetlands are located in or near the site.

2.1.5 Regional vegetation

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

Variations in native vegetation within the site can be further classified based on regional vegetation associations. 'Quindalup' vegetation association. This association is described as 'coastal dune complex consisting mainly of two alliances - the strand and fore dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata* - *Callitris*

preissii and the closed scrub of *Acacia rostellifera*' (Heddle *et al.* 1980). The Quindalup vegetation complex has 55.38% of its pre-European extent remaining on the Swan Coastal Plain with 20.73% protected for conservation purposes (PBP 2013).

Notably the junction between the 'Quindalup' vegetation complex and the 'Cottesloe complex – north' (forming part of the Spearwood dune system) is mapped as occurring approximately 500 m to the south east of the site. Given the proximity between the two vegetation complexes it is possible that the site is transitional between these complexes. The 'Cottesloe complex – north' vegetation complex is described as comprising 'predominantly low open forest and low woodland of *Banksia attenuata - Banksia menziesii - Eucalyptus todtiana*; closed heath on the limestone outcrops' (Heddle *et al.* 1980). The 'Cottesloe complex – north' vegetation complex has 69.5% of its pre-European extent remaining on the Swan Coastal Plain with 31.74% protected for conservation purposes (PBP 2013).

Beard *et al.* (2013) mapping shows the site as comprising the vegetation association 'Guilderton_1007'. This association is described as 'mosaic: shrublands; *Acacia lasiocarpa* & *Melaleuca acerosa* heath / shrublands; *Acacia rostellifera* & *Acacia cyclops* thicket' (Beard *et al.* 2013). The 'Guilderton_1007' association has 68.35% of its pre-European extent remaining on the Swan Coastal Plain with 5.25% protected for conservation purposes (Government of Western Australia 2018).

Similarly to the Heddle *et al.* (1980) mapping, the Beard *et al.* (2013) mapping also shows the site occurring close to the junction between the 'Guilderton_1007' and the 'Spearwood_949' vegetation association to the east. The 'Spearwood_949' association is described as 'low woodland or open low woodland' with '*Acacia* spp., *Banksia* spp., *Agonis flexuosa*, *Callitris* spp., *Allocasuarina* spp. and *Eucalyptus loxophleba*' (Beard *et al.* 2013). The 'Spearwood_949' association has 51.35% of its pre-European extent remaining on the Swan Coastal Plain with 14.12% protected for conservation purposes (Government of Western Australia 2018).

Studies have indicated that the loss of biodiversity caused by habitat fragmentation is significantly greater once a habitat type falls below 30% of its original extent (Miles 2001). The national objectives and targets for biodiversity conservation (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 percentage protected for conservation of the 'Quindalup' complex and the 'Guilderton_1007' and 'Spearwood_949' associations fall below the 30% retention objective. The 'Guilderton_1007' association also falls below the 10% retention objective. The remaining extent of the 'Cottesloe complex – north' vegetation complex is above the 30% and 10% retention objectives.

2.1.6 Historic land use

Review of historical images available from 1965 (**Plate 1**) (WALIA 2019) onwards shows that the majority of the site was cleared of native vegetation between 1965 and 1977, with the exception of a small area in the northern half of the site (**Plate 2**). Clearing is also visible in the areas directly adjacent to the site in all directions.

Planted trees are visible along the western and eastern periphery of the site by 1979. The turf present in the southern half of the site is visible by 1983 (**Plate 3**). Similarly, the northern periphery of the oval appears to have also been subject to planted trees and shrubs at this time.

A number of tracks running through the area of remnant vegetation in the northern half of the site are first visible in 2011 (**Plate 4**).

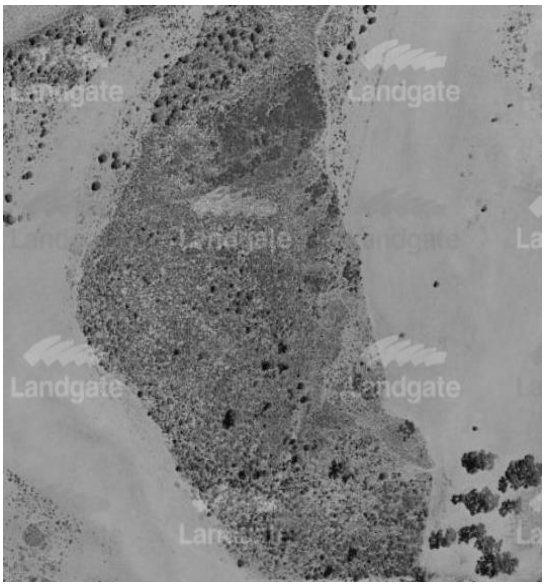

Plate 1: The site was predominantly vegetated in 1965.

Plate 2: Clearing within the site and surrounding areas was visible by 1977.

Plate 3: Planted vegetation present (particularly in southern half of the site) in 1983.

Plate 4: Tracks visible in northern half of the site in 2011.

2.2 Significant flora and vegetation

2.2.1 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' pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action likely to have a significant impact on a taxon listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment and Energy.

In Western Australia flora species may also be classed as 'threatened' under the Biodiversity *Conservation Act 2016* (BC Act). 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. Threatened flora species listed under the EPBC Act and/or BC Act are assigned a conservation status according to their national extent.

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**.

A search was conducted for threatened and priority flora within a 10 km radius of the site using the *Protected Matters Search Tool* (DoEE 2017a), *NatureMap* (DPaW 2017b) and DBCA's threatened and priority flora database (reference no. 03-0319FL). Nine threatened and 18 priority flora species were identified as potentially occurring in the wider local area as listed in **Table 1**.

Of the flora species potentially occurring in the local area, only those with habitat preferences of dry elevated sandy soils and were deemed likely to occur in the site.

On this basis one threatened flora species (*Eucalyptus argutifolia*) and 16 priority flora species were identified as having potential to occur within the site (shaded green in **Table 1**).

Table 1: Significant flora species known or likely to occur within 10 km of the site (species considered to potentially occur within the site are shaded green)

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	BC Act	EPBC Act				
Calectasia cyanea	T	CE	P	Heathland on white sand or laterite gravel over laterite.	Jun-Oct	**Unlikely**
Andersonia gracilis	T	E	P	Seasonally damp, black sandy clay flats near or on the margins of swamps.	Sep - Nov	**Unlikely**
Diuris purdiei	T	E	PG	Sand to sandy clay soils in areas subject to winter inundation.	Sep-Oct	**Unlikely**

Table 1: Significant flora species known or likely to occur within 10 km of the site (species considered to potentially occur within the site are shaded green) (cont.)

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	BC Act	EPBC Act				
Drakaea elastica	T	E	PG	Bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps.	Sept-Nov	**Unlikely**
Anigozanthos viridis subsp. *terraspectans*	T	V	P	Grey sand, clay loam. Winter-wet depressions.	Aug-Sep	**Unlikely**
Diuris micrantha	T	V	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug-Oct	**Unlikely**
Eleocharis keigheryi	T	V	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	**Unlikely**
Eucalyptus argutifolia	T	V	P	Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops	Mar-Apr	**Possible**
Lepidosperma rostratum	T	E	P	Peaty sand and clay amongst low heath, in winter-wet swamps.	May-Jun	**Unlikely**
Baeckea sp. Limestone	P1		P	Grey yellow sand over limestone.	Oct-Dec	**Possible**
Haloragis sp. Parrot Ridge	P1		P/A	Shallow brown/grey sandy loam over limestone ridge.	Sep-Dec	**Possible**
Leucopogon maritimus	P1		P	Sand dunes and lower heath. White, grey and yellow sand.	Mar	**Possible**
Acacia benthamii	P2		P	Sand, typically on limestone breakaways	Aug - sept	**Possible**
Beyeria cinerea subsp. *cinerea*	P3		P	Sand, limestone.	May-Oct	**Possible**
Calandrinia oraria	P3		A	Coastal dunes, in low heath, sand over limestone.	Aug-Oct	**Possible**
Conostylis bracteata	P3		P	Sand, limestone. Consolidated sand dunes	Aug-Sep	**Possible**
Hibbertia spicata subsp. *leptotheca*	P3		P	Sand. Near-coastal limestone ridges, outcrops & cliffs	Jul-Oct	**Possible**
Lasiopetalum membranaceum	P3		P	Sand over limestone	Sep-Dec	**Possible**
Leucopogon sp. Yanchep	P3		P	Light grey-yellow sand, brown loam, limestone, laterite, granite. Coastal plain, breakaways, valley slopes, low hills	Apr-Jun or Sep	**Possible**

Table 1: Significant flora species known or likely to occur within 10 km of the site (species considered to potentially occur within the site are shaded green) (cont.)

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	BC Act	EPBC Act				
Pimelea calcicola	P3		P	Sand, limestone, coastal ridges	Sep-Nov	**Possible**
Pithocarpa corymbulosa	P3		P	Gravelly or sandy loam, amongst granite outcrops.	Jan-Apr	**Unlikely**
Sphaerolobium calcicola	P3		P	White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Jun or Sep-Nov	**Unlikely**
Stylidium maritimum	P3		P	Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	Sep-Nov	**Possible**
Styphelia filifolia	P3		P	Brown over pale yellow sand.	Feb-April	**Possible**
Conostylis pauciflora subsp. euryrhipis	P4		P	White, grey, yellow sand on coastal consolidated dunes.	Aug-Oct	**Possible**
Conostylis pauciflora subsp. *pauciflora*	P4		P	Grey sand, limestone. Hillslopes, consolidated dunes.	Aug-Oct	**Possible**
Lepidium pseudotasmanicum	P4		P	Loam, sand.	Feb or Dec	**Possible**

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.

2.2.2 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 (DoEE 2017b). '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 section 181 of the EPBC Act. Any action likely to have a significant impact on a community listed under the EPBC Act requires approval from the Commonwealth Minister for the Environment and Energy.

TECs will also be listed within Western Australia under Section 27(1) and 33 of the BC Act and under the *Biodiversity Conservation Regulations 2018* (BC Regulations). A list of the TECs included has not yet been gazetted. The significance of TECs 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**.

