

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch

Project No: EP19-068(04)

**Prepared for Rhyian Pty Ltd
July 2019**



Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Document Control

Doc name: Reconnaissance Flora and Vegetation Assessment Lot 1001 Murdoch Drive Murdoch					
Doc no.: EP19-068(04)--003					
Version	Date	Author		Reviewer	
1	July 2019	Sarah Paul		SKP	Tom Atkinson
	Report prepared for client review				

© 2019 Emerge Associates All Rights Reserved. Copyright in the whole and every part of this document belongs to Emerge Associates and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person without the prior written consent of Emerge Associates.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Executive Summary

Rhyian Pty Ltd engaged Emerge Associates (Emerge) to undertake a reconnaissance flora and vegetation survey within Lot 1001 Murdoch Drive in Murdoch (referred to herein as ‘the site’). The site, which is approximately 1.49 hectares (ha) in size, is adjacent to State Energy Commission land to the north, Murdoch Drive to the west and Farrington Road to the south.

A botanist from Emerge Associates visited the site on 24 June 2019 and undertook a reconnaissance flora and vegetation survey. During the survey 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 0.89 ha of the site.
- Remnant native vegetation is present across 0.6 ha of the site in varying levels of condition.
- A total of 66 native and 17 non-native (weed) species were recorded in the site.
- No threatened or priority flora species were recorded within the site. However, some threatened or priority annual or perennial geophytic species would not have been visible at the time of survey, and thus there is a possibility that these species occur within the site. Further survey in spring would be required to confirm the presence or absence of these species.
- The vegetation within the site was classified into the following four plant communities that are present in ‘very good’, ‘good’, ‘degraded’, ‘degraded to completely degraded’ and ‘completely degraded’ condition.
 - Plant community **BaBm** includes the highest quality vegetation in the site and showed high similarity multiple ‘floristic community types’ (FCTs) but was considered most likely to represent FCT 23a ‘Central *Banksia attenuata* – *B. menziesii* woodlands’.
 - Plant community **EmCc** consists of a canopy of large native trees over introduced pasture grasses that and was too degraded to assign to an FCT.
 - Planted vegetation that is disturbed and consists of planted non-native tree species over a low shrubland of *Stirlingia latifolia* and *Acacia pulchella* var. *glaberrima* is present in a small portion of the site and was also too degraded to assign to an FCT.
 - Cleared vegetation is present over the majority of the site and contains bare ground and non-native vegetation.
- The **BaBm** vegetation in good or better condition (0.32 ha) is considered to represent the State listed ‘priority ecological community’ (PEC) ‘banksia dominated woodlands of the Swan Coastal Plain IBRA region’ (P3). The **BaBm** vegetation did not meet the minimum patch threshold to be considered a patch of the ‘banksia woodlands of the Swan Coastal Plain’ ‘threatened ecological community’ (TEC).
- This flora and vegetation survey was undertaken outside of the main flowering period to the level of a reconnaissance assessment. Additional survey effort in spring would be required to confirm the FCT present and the occurrence of threatened and priority flora.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



This page has been left blank intentionally.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Table of Contents

1	Introduction	1
1.1	Project background	1
1.2	Purpose and scope of work	1
2	Environmental Context	2
2.1	Climate	2
2.2	Geomorphology and soils	2
2.3	Topography	3
2.4	Hydrology and wetlands	3
2.5	Regional vegetation	4
2.6	Historic land use	4
2.7	Significant flora and vegetation	6
2.7.1	Threatened and priority flora	6
2.7.2	Threatened and priority ecological communities	6
2.7.3	Local and regional significance	7
2.7.4	Weeds	7
2.8	Bush Forever	7
2.9	Environmentally sensitive areas	7
2.10	Ecological linkages	8
2.11	Previous surveys	8
3	Methods	9
3.1	Desktop assessment	9
3.1.1	Database searches	9
3.1.2	Likelihood of occurrence	9
3.2	Field survey	9
3.2.1	Flora and vegetation	9
3.3	Mapping and data analysis	11
3.3.1	Plant community identification and description	11
3.3.2	Floristic community type assignment	11
3.3.3	Threatened and priority ecological communities	12
3.4	Survey limitations	12
4	Results	14
4.1	General site conditions	14
4.2	Flora	14
4.2.1	Desktop assessment	14
4.2.2	Species inventory	15
4.2.3	Threatened and priority flora	15
4.2.4	Locally and regionally significant flora	15
4.2.5	Declared pests	16
4.3	Vegetation	16
4.3.1	Desktop assessment	16
4.3.2	Plant communities	16
4.3.3	Vegetation condition	19
4.3.4	Floristic community types	20
4.3.5	Threatened and priority ecological communities	21
4.3.6	Locally and regionally significant vegetation	23
5	Discussion	24
5.1	Threatened and priority flora	24
5.2	Vegetation condition	24