Known locations of TECs and PECs within 10 km of the site were searched for using the publicly available *Weed and native flora dataset* (Keighery *et al.* 2012), *Protected Matters Search Tool* (DoEE 2019) and DBCA's threatened and priority ecological communities' database (reference no. 15-0319EC). These search results indicate no TECs or PECs are known to occur within the site, but that four TECs and two PECs occur within 10 km of the site as listed in **Table 2**.

Table 2: TECs and PECs known to occur within 10 km of the site (communities considered to be potentially present within the site shaded green).

Code	Community name	TEC/ PEC	Level of significance	
			State	EPBC Act
SCP 19b	Woodlands over sedgelands in Holocene dune swales of the southern Swan Coastal Plain	TEC	Critically Endangered	Endangered (Sedgelands in Holocene dune swales of the southern Swan Coastal Plain)
CAVES SCP01	Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain	TEC	Critically Endangered	Endangered
SCP 26a	*Melaleuca huegelii – Melaleuca systena* shrublands on limestone ridges	TEC	Endangered	-
Multiple	Banksia Woodlands of the Swan Coastal Plain	TEC	-	Endangered
Multiple	Banksia dominated woodlands of the Swan Coastal Plain IBRA region	PEC	Priority 3	-
SCP 30b	Quindalup Eucalyptus gomphocephala and/or Agonis flexuosa woodlands	PEC	Priority 3	-

Two of these six communities are considered to potentially to occur in the site based geomorphology, soils and regional vegetation patterns (shaded green in **Table 2**):

- 'banksia woodlands of the Swan Coastal Plain' TEC (endangered under EPBC Act)
- 'banksia dominated woodlands of the Swan Coastal Plain IBRA region' PEC.

2.2.3 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.

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

- The vegetation within the site has potential value as habitat for threatened or priority fauna species including, in particular, Carnaby's black cockatoo and the forest red-tailed black cockatoo, which are listed as 'vulnerable' under the EPBC Act and 'endangered' under the BC Act.

- Flora within the site are listed in Bush Forever 'significant flora' list for the Swan Coastal Plain {Government of WA, 2000 #33}.

2.2.4 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 the 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) (DoEE 2018), of which many are also listed under the BAM Act. Further information on categories of declared pests is provided in **Appendix A.**

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

2.3 Land use planning considerations

A range of legislation, regulations and polices are relevant to the evaluation of vegetation in Western Australia. Key considerations applicable to the site are described below and also shown in **Figure 3**.

2.3.1 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 2000). *Bush Forever* sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity.

No *Bush Forever* sites occur within the site. Bush Forever Site No. 288 – *Yanchep National Park and Adjacent Bushland* is located 1.7 km to the east of the site. Bush Forever Site No. 289 – *Ningana Bushland, Yanchep/Eglington* is located 1.5 km to the south and Bush Forever Site No. 397 – *Coastal Strip from Wilbinga to Mindarie* is located 2.3 km to the west of the site. The locations of the *Bush Forever* site in proximity to the site is shown in **Figure 3**.

2.3.2 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 significant, threatened or scheduled flora, vegetation communities or ecosystems. 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, including 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).

One ESA is mapped over the entirety of the site. This ESA is very large and extends to the north, south-west and east of the site over approximately 37515 hectare (ha). This ESA is likely to be associated with Bush Forever sites and the buffer zones of known TECs. The location of this ESA is shown in **Figure 3**.

2.3.3 Ecological linkages

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

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

There are no mapped ecological linkages within the site. One regional ecological linkage (No. 1) occurs approximately two km west of the site and extends beyond the site to the north and south along the coast. A second regional ecological linkage (No. 6) occurs approximately two km east of the site and extends beyond the site to the north and south. This linkage also connects to regional ecological linkage No.7 which extends north-east of the site. The linkages in the wider local area act to link native vegetation in the Yanchep National Park to vegetation to the east and north within the Gnangara-Moore River State Forest. The location of these linkages is shown in **Figure 3**.

2.4 Previous flora surveys

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

3 Methods

3.1 Field survey

A botanist and an ecologist from Emerge visited the site on 19 March 2019 to conduct the flora and vegetation assessment.

3.1.1 Vegetation

The site was traversed on foot and the composition and condition of vegetation was recorded. Searches were conducted for threatened and priority flora species with potential to occur in the site, with a particularly focus on identifying areas of suitable habitat.

Detailed sampling of the vegetation was undertaken using non-permanent 10 x 10 m quadrats. The quadrats were established using fence droppers bound by measuring tape.

A total of three locations were sampled. The position of each sample location was recorded with a hand-held GPS unit, as shown in **Figure 4**.

The data recorded within each sample included:

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

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.

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). For vegetation in the northern portion of the site containing *Banksia* spp., the condition scale provided in the conservation advice for the 'Banksia Woodlands of the Swan Coastal Plain TEC' (TSSC 2016) was applied in addition to the Keighery scale (as shown in **Table 3**).

Table 3: Vegetation condition scales applied during the field assessment

Condition category	Definition (Keighery 1994)	Indicator (TSSC 2016)	
		Typical native vegetation composition	Typical weed cover
Pristine	Pristine or nearly so, no obvious signs of disturbance.	Native plant species diversity fully retained or almost so	Zero or close to
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.	High native plant species diversity	Less than 10%
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	Moderate native plant species diversity	5-20%
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.	Low native plant species diversity	5-50%
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.	Very low native plant species diversity	20-70%
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.	Very low to no native species diversity	Greater than 70%

3.2 Mapping and data analysis

3.2.1 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 then mapped on aerial photography (1:2,000) from the sample locations and boundaries were interpreted from aerial photography and notes taken in the field. Vegetation condition was mapped on aerial photography (1:2,000) based on the locations and notes recorded during the field survey to define areas with differing condition.

3.2.2 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.

3.2.3 Threatened and priority ecological communities

Areas of native vegetation potentially representing a TEC were assessed against key diagnostic characteristics and, if available, size and/or vegetation condition thresholds provided in the *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community (TSSC 2016).*

3.3 Comparison of species list with *Primary School Brief*

The flora species occurring within the site were compared to those listed in appendices within the *Primary School Brief – Subconsultant Brief* (BMW 2018) to determine whether species are present that may be incompatible with the potential use of the site as a primary school. These documents included *Appendix D – Schedule of trees to use with caution* and *Appendix E - Schedule of poisonous plants*.

3.4 Survey limitations

It is important to note the specific constraints imposed on surveys and the degree to which these may have limited survey outcomes. An evaluation of the survey methodology against standard constraints outlined in the EPA document *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) is provided in **Table 4**.

Table 4: Evaluation of survey methodology against standard constraints outlined in EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (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.
	Minor limitation	FCT assignment was undertaken through comparison to the authoritative floristic study of the Swan Coastal Plain by Gibson *et al*. (1994). Having a regional study to compare survey results is advantageous as it provides the ability to classify vegetation to a formal scheme. However, the Gibson *et al*. (1994) data is now more than 20 years out of date and was also derived from a limited sample of vegetation that was largely located on public land. Due to the high degree of local endemism / spatial variation inherent to vegetation on the Swan Coastal Plain it is likely that the groups identified for certain FCTs in Gibson *et al*. (1994) could be further separated into a greater number of groups to better reflect differences in vegetation composition evident at finer/local scales. Limitations of Gibson *et al.* (1994) and floristic analysis generally were acknowledge and other sources of information were drawn upon to inform the classification of vegetation. The survey was undertaken once, in March (outside of the main flowering season) and thus is unlikely to capture the full suite of native species present thus the statistical analysis is not considered to be conclusive.
Experience level of personnel	No limitation	This flora and vegetation assessment was undertaken by a qualified botanist with eight years of botanical experience in Western Australia. Technical review was undertaken by a senior environmental consultant with 16 years' experience in environmental science in Western Australia.
Suitability of timing	Limitation	The survey was conducted in March and thus outside of the main flowering season. Therefore it is likely that some plant species (i.e. annual and geophytic species) would not have been in flower and/or visible at the time of survey.
Temporal coverage	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 only sampled once, and outside of the main flowering season. As such it is unlikely to capture the full suite of native species present. The timing was appropriate for a reconnaissance survey, but additional survey in the main flowering period may be required.
Spatial coverage and access	No limitation	Site coverage was comprehensive (track logged).
	No limitation	All parts of the site could be accessed as required.
Sampling intensity	Limitation	A total of 58 species were recorded, of which 45 were recorded from three sample locations and 13 were recorded opportunistically. The sampling intensity was to the standard of a detailed assessment, but was undertaken outside of the main flowering season. As such, additional annual native and weed species are likely to have been undetectable at the time of the survey.
Influence of disturbance	Minor limitation	Time since fire is greater than 50 years as interpreted form aerial imagery and therefore short lived species more common after fire may not have been visible.
	No limitation	Historical ground disturbance was evident throughout the site. The disturbance history of the site was considered when undertaking field sampling.
Adequacy of resources	No limitation	All resources required to perform the survey were available.

4 Results

4.1 General site conditions

The northern half of the site comprised dry sandy soils, with some remnant native vegetation present, as well as some planted trees and shrubs (**Plate 5**).

The southern half of the site contained managed vegetation, consisting of a turfed oval, with the western and eastern peripheral areas containing steep banks with planted trees, landscaped garden beds and/or mulch (**Plate 6**).

Plate 5: Northern half of the site containing some native vegetation.

Plate 6: Southern portion of the site with oval and landscaped gardens.

4.2 Flora

A total of 36 native and 22 non-native (weed) species were recorded within the site during the field survey, representing 26 families and 49 genera. The dominant families containing native taxa were Fabaceae (seven native taxa and one weed taxa) and Proteaceae (seven native taxa). The most common genera were *Acacia* and *Eucalyptus* with three taxa each. Of the species recorded 45 were recorded in sample locations and 13 were recorded opportunistically. A complete species list is provided in **Appendix B** and sampled data in **Appendix C**.

4.2.1 Poisonous species

Appendix D of the *Primary School Brief – Subconsultant Brief* (BMW 2018) lists *Schinus terebinthifolius* (Japanese pepper) as a 'poisonous tree'. A Japanese pepper is present in the north western portion of the site. Appendix E of the *Primary School Brief – Subconsultant Brief* (BMW 2018) lists *Macrozamia* spp. (zamia palm) as having poisonous seeds. *Macrozamia riedlei* is present within the **BaXpCq**.

4.2.2 Threatened and priority flora

No threatened flora species were recorded within the site.

One Priority 4 (P4) species, *Conostylis pauciflora* subsp. *pauciflora*, was recorded in one location in the northern portion of the site (shown on **Figure 4**). Two individuals were observed during the survey.

4.2.3 Locally and regionally significant flora

Three significant flora species, *Conostylis pauciflora* subsp. *pauciflora* (P4), *Conospermum triplinervium* and *Lechenaultia linarioides*, were recorded in the site in the remnant vegetation in the northern half of the site. All three of these species are listed in the *Bush Forever* significant flora document as being poorly reserved (Government of WA 2000b). *Conostylis pauciflora* subsp. *pauciflora* (P4) and *Conospermum triplinervium* are also listed as having significant populations. *Conostylis pauciflora* subsp. *pauciflora* (P4) is also noted to be endemic to the Swan Coastal Plain.

4.2.4 Declared pests

No declared pests, or weeds of national significance were reported within the site.

4.3 Vegetation

4.3.1 Plant communities

Three plant communities were identified within the site. Plant community **BaXpCq** exists in the northern portion of the site and extends over 0.84 ha. Plant community **Ll** occurs in the central portion of the site adjacent to the oval. This community extends over 0.38 ha of the site. The remainder of the site (2.82 ha) contains non-native vegetation with bare soil, weeds or planted vegetation including *Agonis flexuosus* (peppermint) and *Eucalyptus gomphocephala* (tuart).

A description and the area of each plant community is provided in **Table 5** and representative photographs of each are provided in **Plate 7** to **Plate 9**. The location of each plant community is shown in **Figure 4**.

Table 5: Plant communities identified within the site

Plant community	Description	Area (ha)
BaXpCq	Sparse woodland of *Banksia attenuata* over shrubland of *Xanthorrhoea preissii*, *Calothamnus quadrifidus*, *Melaleuca systena* and *Hibbertia hypericoides* over open sedgeland of *Mesomelaena pseudostygia* over open forbland of **Carpobrotus edulis*, **Ursinia anthemoides* and open grassland to grassland of **Briza maxima*, **Lagurus ovatus* and *Rytidosperma* sp. (**Plate 7**).	0.84
Ll	Isolated *Eucalyptus gomphocephala* and *Agonis flexuosus* trees (likely planted) over tall closed shrubland of **Leptospermum laevigatum* over sparse shrubland of *Xanthorrhoea preissii*, *Rhagodia baccata* subsp. *baccata* and *Acacia saligna* over weeds (**Plate 8**).	0.38
Non-native vegetation	Heavily disturbed areas comprising weeds or planted vegetation (**Plate 9**).	2.82

*Plate 7: Plant community **BaXpCq** in very good-good condition*

*Plate 8: Plant community **LI** in degraded-completely degraded condition.*

Plate 9: Cleared areas of the site in completely degraded condition.

4.3.2 Vegetation condition

The most intact native vegetation was located in the north-eastern corner of the site (approximately 0.29 ha of the **BaXpCq** plant community). This vegetation was mapped as being in 'good-very good' condition as it retains the structure expected of a banksia woodland community and has moderate native species diversity but was associated with weed cover over 20%. Past disturbance of this area is evident from historical aerial photography and through the presence of some areas of weed invasion, particularly from the tall shrub **Leptospermum laevigatum* (coast tea tree), which was likely planted along the edge of the oval (plant community **Ll**).

Portions of the **BaXpCq** vegetation were mapped as being in 'good' or 'good-degraded' condition due to higher cover of weeds (particularly dense areas of **L. laevigatum)* and lower native species diversity.

Plant community **Ll** was mapped as being in 'degraded-completely degraded' condition as it was dominated by introduced species, with scattered native species having recolonised the understorey.

Remaining areas in the site are in 'completely degraded' condition and consist of non-native species such as turf, **Carpobrotus edulis* (hottentot fig) and planted trees.

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

Table 6: Vegetation condition categories within the site

Condition category (Keighery 1994)	Size (ha)
Pristine	0
Excellent	0
Very good	0
Very good – good	0.29
Good	0.12
Good – degraded	0.25
Degraded	0
Degraded – completely degraded	0.57
Completely degraded	2.82

4.3.3 Floristic community type assignment

Plant community **BaXpCq** was considered to most likely represent FCT 24 'Northern Spearwood shrublands and woodlands' or FCT 28 – 'Spearwood *Banksia attenuata* or *Banksia attenuata* – *Eucalyptus* woodlands'. Both of these FCT were considered to be 'well reserved' and 'low risk' by Gibson *et al.* (1994). None of the samples clearly aligned with any FCT in the cluster analysis, with all three samples clustering with low similarity to a large group of FCTs. Sample Q1 was most similar to three Gibson *et al.* (1994) sites representing FCT 24 with 36-39% similarity (**Table 7**). Sample Q2 was most similar to a Gibson *et al. (1994)* site representing FCT 28 with 35% similarity but was also similar to two Gibson *et al.* (1994) sites comprising FCT 24 (**Table 7**). Sample Q3 was most similar to two Gibson *et al.* (1994) sites representing FCT 24 with 34-35% similarity (**Table 7**). The relevant portions of the cluster dendrograms showing Q1, Q2 and Q3 are provided in **Appendix D**.

Plant community **Ll** and cleared vegetation were considered too degraded to assign to a FCT.

Table 7: Plant community and likely FCT represented within the site for each sample

Plant community	Sample unit	Most similar Gibson *et al.* (1994) sites	Similarity (%)	Floristic community type (FCT)	Reservation and conservation status (Gibson *et al.* 1994)
BaXpCq	**Q1**	KERO-2 (FCT 24)	39	FCT 24 - Northern Spearwood shrublands and woodlands or FCT 28 – Spearwood *Banksia attenuata* or *Banksia attenuata* – *Eucalyptus* woodlands	'well reserved' 'low risk'
		TRIG-6 (FCT 24)	38		
		BOLD-2 (FCT 24)	36		
		KING-1 (FCT 28)	35		
	Q2	NEER-3 (FCT 28)	35		
		TRIG-5 (FCT 24)	34		
		TRIG-6 (FCT 24)	32		
		KING-1 (FCT 28)	31		
	Q3	TRIG-6 (FCT 24)	35		
		TRIG-5 (FCT 24)	34		
		NWIL-2 (FCT 26b)	32		

4.3.4 Threatened and priority ecological communities

The structure and composition of plant community **BaXpCq** indicates that it could have represented the 'banksia woodlands of the Swan Coastal Plain' TEC. This TEC, herein referred to as the 'banksia woodland TEC', is listed as 'endangered' under the EPBC Act. Whether a patch of vegetation is considered to represent the banksia woodland TEC depends on a number of diagnostic criteria including geographic location, soils, landform, structure, composition, condition and patch size (DoEE 2016). As outlined in **Table 8,** the **BaXpCq** vegetation does not satisfy the minimum size criteria to be considered a patch of the 'banksia woodland TEC'.

Table 8: Criteria for determining presence of Banksia Woodlands of the Swan Coastal Plain TEC adapted from (TSSC 2016)

Criteria	Requirements for meeting criteria	Site implications
1. Must meet key diagnostic characteristics	A variety of factors relating to: • Location • Soils • Structure • Composition	• Site meets location and soils criteria. • The **BaXpCq** vegetation includes the key diagnostic feature of a tree layer of *Banksia attenuata*. Note that cover of the species is not high (<10%) but the conservation advice lists percentage canopy cover for the Banksia woodlands TEC as ranging from 2% to typically less than 50% (DoEE 2016). As such the **BaXpCq** vegetation is likely to meet the lower end of this range. • The **BaXpCq** vegetation within site also meets structure and composition criterion. FCT 24 and FCT 28 are identified as two of the FCTs of the banksia woodland TEC.

Table 8: Criteria for determining presence of Banksia Woodlands of the Swan Coastal Plain TEC adapted from (TSSC 2016) (cont.)

Criteria	Requirements for meeting criteria	Site implications
2. Must meet condition thresholds	• A patch should at least meet the 'good' condition category (see **Table 3**)	• The **BaXpCq** vegetation is present in 'very good to good', 'good' and 'good to degraded' condition, which meets this criterion. The conservation advice indicates that a single patch may include areas of variable condition, meaning parts of the **BaXpCq** vegetation in 'good to degraded' condition may still be considered the TEC.
3. Must meet minimum patch size	Minimum size of patch: • Pristine=no minimum size • Excellent=0.5 ha • Very Good=1 ha • Good=2 ha	• The **BaXpCq** vegetation in 'good-very good' condition comprises 0.29 ha and does not independently meet this criterion. • The adjoining **BaXpCq** vegetation in 'good' (0.12 ha), 'good to degraded' (0.25 ha) and 'degraded to completely degraded' (0.19 ha) condition would be viewed as contiguous and part of the same patch. Therefore the mapped 0.84 ha of **BaXpCq** vegetation does not comprise a patch of the TEC.
4. Must incorporate surrounding context	• Breaks (e.g. tracks) < 30 m do not separate vegetation into separate patches • Buffer zones may apply (20-50 m recommended from patch edge) • The site should be thoroughly sampled (2 surveys in same spring). • Survey timing should be appropriate. • Surrounding environment should be considered (e.g. connectivity, conservation values, fauna habitat)	• Some tracks exist within the patch. • Land surrounding the patch is a combination of cleared and planted vegetation. • This survey was undertaken in March and thus outside of the main flowering period. Survey in spring would provide more conclusive information. • Survey timing was not appropriate for recording the full suite of native species likely to be present. • No intact native vegetation that is likely to meet criteria as banksia woodland exists in close proximity to the site.