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



5.3	Floristic community type assignment	25
5.4	Threatened and priority ecological communities	25
5.5	Local and regional significance	26
6	Conclusions	27
7	References	28
7.1	General references	28
7.2	Online references.....	30

List of Tables

Table 1:	Vegetation condition scale applied during the field assessment	10
Table 2:	Evaluation of survey methodology against standard constraints outlined in EPA (2016).....	12
Table 3:	Conservation significant flora species considered to have potential to occur in the site	14
Table 4:	Plant communities identified within the site	17
Table 5:	Vegetation condition categories within the site	20
Table 6:	Plant community and likely FCT represented within the site for each sample.	21
Table 7:	Criteria for determining presence of Banksia Woodlands of the Swan Coastal Plain TEC adapted from (TSSC 2016)	22

List of Plates

Plate 1:	Aerial photograph of the site in 1965	5
Plate 2:	Aerial photograph of clearing and establishment of drainage sump within the site in 1974 (WALIA 2019).	5
Plate 3:	Fire scar present in 1995 (WALIA 2019).....	5
Plate 4:	Aerial photograph of additional clearing within the site. Also note that the drainage sump is no longer present (WALIA 2019).....	5
Plate 5:	Plant community BaBm in very good condition (Q3).....	17
Plate 6:	Plant community EmCc in degraded-completely degraded condition.	18
Plate 7:	Planted vegetation in degraded condition.....	18
Plate 8:	Cleared vegetation in completely degraded condition.....	19

Figures

Figure 1:	Site Location
Figure 2:	Environmental Features
Figure 3:	Plant Communities
Figure 4:	Vegetation Condition
Figure 5:	Priority Ecological Community

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Appendices

Appendix A

Additional Information

Appendix B

Conservation Significant Flora Species and Likelihood of Occurrence Assessment

Appendix C

Conservation Significant Communities and Likelihood of Occurrence Assessment

Appendix D

Species List

Appendix E

Species x Plant Community Matrix

Appendix F

Sample Data

Appendix G

Cluster Dendrograms

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Abbreviation Tables

Table A1: Abbreviations – Organisations

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

Table A2: Abbreviations – General terms

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

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Table A3: Abbreviations –Legislation

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

Table A4: Abbreviations – planning

Planning terms	
MRS	Metropolitan region scheme
TPS	Town planning 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

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



This page has been left blank intentionally.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



1 Introduction

1.1 Project background

Rhyian Pty Ltd intends to develop Lot 1001 Murdoch Drive in Murdoch for commercial development purposes. This lot (referred to herein as 'the site') is located approximately 18 kilometres (km) south of the Perth Central Business District within the City of Melville and is zoned 'urban' under the Metropolitan Region Scheme and reserved 'service commercial' under the City of Melville *Local Planning Scheme* (LPS) No. 6.

The site is approximately 1.49 hectares (ha) in size and is bound by commercial land to the east, State Energy Commission land to the north, Murdoch Drive to the west and Farrington Road to the south. 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 Rhyian Pty Ltd 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.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



2 Environmental Context

2.1 Climate

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

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

An average of 702.7 millimetres (mm) of rainfall is recorded annually from the Murdoch weather station, which is the closest weather station, located approximately 1 km from the site. The majority of this rainfall is received between the months of May and September. Mean maximum temperatures at the Jandakot Aero weather station, which is the nearest temperature recording station approximately 7 km south-east of the site, range from 18.0°C in July to 31.6°C in February, while mean minimum temperatures range from 6.9°C in July and August to 17.1°C in February (BoM 2019).

2.2 Geomorphology and soils

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

The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly the Swan Coastal Plain consists of two sedimentary belts of different origin. Its eastern side has formed from the deposition of alluvial material washed down from the Darling Scarp, while its western side is comprised of three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004). 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 mapping places the site within the Bassendean association (Churchward and McArthur 1980). The Bassendean dune system comprises sand plains with low dunes and occasional swamps, iron or humus podzols and areas of complex steep dunes.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Finer scale mapping by (Gozzard 2011) also places the site in Bassendean sand (S8) which was later confirmed during the field survey. The Bassendean sands typically very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted of eolian origin (Purdie 2004). The soil types mapped within the site are shown in **Figure 2**.