Due to the presence of *Banksia attenuata,* on deep sands the **BaXpCq** vegetation is likely to represent the 'banksia dominated woodlands of the Swan Coastal Plain IBRA region' PEC (P3). There is no conservation advice for this PEC so it is unclear whether a condition threshold should be applied when identifying its presence. However, DBCA has historically applied good condition as a threshold for the identification of PEC vegetation. Using good condition as basis a basis for identification, 0.41 ha of the **BaXpCq** vegetation is considered to represent the PEC.

No other TECs or PECs occur within the site.

The area of the banksia woodland PEC within the site is outlined in **Figure 6**.

4.3.5 Locally and regionally significant vegetation

A number of mature eucalypt trees (diameter at breast height larger than 500 mm) including *Eucalyptus gomphocephala* (tuart) are present along the eastern and western periphery of the site. Due to their size these trees have the potential to provide foraging, roosting and nesting habitat for black cockatoos (especially Carnaby's black cockatoo), along with other ecological services.

5 Discussion

The site largely consists of cleared, planted vegetation. Where remnant native vegetation is present, it was more consistent with the vegetation described as occurring within the Spearwood dune system, compared to the Quindalup dunes, on which landform it is mapped. As discussed in **Section 2.1.5**, the junction of these landform and soil units occurs close to the south east site, as mapped by Heddle *et al.* (1980) and Beard *et al.* (2013). These datasets are mapped at the regional scale, thus discrepancies at the local scale close to the junction of units are not uncommon.

5.1 Threatened and priority flora

Conostylis pauciflora subsp. pauciflora (P4) was the only priority flora species were recorded within the site. Given that *Conostylis pauciflora subsp. pauciflora* (P4) was not in flower at the time of the survey it is possible that additional undetected individuals of the species occur within the **BaXpCq** vegetation.

Despite the timing of the survey outside of the main flowering season, it is not considered likely that additional threatened and priority flora species occur within the site. The absence of the larger perennial species such as *Eucalyptus argutifolia* and *Lasiopetalum membranaceum* was relatively easy to confirm, particularly given the small area of remnant vegetation. Perennial geophytic species known to occur within the wider local area (such as *Drakaea elastica* and *Diuris purdiei*) would not have been visible at the time of the survey due to their life history. However, these species are not considered likely to occur within the site based on their preference for lower, winter wet habitats (as described in **Table 1**). The majority of threatened and priority flora species likely to occur within the site are perennial species that would have been detectible at the time of the survey.

Two annual species are known to occur within the wider local area (*Haloragis* sp. Parrot Ridge and *Calandrinia oraria* (P1)). *Haloragis* sp. Parrot Ridge has a highly limited distribution and is known to occur approximately 9 ha to 10 ha north east of the site on a ridgeline with considerable levels of limestone outcropping (Government of Western Australia 2019). *Calandrinia oraria* has been recorded occurring on the secondary Quindalup dunes close to the coast between Port Kennedy in the south to Leeman in the north (Government of Western Australia 2019). The vegetation within the site is more characteristic of the Spearwood dune system to the east of the Quindalup dunes. As such, neither of these species is considered likely to occur within the site.

5.2 Vegetation condition

The vegetation within the site has been subject to significant past disturbance and is largely in degraded and completely degraded condition. Approximately 80% of the site is covered by non-native vegetation.

Assigning condition using a categorical scale is always most difficult when vegetation qualities are close to the boundary between two categories. Categorical schemes may also invariably yield different results when applied by different assessors, because of differences in skill levels or personal bias. For this survey compound condition categories were used to indicate that some uncertainty remains as to the appropriate condition category for areas of native vegetation. The compound

categories were appropriate because the survey was undertaken outside of the main flowering period and thus there is a likelihood that additional native and weed species occur within the site which could influence the condition category that would ultimately be assigned.

The best condition **BaXpCq** vegetation was mapped as being in 'very good – good' condition due to the potential for additional native and weed species occurrences that would be visible in spring. Should weed cover be found to exceed 20% within the main flowering season, then 'good' may be the more appropriate condition category. Conversely, should weed cover be limited to under 20% and additional native species be detected, 'very good' would be the more appropriate category. The compound 'good - degraded' category was included over the southern portion of the **BaXpCq** vegetation due to low native species diversity with increasing incursion of self-seeding *Leptospermum laevigatum* shrubs from the adjacent **Ll** vegetation. The compound 'degraded - completely degraded' condition category was included in the results of this survey for the **Ll** vegetation and particularly disturbed areas of **BaXpCq** vegetation. The **Ll** vegetation had some scattered native understorey cover, but was otherwise dominated by the weed **Leptospermum laevigatum*. The disturbed areas of **BaXpCq** comprised *Banksia attenuata* trees over a highly limited native understorey which was otherwise dominated by weed species.

5.3 Floristic community types

With respect to the FCT present, the results of the analysis were not clear. This is likely due to the timing of the survey outside of the main flowering period coupled with high level of historical disturbance, loss of native species and weed invasion. The Gibson *et al.* (1994) dataset is comprised of data from survey locations that were sampled multiple times over the same spring and thus include annual species that are only present between late winter and early summer. There are also some additional limitations inherent in the use of the Gibson *et al.* (1994) dataset, as discussed in **Table 4**. As a result of these limitations statistical comparisons between the site data and the Gibson *et al.* (1994) dataset have not provided a definitive result.

Nonetheless, the samples from the **BaXpCq** vegetation showed high similarities to two FCTs (FCT 24 and FCT 28). All native species recorded within the **BaXpCq** vegetation are listed as occurring within both FCT 24 and FCT 28, but based on the percent frequency of each species within each FCT, the site was slightly more similar to FCT 28. FCT 28 is also more commonly found within the wider local area, based on the mapped locations of Gibson *et al.* (1994) samples. Further survey in spring may record additional species that may provide more certainty as to the FCT present within the site.

5.4 Threatened and priority ecological communities

The most intact portions of the **BaXpCq** plant community largely consist of a shrubland, rather than a woodland. *Banksia attenuata* trees were mainly found to occur in the peripheral areas in reduced condition. As such, the **BaXpCq** vegetation does not entirely satisfy the key diagnostic feature of a tree layer of *Banksia attenuata* and *B. menziesii*. However, the conservation advice lists percentage canopy cover for the banksia woodlands TEC as ranging from 2% to typically less than 50% (DoEE 2016). As such the **BaXpCq** vegetation is likely to meet the lower end of this range. The **BaXpCq** vegetation was also considered most likely to represent FCT 24 – 'Northern Spearwood shrublands and woodlands' or FCT 28 – 'Spearwood *Banksia attenuata* or *Banksia attenuata* – *Eucalyptus*

woodlands', which are two of the regional FCTs identified in the banksia woodland TEC conservation advice (DoEE 2016). However, to be considered the banksia woodland TEC a patch of banksia vegetation must also meet thresholds for condition and minimum patch size (refer to **Table 3**).

The DoEE (2016) conservation advice states that a patch of banksia woodland vegetation in very good condition must be greater than 1 ha in size for it to be considered the TEC. The conservation advice also states that a patch may include areas of variable condition and that the condition that is most representative should be used to assign overall condition of a patch.

For the **BaXpCq** community, 0.29 ha was mapped as very good-good, 0.12 ha was mapped as good, 0.25 ha was mapped as good-degraded and 0.19 ha was mapped as degraded-completely degraded. As there are no breaks of 30 m or more to separate the areas of varying condition, these areas are understood as a single patch extending over 0.84 ha. Given that the highest condition category that could be assigned to this patch is very good, the patch falls below the 1 ha minimum size threshold for the TEC and thus the **BaXpCq** vegetation does not comprise a patch of the banksia woodland TEC.

Despite not qualifying as the Banksia woodlands TEC, due to the presence of *Banksia attenuata* on deep sands, the **BaXpCq** community is likely to represent the State listed PEC 'banksia dominated woodlands of the Swan Coastal Plain IBRA region'. Conservation advice for PECs is less specific, but it is likely that only the area of **BaXpCq** vegetation in good or better condition (0.41 ha) would be considered to represent this PEC.

6 Conclusions

The majority of vegetation within the site is highly disturbed and modified. Approximately 2.82 ha of the site contains completely degraded, non-native vegetation. The remaining 1.22 ha of the site contains native vegetation that is present in predominantly 'degraded-completely degraded' (0.57 ha) or 'good-degraded' (0.25 ha) condition. However, the site contains approximately 0.29 ha of relatively intact native vegetation in 'very good-good' and 0.12 ha in 'good' condition.

A total of 36 native flora species were recorded within the site, along with 22 non-native species. Two recorded species (**Schinus terebinthifolius* and *Macrozamia riedlei*) are listed as poisonous within the *Primary School Brief* (BMW 2018).

Two individuals of the priority flora species *Conostylis pauciflora subsp. pauciflora* (P4) were recorded in one location in the northern portion of the site. No other threatened or priority flora species were recorded or are considered likely to occur.

The site contains a 0.41 ha patch State listed PEC 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region'. The **BaXpCq** vegetation does not meet the criteria to be considered to represent the EPBC Act listed 'banksia woodlands of the Swan Coastal Plain' TEC.

Numerous large remnant native trees across the site may be locally or regionally significant due to their potential to provide black cockatoo habitat.