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

2.3 Topography

The elevation of the site ranges from 21 m in relation to the Australian height datum (mAHD) on the western side of the site to 28 mAHD on the eastern side of the site (DoW 2008) (**Figure 2**).

2.4 Hydrology and wetlands

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

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

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

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

Examination of the Department of Water and Environmental Regulation (DWER) hydrography dataset (DWER 2018) shows no wetland or water related features within the site.

On the Swan Coastal Plain DBCA (2017a) have used the geomorphic wetland classification system developed by Semeniuk (1987) and Semeniuk and Semeniuk (1995) to classify wetlands based on the landform shape and water permanence (hydro-period). The Department of Biodiversity, Conservation and Attractions (DBCA) maintains the *Geomorphic Wetlands of the Swan Coastal Plain* dataset (DBCA 2018b), which further categorises geomorphic wetland features into specific management categories to guide land use and conservation. Note that as this dataset was drafted at a regional scale the boundaries of mapped wetland features are often inconsistent with physical wetland boundaries.

A review of the *Geomorphic Wetlands, Swan Coastal Plain* dataset (DBCA 2018b) indicated that no wetlands occur within or close to the site. However, one conservation category wetland feature (UFI 14645) occurs approximately 130 m to the west of the site. This feature is classified as a sumpland wetland. The location of this geomorphic wetland is shown in **Figure 2**.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



2.5 Regional vegetation

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

Variations in native vegetation within the site can be further classified based on regional vegetation associations. Heddle *et al.* (1980) mapped the site as comprising the 'Bassendean central and south complex', which is described as vegetation ranging from woodland of *Eucalyptus marginata* - *Allocasuarina fraseriana* - *Banksia* spp. to low woodland of *Melaleuca* spp. and sedgelands on the moister sites. This complex was determined to have 27.7% remaining in 2013 (PBP 2013), of which 2.6% is under formal protection.

More recent Beard *et al.* (2013) mapping shows the site as comprising vegetation association 'Bassendean_1001'. This association is described as 'low forest, woodland or low woodland with scattered trees' of '*Eucalyptus marginata*, *Banksia* spp., *Allocasuarina* spp.' (Beard *et al.* 2013). 'Bassendean_1001' association has 22% of its pre-European extent remaining on the Swan Coastal Plain with 13% protected for conservation purposes (Government of Western Australia 2018).

Studies have indicated that the loss of biodiversity caused by habitat fragmentation is significantly greater once a habitat type falls below 30% of its original extent (Miles 2001). The national objectives and targets for biodiversity conservation established an objective of retaining 30% of the original extent of each vegetation complex (Environment Australia 2001). However, a lower objective of 10% is applied in 'constrained urban areas' such as the Swan Coastal Plain (Ministry for Planning 1995). The percentage protected for conservation of the 'Bassendean central and south complex' and the 'Bassendean_1001' association fall below the 30% retention objective. The percentage protected for conservation of the 'Bassendean central and south complex' also falls below the 10% retention objective but the 'Bassendean_1001' association is above this objective.

2.6 Historic land use

Review of historical images available from 1953 onwards shows that the majority of the site was uncleared prior to 1953 (WALIA 2019). However, a track is visible running across the northern portion of the site and a portion of the north western edge of the site appears to have been cleared at this time, likely for grazing and/or cropping uses (**Plate 1**).

By 1974 more extensive clearing is visible in the north eastern portion of the site and extending down into the south western portion of the site (**Plate 2**). A drainage sump is also visible in the south western cleared area. This sump was inundated between June 1981 and 1989.

In February 1995 most of the vegetation within the site has been visibly burnt, with the exception of the western most trees (**Plate 3**).

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch

By 2000 the sump within the site appears to have been filled and a drainage sump was established directly east of the site.

The northern edge of the site was cleared by 2006 in association with the building of a power station in the adjacent lot (**Plate 4**). Some planting is visible in this area by 2008 and is established by 2012. Since this time the vegetation present within the site appears to have remained relatively stable.