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Figures

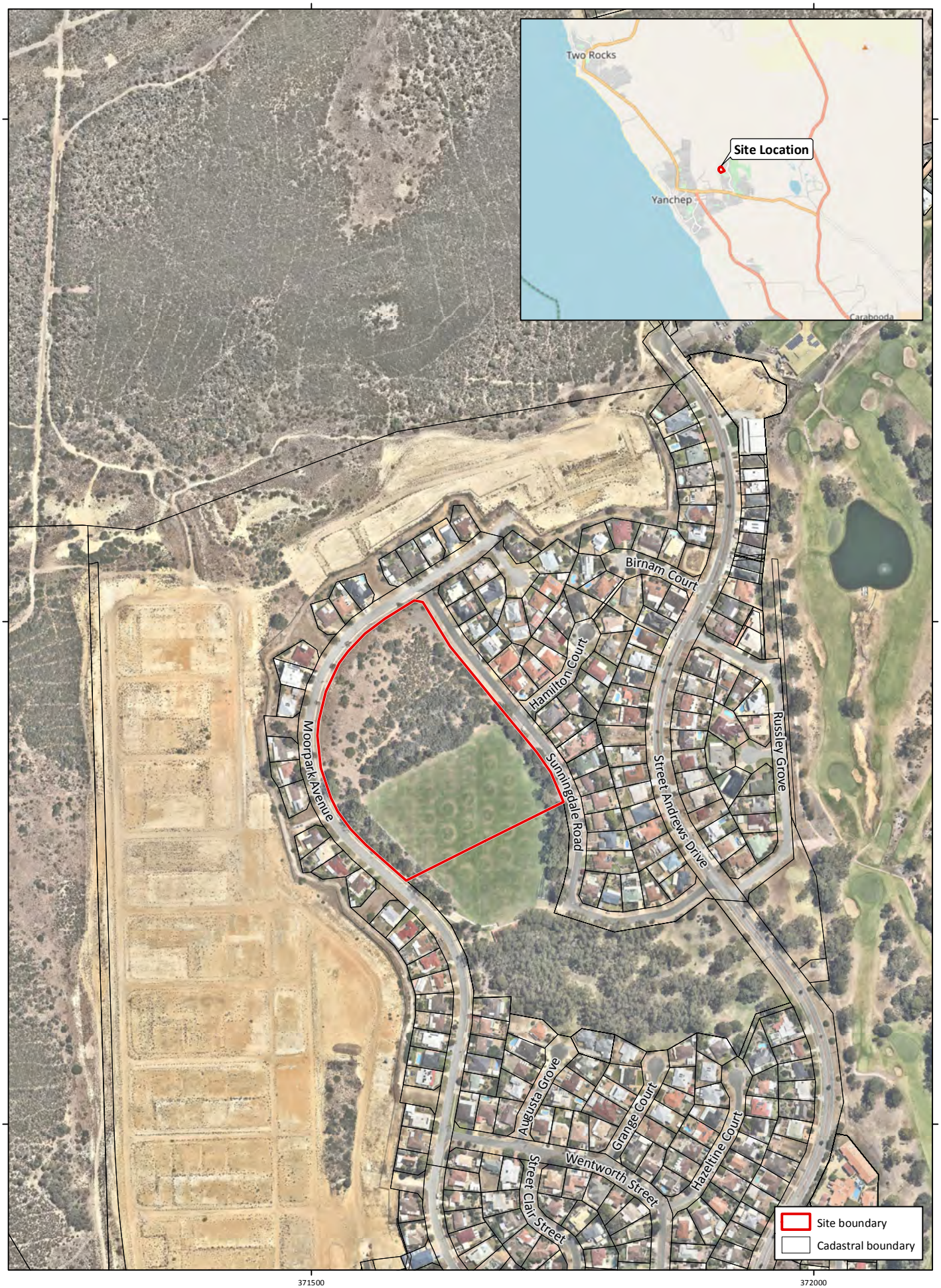

Figure 1: Site Location

Project: Reconnaissance Flora and Vegetation Assessment
Lot 9766 Sunningdale Road Yanchep

Client: Department of Finance

Plan Number: EP19-021(01)--F19

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Date:	02/04/2019
Checked:	SKP
Approved:	TAA
Date:	05/04/2019

N

0 50 100
Metres

Scale: 1:5,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

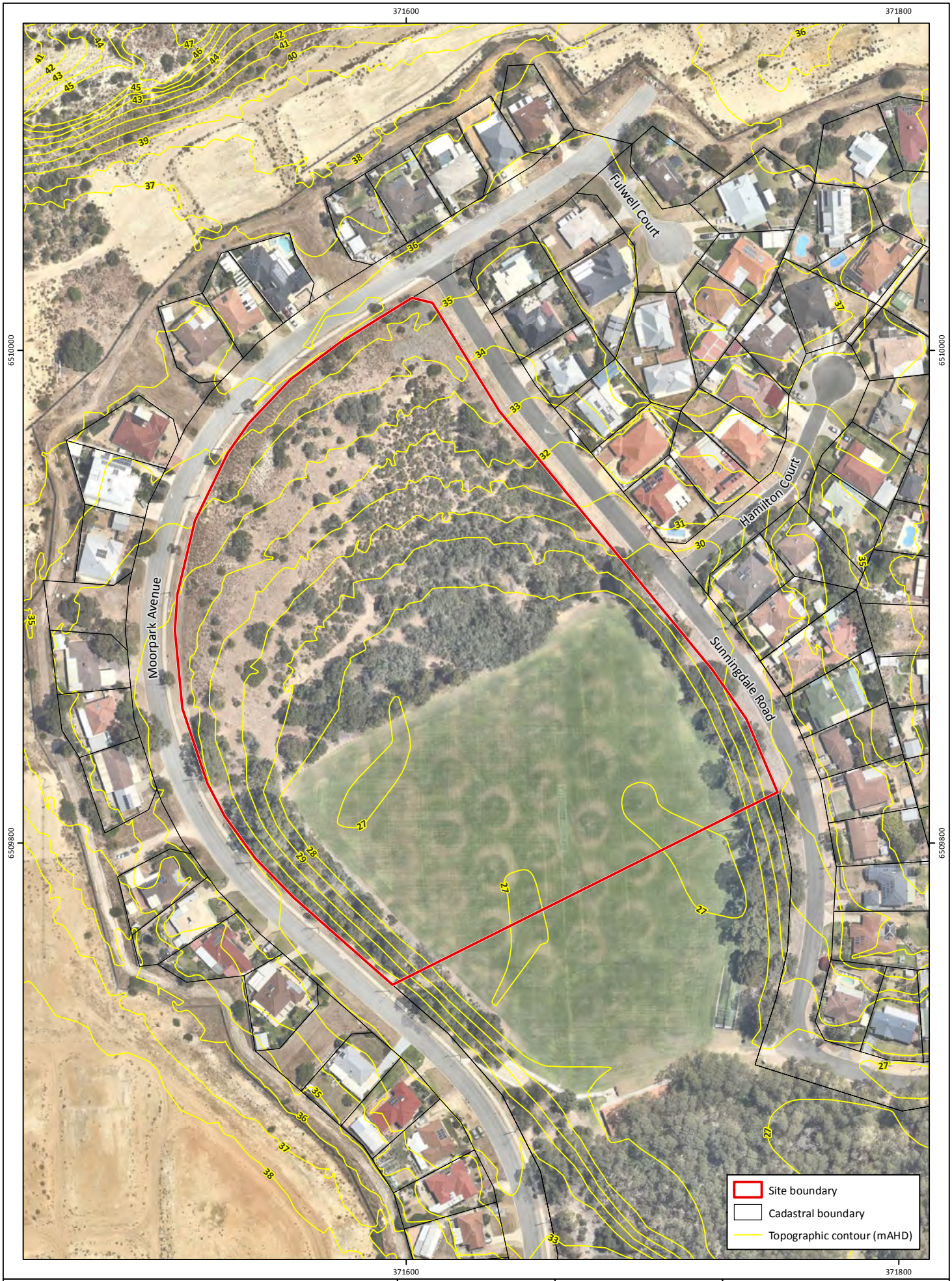

Figure 2: Elevation

Project: Reconnaissance Flora and Vegetation Assessment
Lot 9766 Sunningdale Road Yanchep

Client: Department of Finance

Plan Number:
EP19-021(01)--F20

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Date:	02/04/2019
Checked:	SKP
Approved:	TAA
Date:	05/04/2019

N

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Metres

Scale: 1:2,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

Figure 2: Environmental Features

Project: Reconnaissance Flora and Vegetation Assessment
Lot 9766 Sunningdale Road Yanchep

Client: Department of Finance

Plan Number: EP19-021(01)--F21

Drawn:	KNM
Date:	02/04/2019
Checked:	SKP
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Date:	05/04/2019