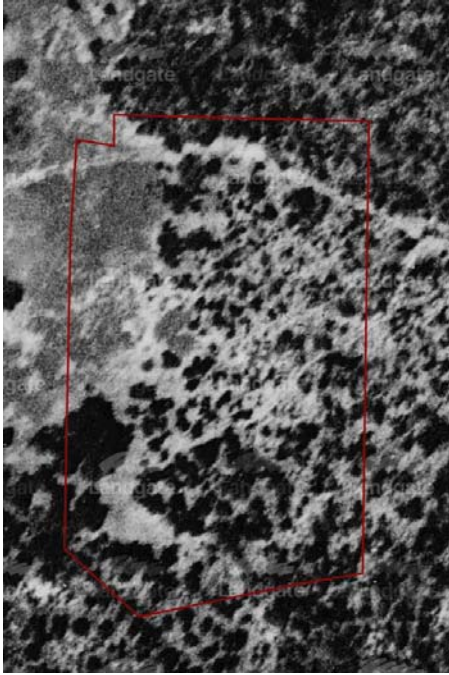


Plate 1: Aerial photograph of the site in 1965 (WALIA 2019).

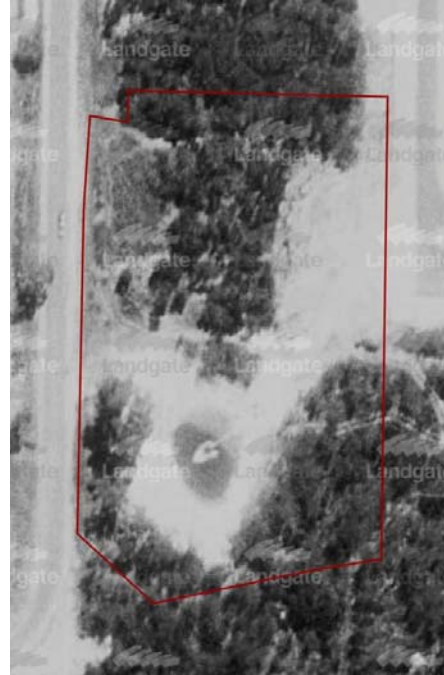


Plate 2: Aerial photograph of clearing and establishment of drainage sump within the site in 1974 (WALIA 2019).



Plate 3: Fire scar present in 1995 (WALIA 2019).



Plate 4: Aerial photograph of additional clearing within the site. Also note that the drainage sump is no longer present (WALIA 2019).

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



2.7 Significant flora and vegetation

2.7.1 Threatened and priority flora

Certain flora taxa that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, flora taxa may be listed as 'threatened' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened flora species listed under the EPBC Act are assigned a conservation status according to attributes such as population size and geographic distribution. Any action likely to have a significant impact on a taxon listed under the EPBC Act requires 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). It is an offence to 'take' or 'disturb' threatened flora listed under the BC Act without Ministerial approval.

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

2.7.2 Threatened and priority ecological communities

An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. An ecological community's structure, composition and distribution are influenced by environmental factors such as soil type, position in the landscape, altitude, climate and water availability (DoEE 2019b). 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

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

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

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

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



2.7.3 Local and regional significance

Flora species and ecological communities may be significant for a number of reasons irrespective of whether they have special protection under policy or legislation. Two key reasons that vegetation within the site may be significant are listed below:

- The site is in proximity to a CCW.
- The vegetation 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.

2.7.4 Weeds

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

A particularly invasive or detrimental weed species may be listed as a 'declared pest' pursuant to Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act), indicating that it warrants special management to limit its spread. At a National level, the Australian government has compiled a list of 32 *Weeds of National Significance* (WoNS) (DoEE 2019c). Whilst the WoNS list is non-statutory, many WoNS are also listed under the BAM Act. Further information on categories of declared pests is provided in **Appendix A**.

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

2.8 Bush Forever

The Government of Western Australia's *Bush Forever* policy is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of *Bush Forever* is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10% of each vegetation complex for protection (Government of WA 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 or in close proximity to the site. Bush Forever Site 244 (North Lake and Bibra Lake, North Lake/Bibra Lake) lies approximately 550 m to the west of the site and extends to the south west of the site.

2.9 Environmentally sensitive areas

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

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



No ESAs are present over the site or in close proximity to the site. One ESA is located to the west of the site and is associated with CCW UFI 14645. The location of this ESA is shown in **Figure 2**.

2.10 Ecological linkages

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

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

There are no mapped ecological linkages within or in close proximity to the site. One regional ecological linkage (No. 50) occurs approximately 800 m west of the site running from north to south and intersects with another ecological linkage (No. 48) running east to west approximately 500 m south of the site. These ecological linkages connect areas of *Bush Forever* located in the wider local area.

2.11 Previous surveys

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

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



3 Methods

3.1 Desktop assessment

3.1.1 Database searches

A search was conducted for threatened and priority flora that may occur or have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DoEE 2019a) and *NatureMap* (DBCA 2019).

A search was also conducted for TECs and PECs that may occur or have been recorded within a 10 km radius of the site using the *Protected Matters Search Tool* (DoEE 2019a) and the *weed and native flora dataset* (Keighery *et al.* 2012).

3.1.2 Likelihood of occurrence

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

An assessment of the likelihood of occurrence of threatened and priority flora species and communities within the site was undertaken and each species was assigned to one of the following categories:

- Recorded: the species has been previously recorded in the site or was recorded during the current field survey.
- Likely: suitable habitat for the species occurs in the site.
- Possible: suitable habitat for the species may occur in the site but is sub-optimal and no existing records occur close to the site.
- Unlikely: no suitable habitat for the species is present within the site.

3.2 Field survey

A botanist from Emerge visited the site on 24 June 2019 to conduct the flora and vegetation field survey.

3.2.1 Flora and vegetation

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

Detailed sampling of the vegetation was undertaken using 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 3**.

The data recorded within each sample included:

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



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

Additional plant taxa not observed within samples were recorded opportunistically as the botanist traversed the site. Photographs were taken throughout the field visit to show particular site conditions.

Conservation significant species previously recorded within the site (refer **Section 3.1.2**) were searched for, where appropriate. The site was also assessed to determine whether suitable habitat was present for conservation significant species identified as potentially occurring within the site and (refer **Section 3.1.2**) whether the survey effort was appropriate to determine if they occur in the site.

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 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 1**).

Table 1: Vegetation condition scale 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%

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Table 1: Vegetation condition scale applied during the field assessment (continued)

Condition category	Definition (Keighery 1994)	Indicator (TSSC 2016)	
		Typical native vegetation composition	Typical weed cover
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%

3.3 Mapping and data analysis

3.3.1 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 mapped on aerial photography from the sample locations and boundaries were interpreted from aerial photography and notes taken in the field. Vegetation condition was mapped on aerial photography based on the locations and notes recorded during the field survey to define areas with differing condition.

3.3.2 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.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



3.3.3 Threatened and priority ecological communities

Areas of native vegetation potentially representing a TEC were assessed against key diagnostic characteristics and, if available, size and/or vegetation condition thresholds provided in the following document:

- *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community (TSSC 2016).*

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 2**.

Table 2: Evaluation of survey methodology against standard constraints outlined in EPA (2016)

Constraint	Degree of limitation	Details
Availability of contextual information	No limitation	The broad scale contextual information described in Section 2 is adequate to place the site and vegetation in context.
	Limitation	Regarding assignment of FCTs, the authoritative Gibson <i>et al.</i> (1994) dataset was derived from a necessarily limited sample of vegetation from largely publicly owned land which is now more than 20 years out of date. Consequently, it is unknown to what degree official FCTs are appropriate reference to biodiverse vegetation across the Swan Coastal Plain. Furthermore, Gibson <i>et al.</i> (1994) collected data in the spring main flowering period and in many cases sampled plots multiple times to provide a complete species list. This reconnaissance survey only sampled the site once and outside of the main flowering period, thus FCTs assignment is based on incomplete data and should be considered preliminary and indicative.
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 June and thus outside of the main flowering season. The site has been subject to historical disturbance but there is still the possibility that annual and geophytic threatened and priority species may occur and would not have been detectable at the time of survey. The survey timing was acceptable for a reconnaissance level 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. As the survey was a reconnaissance level survey conducted in outside of the main flowering period, this limitation is acceptable but the survey does not meet the requirements of a 'detailed' survey.
Spatial coverage and access	No limitation	Site coverage was comprehensive (track logged).
	No limitation	All parts of the site could be accessed as required.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Table 2: Evaluation of survey methodology against standard constraints outlined in EPA (2016) (continued)