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emerge ASSOCIATES

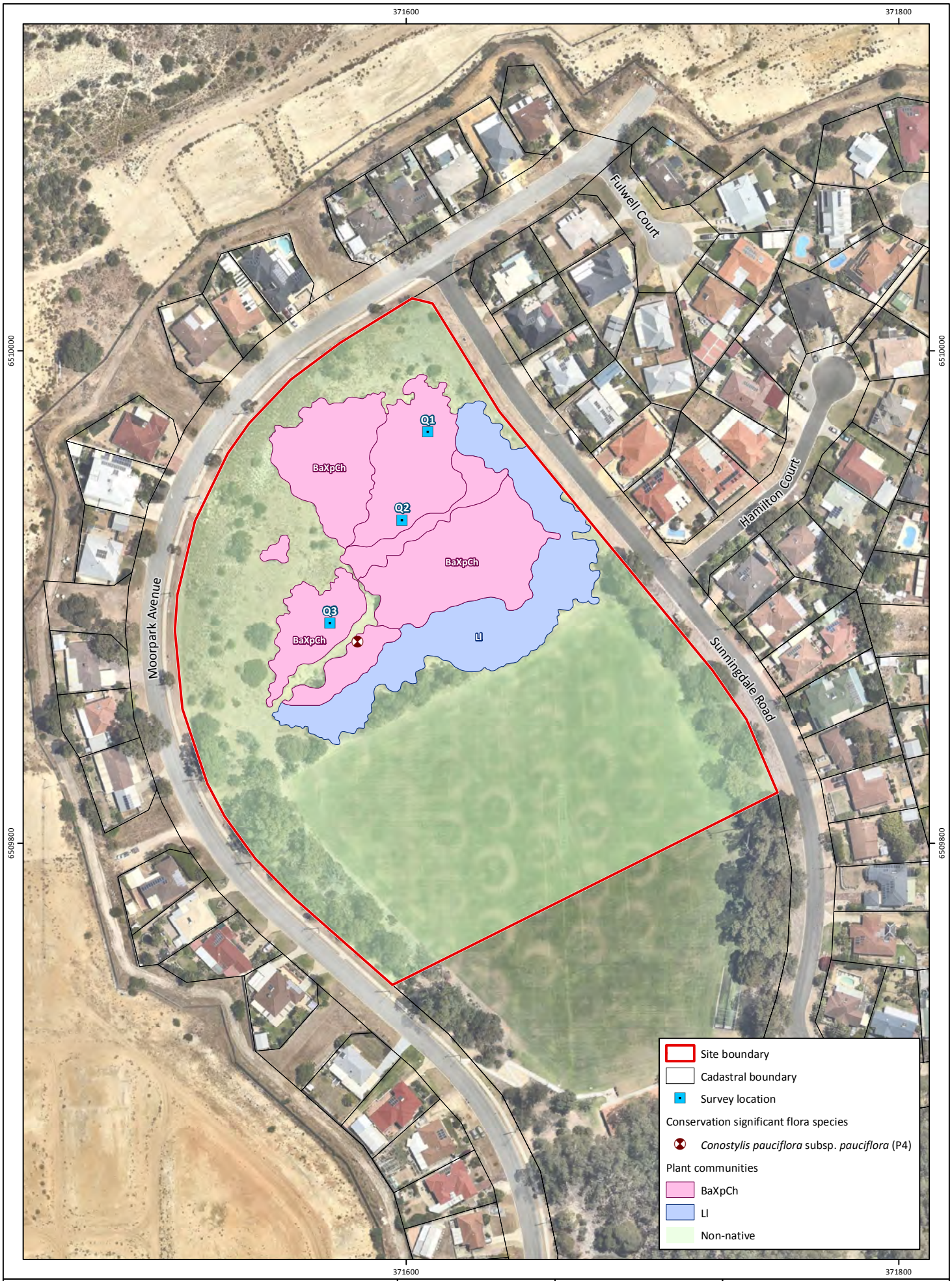

Figure 4: Plant Communities

Project: Reconnaissance Flora and Vegetation Assessment
Lot 9766 Sunningdale Road Yanchep

Client: Department of Finance

Plan Number: EP19-021(01)--F22

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Date:	05/04/2019

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

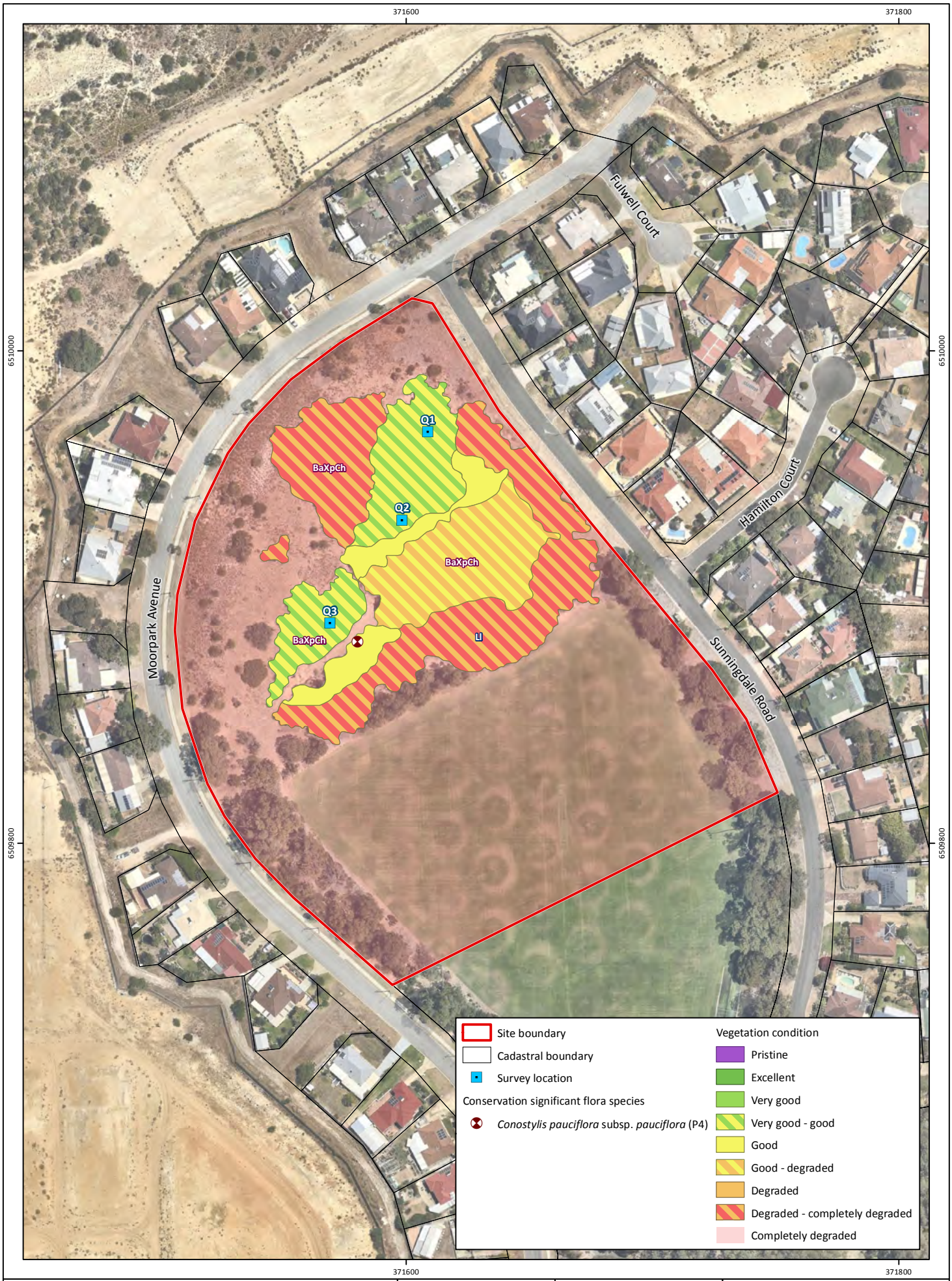

Figure 4: Vegetation Condition

Project: Reconnaissance Flora and Vegetation Assessment
Lot 9766 Sunningdale Road Yanchep

Client: Department of Finance

Plan Number:
EP19-021(01)--F23

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Date:	02/04/2019
Checked:	SKP
Approved:	TAA
Date:	05/04/2019

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

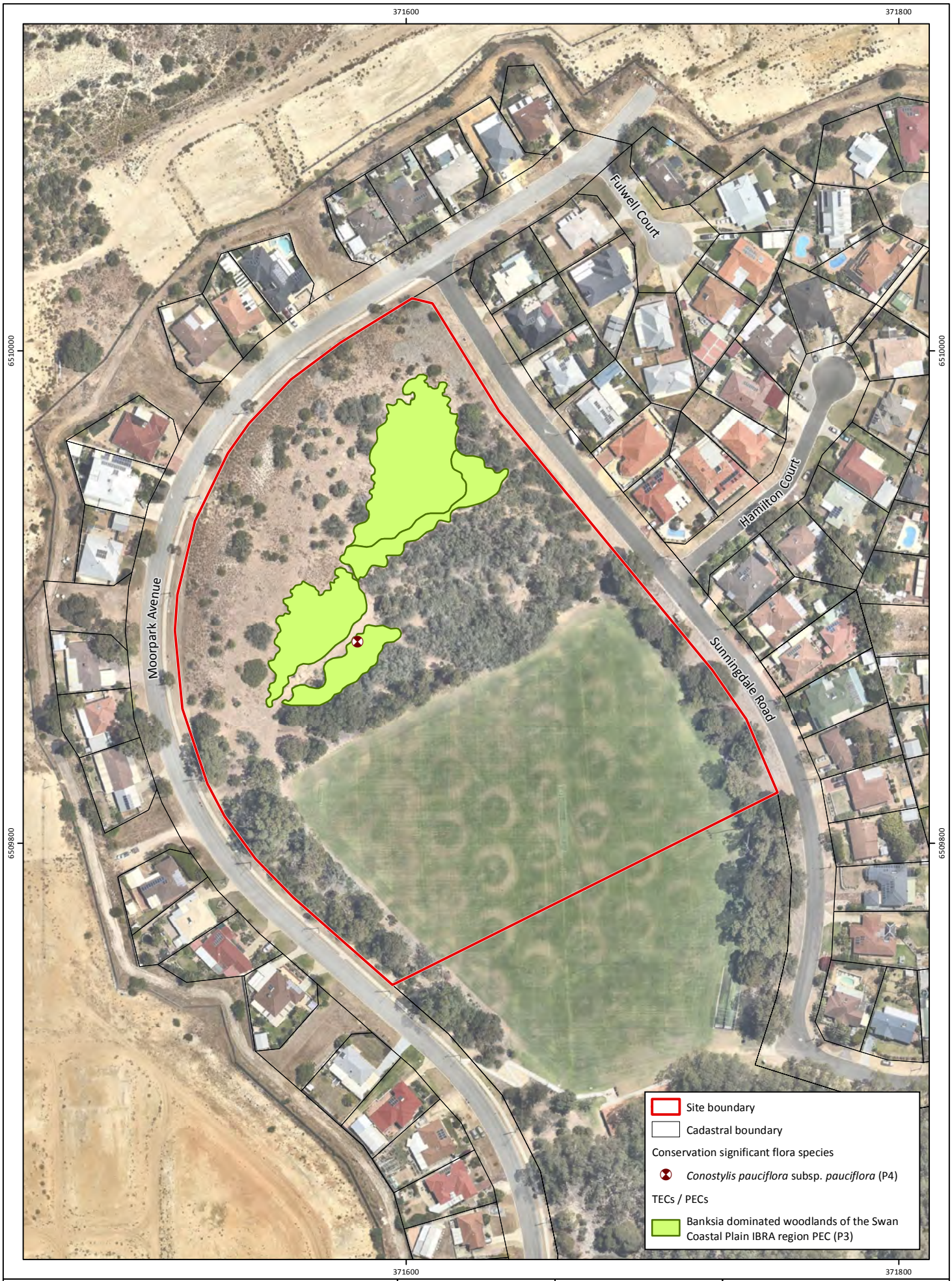

Figure 6: Conservation Significant Features

Project: Reconnaissance Flora and Vegetation Assessment
Lot 9766 Sunningdale Road Yanchep

Client: Department of Finance

Plan Number:
EP19-021(01)--F24

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Checked:	SKP
Approved:	TAA
Date:	05/04/2019

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Metres

Scale: 1:2,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix A

Additional Background 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 and Energy. 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 and Energy.