Constraint	Degree of limitation	Details
Sampling intensity	Minor limitation	A total of 83 species were recorded, of which 71 were recorded from three sample locations and 12 were recorded opportunistically. An adequate degree of sampling was undertaken for a reconnaissance level survey, given the degree of disturbance and the small area of intact vegetation. Additional sampling in the main flowering period could be combined with the current assessment to meet the requirements of a detailed survey.
Influence of disturbance	Minor limitation	Time since fire is greater than 20 years as interpreted from aerial imagery and therefore short lived species more common after fire may not have been visible.
	No limitation	Historical ground disturbance was evident throughout much of the site. The disturbance history of the site was considered when undertaking field sampling.
Adequacy of resources	No limitation	All resources required to perform the survey were available.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



4 Results

4.1 General site conditions

The site forms a west facing slope with sandy soils. Historical clearing is evident, particularly in the western half of the site. A number of tracks are present throughout and surrounding the periphery of the site. Evidence of disturbance to the landform was observed, particularly the presence of steep sloping sand banks in the north eastern and south eastern portions of the site.

4.2 Flora

4.2.1 Desktop assessment

The database search results identified a total of 17 threatened and 37 priority flora species occurring or potentially occurring within a 10 km radius of the site. Information on these species including their habitat preferences is provided in **Appendix B**.

Based on existing information available for the site, four threatened flora species and eight priority flora species were identified as having potential to occur within the site as shown in **Table 3**.

Table 3: Conservation significant flora species considered to have potential to occur in the site

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
<i>Andersonia gracilis</i>	T	E	P	White/grey sandy, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Sept-Nov	Possible
<i>Caladenia huegelii</i>	T	E	PG	Grey or brown sand, clay loam.	Sept-Oct	Possible
<i>Drakaea elastica</i>	T	E	PG	White or grey sand in dense vegetation in low-lying winter-wet areas.	Oct-Nov	Possible
<i>Drakaea micrantha</i>	T	V	PG	Open sandy patches often adjacent to winter-wet swamps.	Sep-early Oct	Possible
<i>Poranthera moorokatta</i>	P2	-	A	Sandy or clay soils. Dampland or low sandy dunes.	Sep-Nov	Possible
<i>Thelymitra variegata</i>	P2	-	PG	Sandy clay, sand, laterite.	Jun-Sep	Possible
<i>Babingtonia urbana</i>	P3	-	P	Grey sand, sometimes with lateritic gravel.	Jan-Mar	Possible
<i>Dampiera triloba</i>	P3	-	P	Sand/loam/peaty clay. Often low-lying habitats but also recorded on dry sand.	Aug-Dec	Possible

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Table 3: Conservation significant flora species considered to have potential to occur in the site (continued)

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
<i>Jacksonia gracillima</i>	P3	-	P	Sand, often adjacent to winter wet areas	Sep-Dec	Possible
<i>Phlebocarya pilosissima</i> subsp. <i>pilosissima</i>	P3	-	P	White or grey sand, lateritic gravel.	Aug-oct	Possible
<i>Styphelia filifolia</i>	P3	-	P	Brown over pale yellow sand.	Feb-Apr	Possible
<i>Jacksonia sericea</i>	P4	-	P	Calcareous and sandy soils on Swan Coastal Plain	Dec-Feb	Possible

4.2.2 Species inventory

A total of 66 native and 17 non-native (weed) species were recorded within the site during the field survey, representing 31 families and 61 genera. The dominant families containing native taxa were Myrtaceae (12 native taxa and three non-native planted taxa) and Fabaceae (ten native taxa). The most common genera were *Hibbertia*, *Lomandra*, *Eucalyptus* (four taxa each), *Acacia* and *Banksia* (three taxa each). Of the species recorded 71 were recorded in sample locations and 12 were recorded opportunistically.

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

4.2.3 Threatened and priority flora

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

The majority of the threatened and priority flora species identified in the desktop assessment are not considered to occur in the site due to lack of suitable habitat and/or because they were not recorded during the field survey. The survey was unable to confirm the presence or absence of the following three threatened and two priority flora species:

- *Caladenia huegelii* (endangered under the EPBC Act and threatened under the BC Act)
- *Drakaea elastica* (endangered under the EPBC Act and threatened under the BC Act)
- *Drakaea micrantha* (vulnerable under the EPBC Act and threatened under the BC Act)
- *Poranthera moorokatta* (P2)
- *Thelymitra variegata* (P2).

4.2.4 Locally and regionally significant flora

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

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



4.2.5 Declared pests

One species, **Zantedeschia aethiopica* (arum lily) listed as a declared pest (C3) pursuant to the BAM Act, was recorded within the site. A number of young individuals were recorded scattered throughout the site.

No weeds of national significance (WoNS) were recorded.

4.3 Vegetation

4.3.1 Desktop assessment

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

Based geomorphology, soils and regional vegetation patterns, one TEC and one PEC are considered to potentially occur in the site:

- 'Banksia woodlands of the Swan Coastal Plain' TEC which is listed as 'endangered' under EPBC Act. This TEC has potential to also represent a State listed TEC.
- 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region' PEC (P3). This PEC may also represent another PEC.

4.3.2 Plant communities

Four plant communities were identified within the site. Plant community **BaBm** exists across the eastern portion of the site and extends over 0.47 ha. Plant community **EmCc** occurs in small patches on the south western portion of the site adjacent to Murdoch Drive. This community extends over 0.09 ha of the site. A small area of **planted** vegetation is located in the north eastern corner of the site and extends over 0.04 ha. The remainder of the site (0.89 ha) contains non-native vegetation with bare soil, weeds or planted vegetation including **Chamelaucium uncinatum* (Geraldton wax).

A description and the area of each plant community is provided in **Table 4** and representative photographs of each are provided in **Plate 5** to **Plate 8**. The location of each plant community is shown in **Figure 3**. A matrix of species recorded within each plant community is provided in **Appendix E** and raw sample data in **Appendix F**.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch

Table 4: Plant communities identified within the site

Plant community	Description	Area (ha)
BaBm	Low open woodland of <i>Banksia menziesii</i> , <i>Banksia attenuata</i> , <i>Banksia ilicifolia</i> , <i>Eucalyptus marginata</i> and <i>Nuytsia floribunda</i> over open shrubland of <i>Kunzea glabrescens</i> , <i>Xanthorrhoea preissii</i> and <i>Allocasuarina humilis</i> over low shrubland of <i>Acacia pulchella</i> var. <i>glaberrima</i> , <i>Stirlingia latifolia</i> , <i>Eremaea pauciflora</i> var. <i>pauciflora</i> and <i>Hibbertia</i> spp. over forbland of <i>Desmocladius flexuosus</i> , <i>Patersonia occidentalis</i> and <i>Lomandra</i> spp. and open grassland of <i>*Ehrharta calycina</i> and <i>*Briza maxima</i> (Plate 5).	0.47
EmCc	Scattered <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> trees over weeds (Plate 6).	0.09
Planted	Open woodland of planted <i>*Eucalyptus</i> spp. over shrubland of <i>Stirlingia latifolia</i> and <i>Kunzea glabrescens</i> over weeds (Plate 7).	0.04
Cleared	Heavily disturbed areas comprising weeds with occasional native shrubs and forbs and planted vegetation (Plate 8).	0.89



Plate 5: Plant community **BaBm** in 'very good' condition (Q3).

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



*Plate 6: Plant community **EmCc** in 'degraded-completely' degraded condition.*



Plate 7: Planted vegetation in 'degrade'd condition.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Plate 8: Cleared vegetation in 'completely degraded' condition.

4.3.3 Vegetation condition

The most intact native vegetation was located in the eastern portion of the site (approximately 0.47 ha of the **BaBm** plant community). Some of the **BaBm** vegetation was mapped as being in 'very good' condition as it retains the structure expected of a banksia woodland community and has moderate native species diversity. Past disturbance of this area is evident from historical aerial photography and through the presence of weed species. Portions of the **BaBm** vegetation in the north eastern portion of the site were mapped as being in 'good' or 'degraded' condition due to higher weed cover with lower native species cover.

The area of **planted** vegetation in the north eastern corner of the site shows a high level of disturbance, with planted non-native tree species present on a steep north facing slope out of the site boundary (as shown in **Plate 7**). The understorey in this area is sparse and dominated by the native species *Kunzea glabrescens*, *Jacksonia furcellata* and *Stirlingia latifolia*. It is likely that the understorey species present are the result of both planting and recolonisation of native species from the adjacent remnant vegetation. The understorey is also dominated by weeds with notable patches of sandy open ground present. Despite reasonable native cover in parts, this vegetation was mapped as being in 'degraded' condition, due to the degree of disturbance and alteration of the vegetation structure.