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 2009). Listed PECs are published by DBCA (DBCA 2017b).

Table 3: Categories of priority ecological communities (DEC 2009).

Priority code	Description
P1	Priority One Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. 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 Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat 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 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: (i) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (ii) communities made up of large, and/or widespread occurrences, that may or 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, and inappropriate fire regimes. 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.
P5	Priority Five Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Weeds

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

Declared Pests

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

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

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

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DAFWA 2016).

Table 4: Legal status of declared pest species listed under the BAM Act (DAFWA 2016).

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 (DAFWA 2016).

Category	Description
C1	Exclusion Not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2	Eradication Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3	Management Established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Table 6: Keeping categories of declared pest species listed under the BAM Act (DAFWA 2016).

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

Wetland Habitat

Geomorphic wetland types

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

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

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

Wetland management categories

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

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

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

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

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

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

Wetland reclassification

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

References

General references

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Appendix B

Species List

Flora Species List - Lot 9766 Sunningdale Road, Yanchep

Note: * denotes introduced (weed) species. P4 denotes Priority 4 species

Family	Species
Aizoaceae	
	* *Carpobrotus edulis*
Amaranthaceae	
	Ptilotus sericostachyus subsp. sericostachyus
Asparagaceae	
	Lomandra maritima
Asteraceae	
	* *Arctotis stoechadifolia*
	* *Ursinia anthemoides*
Brassicaceae	
	* *Heliophila pusilla*
Caryophyllaceae	
	* *Petrorhagia dubia*
Casuarinaceae	
	Allocasuarina humilis
Centrolepidaceae	
	Centrolepis sp.
Colchicaceae	
	Burchardia congesta
Crassulaceae	
	* *Crassula glomerata*
Cupressaceae	
	* *Cupressus sp.*
Cyperaceae	
	Mesomelaena pseudostygia
	Schoenus grandiflorus
Dilleniaceae	
	Hibbertia hypericoides
Ericaceae	
	Astroloma pallidum
	Leucopogon propinquus

Flora Species List - Lot 9766 Sunningdale Road, Yanchep

Note: * denotes introduced (weed) species. P4 denotes Priority 4 species

Family		Species
Fabaceae		
		Acacia cyclops
		Acacia pulchella var. glaberrima
		Acacia saligna
		Hardenbergia comptoniana
		Hovea trisperma
		Jacksonia calcicola
		Jacksonia sternbergiana
	*	*Trifolium campestre*
Goodeniaceae		
		Lechenaultia linarioides
		Scaevola canescens
Haemodoraceae		
	P4	*Conostylis pauciflora subsp. pauciflora*
Hemerocallidaceae		
		Corynotheca micrantha
		Dianella revoluta
Iridaceae		
	*	*Gladiolus caryophyllaceus*
	*	*Romulea rosea*
Myrtaceae		
	*	*Agonis flexuosa*
		Calothamnus quadrifidus
	*	*Eucalyptus erythrocorys*
		Eucalyptus gomphocephala
	*	*Eucalyptus sp.*
	*	*Leptospermum laevigatum*
		Melaleuca systena
Poaceae		
	*	*Aira sp.*
	*	*Avena barbata*
	*	*Briza maxima*
	*	*Briza minor*
	*	*Bromus sp.*
	*	*Ehrharta calycina*
	*	*Lagurus ovatus*
		Rytidosperma sp.
Proteaceae		
		Banksia attenuata
		Banksia nivea subsp. nivea

Flora Species List - Lot 9766 Sunningdale Road, Yanchep

Note: * denotes introduced (weed) species. P4 denotes Priority 4 species

Family	Species
Proteaceae (cont.)	
	Banksia sessilis
	Conospermum triplinervium
	Hakea lissocarpha
	Hakea trifurcata
	Petrophile macrostachya
Restionaceae	
	Desmocladus asper
Rhamnaceae	
	Spyridium globulosum
Xanthorrhoeaceae	
	Xanthorrhoea preissii
Zamiaceae	
	Macrozamia riedlei

Appendix C

Sample Data

Vegetation Sample Data

Sample Name: Q1

Project no.: EP19-021
Date: 19/02/2019
Author: SKP,other

Status Non-permanent

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	371609	NW corner northing:	6509967
Altitude (m):	32	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	mid-slope
Time since fire:	no evidence	Disturbance:	moderate - Weeds, kangaroos
Soil type/texture	sand/	Bare ground (%):	5
Rocks (%) and type:	2%, limestone	Soil colour:	brown/orange
Litter:	5% (twigs,leaves,)	Vegetation condition:	good-very good

Strata	Cover (%)	Height (m)
Upper:	0 to 5	<10
Mid:	30 to 70	1 to 2
Ground layer 1:	<10	<0.5
Ground layer 2:	10 to 30	<0.5

Vegetation description

Isolated *Banksia attenuata* over shrubland *Xanthorrhoea preissii, Calothamnus quadrifidus, Melaleuca systena* and *Hibbertia hypericoides* over low sparse sedgeland *Mesomelaena pseudostygia* over low open tussock grassland of weed species.

Vegetation Sample Data

Sample Name: Q1

Project no.: EP19-021
Date: 19/02/2019 **Status** Non-permanent
Author: SKP,other

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Xanthorrhoea preissii	15
	Banksia attenuata	5
	Allocasuarina humilis	5
	Hibbertia hypericoides	15
	Melaleuca systena	10
	Calothamnus quadrifidus	10
	Petrophile macrostachya	3
	Astroloma pallidum	0.5
	Banksia sessilis	opp
	Leptospermum laevigatum	opp
	Acacia pulchella subsp. glaberrima	2
	Leucopogon propinquus	1
	Hovea trisperma	1
	Scaevola canescens	1
	Mesomelaena pseudostygia	5
	Banksia nivea subsp. nivea	3
	Desmocladus asper	3
*	*Gladiolus caryophyllaceus*	2
*	*Carpobrotus edulis*	3
*	*Lagurus ovatus*	4
*	*Briza maxima*	10
*	*Avena barbata*	2
	Rytidosperma sp.	1
*	*Briza minor*	1
*	*Heliophila pusilla*	1
*	*Trifolium campestre*	3
*	*Petrorhagia dubia*	2
	Spyridium globulosum	opp
	Macrozamia riedlei	opp
	Hakea lissocarpha	opp
	Jacksonia sternbergiana	opp
	Lomandra maritima	2
	Burchardia congesta	0.5
*	*Romulea rosea*	0.5
	Leucopogon propinquus	1
*	*Bromus sp.*	0.5

Vegetation Sample Data

Sample Name: Q1

Project no.:

Date: 19/02/2019 **Status** Non-permanent

Author: SKP,other

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Hakea trifurcata	opp
	Ptilotus sericostachyus subsp. sericostachyus	0.5
*	*Arctotis stoechadifolia*	opp

Vegetation Sample Data

Sample Name: Q2

Project no.: EP19-021
Date: 19/02/2019
Author: SKP,other

Status Non-permanent

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	371598	NW corner northing:	6509931
Altitude (m):	30	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	mid-slope
Time since fire:	no evidence	Disturbance:	moderate - Weeds, kangaroos
Soil type/texture	sand/	Bare ground (%):	10
Rocks (%) and type:	2%, limestone	Soil colour:	brown/orange
Litter:	5% (twigs,leaves,)	Vegetation condition:	good-very good

Strata	Cover (%)	Height (m)
Upper:	0%	Treeless
Mid:	30 to 70	1 to 2
Ground layer 1:	10 to 30	<0.5
Ground layer 2:	10 to 30	<0.5

Vegetation description

Shrubland *Xanthorrhoea preissii, Calothamnus quadrifidus, Melaleuca systena* and **Leptopsermum laevigatum* over low open sedgeland *Mesomelaena pseudostygia* over low open tussock grassland of weed species.

Vegetation Sample Data

Sample Name: Q2

Project no.: EP19-021
Date: 19/02/2019 **Status** Non-permanent
Author: SKP,other Q2: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Xanthorrhoea preissii	20
	Calothamnus quadrifidus	10
	Melaleuca systena	5
	Leptospermum laevigatum	3
	Leucopogon propinquus	2
	Allocasuarina humilis	3
	Hibbertia hypericoides	10
	Astroloma pallidum	0.5
	Acacia saligna	1
	Petrophile macrostachya	2
	Jacksonia calcicola	2
	Spyridium globulosum	2
	Leucopogon propinquus	1
	Acacia cyclops	opp
	Hardenbergia comptoniana	5
	Banksia nivea subsp. nivea	3
	Mesomelaena pseudostygia	10
	Centrolepis sp.	0.5
	Lomandra maritima	2
	Desmocladus asper	2
*	*Bromus sp.*	1
*	*Gladiolus caryophyllaceus*	1
*	*Briza maxima*	10
*	*Aira sp.*	3
*	*Avena barbata*	3
*	*Petrorhagia dubia*	2
*	*Ursinia anthemoides*	3
*	*Lagurus ovatus*	5
*	*Trifolium campestre*	3
*	*Ehrharta calycina*	1
*	*Carpobrotus edulis*	2
*	*Romulea rosea*	0.5

Vegetation Sample Data

Sample Name: Q3

Project no.: EP19-021
Date: 19/02/2019
Author: SKP,other

Status Non-permanent

Quadrat and landform details

Sample type:	quadrat	Size:	10 m x 10 m
NW corner easting:	371569	NW corner northing:	6509889
Altitude (m):	31	Geographic datum/zone:	GDA94/Zone 50
Soil water content:	dry	Landform:	mid-slope
Time since fire:	no evidence	Disturbance:	moderate - Weeds, kangaroos
Soil type/texture	sand/	Bare ground (%):	10
Rocks (%) and type:	No rocks	Soil colour:	brown/orange
Litter:	3% (twigs,leaves,)	Vegetation condition:	good-very good

Strata	Cover (%)	Height (m)
Upper:	0%	Treeless
Mid:	<10	>2
Ground layer 1:	30 to 70	1 to 2
Ground layer 2:	<10	<0.5

Vegetation description

Isolated *Banksia attenuata* trees over shrubland of *Xanthorrhoea preissii, Calothamnus quadrifidus, Melaleuca systena and *Leptopsermum laevigatum* over tussock grassland of weed species over low sparse sedgeland *Mesomelaena pseudostygia*

Vegetation Sample Data

Sample Name: Q3

Project no.: EP19-021
Date: 19/02/2019 **Status** Non-permanent
Author: 0 Q3: Page 2 of 2

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	Acacia saligna	3
	Leptospermum laevigatum	5
	Xanthorrhoea preissii	5
	Calothamnus quadrifidus	30
	Jacksonia sternbergiana	5
	Hardenbergia comptoniana	3
	Macrozamia riedlei	2
	Banksia attenuata	opp
	Petrophile macrostachya	5
	Jacksonia calcicola	2
	Hibbertia hypericoides	3
	Scaevola canescens	2
	Banksia nivea subsp. nivea	3
	Corynotheca micrantha	5
	Lechenaultia linarioides	2
	Mesomelaena pseudostygia	10
	Schoenus grandiflorus	5
	Desmocladus asper	3
	Conospermum triplinervium	1
	Dianella revoluta	opp
	Avena barbata	2
P	*Agonis flexuosa*	opp
*	*Petrorhagia dubia*	2
*	*Briza maxima*	10
*	*Heliophila pusilla*	3
*	*Trifolium campestre*	3
	Conostylis pauciflora subsp. pauciflora	opp
*	*Lagurus ovatus*	2
*	*Crassula glomerata*	opp
*	*Eucalyptus erythrocorys*	opp
	Eucalyptus gomphocephala	opp
*	*Eucalyptus sp.*	opp
*	*Cypressus sp.*	opp
*	*Arctotis stoechadifolia*	opp

Appendix D

Cluster Dendrograms

Group average

Resemblance: S17 Bray Curtis similarity

Similarity

25

30

35

40

YAN-20 23b
APBF-1 20a
APBF-2 20a
M53 20a
GOLF-1 20a
LAND-1 20a
KOON-1 20a
KOON-2 20a
TWIN-7 21c
TWIN-8 21c
HYMUS04 21c
DEJONG-C 21c
HYMUS03 21c
FL-5 21c
FL-6 21c
BULL-9 28
BULL-1 28
BULL-4 28
BULL-10 28
BULL-11 28
YULE-3 21c
TALB6 20c
TALB10 20c
TALB11 20c
TALB7 20c
TALB3 20c
TALB5 20c
TALB2 20c
TALB8 20c
TALB9 20c
CARD8 20b
CARD9 20b
BURNRD01 20b
YARL04 20b
CARD3 21a
BRICK2 20b
CARD1 20b
CARD2 20b
CARD5 20b
CARD6 20b
BURNRD02 3b
YARL03 3b
CARD12 3b
CARD13 3b
WARO 01 3b
WARO 02 3b
DUNS-1 3b
KOOLI-5 3b
Q1_YANCHEPSCHOOL
YAN-6 28
NEER-8 28
YAN-4 28
WABL-4 28
MILT-4 28
SHE-2 28
WATERRD1 28
YAN-25 28
SEAB-6 28
YAN-8 28
YAN-9 28
KERO-1 24
THOM-2 24
KERO-2 24
MTB-1 24
HARRY-1 28
HARRY-2 28
TAM-1 21a
WELL-1 21a
PAGA-4 21a
PAGA-7 21a
HARRY-5 21a
WELL-2 21a
NEER-23 28
NEER-22 28
NEER-20 28
NEER-21 28
NEER-2 28
NEER-6 28
WOODV-1 28
WOODV-2 28
DEPOT-1 28
NEER-5 28
YAN-3 28
NEER-3 28
NEER-4 28
TRIG-4 28
KING-1 28
KING-2 28
WARI-1 28
WARI-2 28
SHENT-1 28
TRIG-3 28
TRIG-6 24
NEER-1 24
NEER-11 24
PEPB-1 30b
C71-4 25
MINN-1 25
MINN-2 25
MEAL-2 26b
YALG-2 26b
YALG-6 26b
YALG-7 26b
WHILL-5 26b
YALG-1 26b
PAGA-8 25
MEAL-1 25
MYALUP-2 25
CORON-2 25
KEME-1 25
LYONS-2 25
MINN-3 25
YOON-2 2
CARB-2 1b
YOON-1 1b
OATES-1 21b
CAPEL-5 1b
WONN02 1b

Samples

Group average

Resemblance: S17 Bray Curtis similarity

Similarity

10
15
20
25
30

SEAB-5 29a
SEAB-7 29b
SEAB-2 29b
SEAB-3 29b
NWIL-1 29b
NWIL-3 29b
NPRES-1 29b
WHILL-1 29b
WHILL-3 27
YALG-3 27
YALG-8 27
SVH-2 27
WHILL-4 27
YALG-4 27
YALG-5 27
SHE-6 26b
WABL-2 26b
YAN-1 26b
YAN-5 26b
YAN-10 26b
YAN-11 26b
NWIL-2 26b
SHE-1 26b
SHE-3 26b
WABL-3 26b
YAN-23 26b
YAN-14 26b
YAN-16 26b
NEER-7 24
NEER-10 24
NEER-9 24
CLIF-2 26a
CLIF-3 26a
SHE-4 26a
SVH-1 26a
YAN-13 26a
WABL-1 26a
SHE-5 26a
YAN-12 26a
YAN-15 26a
YAN-2 26a
YAN-24 26a
SEAB-1 30c
MHENRY-1 30c
MHENRY-2 30c
CHIDPT-1 24
PEPGRV-1 30a
PEPGRV-2 30a
POSSUM3 30b
POSSUM4 30b
LESCH-5 30b
LESCH-1 30b
LESCH-2 30b
LESCH-3 30b
LESCH-4 30b
GARDEN-1 30a
GARDEN-3 30a
GARDEN-4 30a
WOODP-2 30a
GARDEN-2 29a
BURN-2 29a
PRES-1 29a
TRIG-2 29a
NAVB-2 29a
BURN-1 29a
SEAB-8 29a
CARD10 6
Q2_YANCHEPSCHOOL
CARD11 6
CARD4 6
ELLEN-7 6
PEARCE-1 6
TWIN-4 6
TWIN-1 6
TWIN-2 6
TWIN-3 6
PLINE-6 22
YAN-18 22
YAN-17 22
YAN-22 22
YAN-6 28
NEER-8 28
YAN-4 28
WABL-4 28
MILT-4 28
SHE-2 28
WATERRD1 28
YAN-25 28
SEAB-6 28
YAN-8 28
YAN-9 28
KERO-1 24
THOM-2 24
KERO-2 24
MTB-1 24
HARRY-1 28
HARRY-2 28
TAM-1 21a
WELL-1 21a
PAGA-4 21a
PAGA-7 21a
HARRY-5 21a
WELL-2 21a
NEER-23 28
NEER-22 28
NEER-20 28
NEER-21 28
NEER-2 28
NEER-6 28
WOODV-1 28
WOODV-2 28
DEPOT-1 28
NEER-5 28
YAN-3 28
NEER-3 28
NEER-4 28
TRIG-4 28
KING-1 28

Samples

Group average

Resemblance: S17 Bray Curtis similarity

Similarity

15
20
25
30

WOODP-1 30a
03_YANCHEPSCHOOL
NAVB-4 24
MTB-2 24
MTB-3 24
MTB-4 24
COOL08 24
COOL02 24
COOL03 24
NAVB-3 24
PTWALT-1 10
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
SEAB-7 29b
SEAB-2 29b
SEAB-3 29b
NWIL-1 29b
NWIL-3 29b
NPRES-1 29b
WHILL-1 29b
WHILL-3 27
YALG-3 27
YALG-8 27
SVH-2 27
WHILL-4 27
YALG-4 27
YALG-5 27
SHE-6 26b
WABL-2 26b
YAN-1 26b
YAN-5 26b
YAN-10 26b
YAN-11 26b
NWIL-2 26b
SHE-1 26b
SHE-3 26b
WABL-3 26b
YAN-23 26b
YAN-14 26b
YAN-16 26b
NEER-7 24
NEER-10 24
NEER-9 24
CLIF-2 26a
CLIF-3 26a
SHE-4 26a
SVH-1 26a
YAN-13 26a
WABL-1 26a
SHE-5 26a
YAN-12 26a
YAN-15 26a
YAN-2 26a
YAN-24 26a
SEAB-1 30c
MHENRY-1 30c
MHENRY-2 30c
CHIDPT-1 24
PEPGRV-1 30a
PEPGRV-2 30a
POSSUM3 30b
POSSUM4 30b
LESCH-5 30b
LESCH-1 30b
LESCH-2 30b
LESCH-3 30b
LESCH-4 30b
GARDEN-1 30a
GARDEN-3 30a
GARDEN-4 30a
WOODP-2 30a
GARDEN-2 29a
BURN-2 29a
PRES-1 29a
TRIG-2 29a
NAVB-2 29a
BURN-1 29a
SEAB-8 29a
PLINE-6 22
YAN-18 22
YAN-17 22
YAN-22 22
YAN-6 28
NEER-8 28
YAN-4 28
WABL-4 28
MILT-4 28
SHE-2 28
WATERRD1 28
YAN-25 28
SEAB-6 28
YAN-8 28
YAN-9 28
KERO-1 24
THOM-2 24
KERO-2 24
MTB-1 24
HARRY-1 28
HARRY-2 28
TAM-1 21a
WELL-1 21a
PAGA-4 21a
PAGA-7 21a
HARRY-5 21a
WELL-2 21a
NEER-23 28
NEER-22 28

Samples