The small patches of **EmCc** vegetation in the south western portion of the site consists of trees over scattered native shrubs and dense pasture weeds. This vegetation was mapped as being in 'degraded-completely degraded' condition as it lacks understory structure and has very low species diversity. Past disturbance and clearing is particularly significant in these areas. Consequently the vegetation is effectively parkland cleared and rehabilitation would require intensive management.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Remaining areas in the site are in ‘completely degraded’ condition and consist of non-native species such as pasture grasses and planted trees and shrubs (particularly **Chamelaucium uncinatum* (Geraldton wax)). Sandy tracks within the site were also mapped as being in ‘completely degraded’ condition.

The extent of vegetation by condition category is detailed in **Table 5** and shown in **Figure 4**.

Table 5: Vegetation condition categories within the site

Condition category (Keighery 1994)	Size (ha)
Pristine	0
Excellent	0
Very good	0.13
Good	0.19
Degraded	0.18
Degraded – completely degraded	0.09
Completely degraded	0.89

4.3.4 Floristic community types

Plant community **BaBm** was considered most likely to represent FCT 23a ‘Central *Banksia attenuata* – *Banksia menziesii* woodlands and shrublands’. FCT 23a is listed as ‘well reserved’ and ‘low risk’ by Gibson *et al.* (1994). However, the results of the cluster analysis were not conclusive, with the samples clustering with high similarity to several different FCTs. Sample Q1 grouped with FCT 21c in the cluster analysis with 32% similarity (**Table 6**). Sample Q2 grouped with sites representing FCT 23a in the cluster analysis with 51% similarity (**Table 6**). Sample Q3 clustered with a large group of Gibson *et al.* (1994) sites representing FCT 23a and FCT 23b with 39% similarity. Similarity to individual sites for sample Q3 indicated highest similarity to an FCT 21a site (NINE-2) and a number of FCT 23a sites (as shown in **Table 6**). The relevant portions of the cluster dendrograms showing Q1 - Q3 are provided in **Appendix G**.

Other plant communities in the site were considered too degraded to assign to an FCT.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Table 6: Plant community and likely FCT represented within the site for each sample.

Plant community	Sample unit	Most similar Gibson <i>et al.</i> (1994) sites	Similarity (%)	Most likely floristic community type (FCT)	Reservation and conservation status (Gibson <i>et al.</i> 1994)
BaBm	Q1	HYMUS04 (FCT 21c)	32	FCT 23a: Central <i>Banksia attenuata</i> – <i>B. menziesii</i> woodlands	Well reserved Low risk
		DEJONG-C (FCT 21c)	32		
	Q2	WAND-1 (FCT 23a)	51		
		HARRY-4 (FCT 23a)	46		
		BANK-3 (FCT 23a)	46		
	Q3^	NINE-2 (FCT 21a)	52		
		WAND-1 (FCT 23a)	50		
		HURST04 (FCT 23a)	46		

Note: ^ shows highest percent similarity to individual Gibson *et al.* (1994) samples rather than similarity to a cluster of samples.

4.3.5 Threatened and priority ecological communities

The structure and composition of plant community **BaBm** indicates that it has the potential to represent the Commonwealth ‘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 7**, the **BaBm** vegetation does not satisfy the criteria to be considered a patch of the ‘banksia woodland TEC’ due to its small patch size.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Table 7: 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	<p>A variety of factors relating to:</p> <ul style="list-style-type: none"> • Location • Soils • Structure • Composition 	<ul style="list-style-type: none"> • Site meets location and soils criteria. • The BaBm vegetation includes the key diagnostic feature of a tree layer of <i>Banksia attenuata</i>, <i>Banksia menziesii</i> and <i>Banksia ilicifolia</i>. • The BaBm vegetation within site also meets structure and composition criterion. FCT 23a is identified as one of the FCTs comprising the banksia woodland TEC.
2. Must meet condition thresholds	<ul style="list-style-type: none"> • A patch should at least meet the 'good' condition category (see Table 1) 	<ul style="list-style-type: none"> • The BaBm vegetation is present in 'very good', 'good' and 'degraded' condition, which meets this criterion. The conservation advice indicates that a single patch may include areas of variable condition, meaning parts of the BaBm vegetation in 'degraded' condition may still be considered the TEC.
3. Must meet minimum patch size	<p>Minimum size of patch:</p> <ul style="list-style-type: none"> • Pristine=no minimum size • Excellent=0.5 ha • Very Good=1 ha • Good=2 ha 	<ul style="list-style-type: none"> • The BaBm vegetation in 'very good' condition comprises 0.13 ha and does <u>not</u> independently meet this criterion. • The BaBm vegetation in 'good' condition comprises 0.19 ha and does <u>not</u> independently meet this criterion. • The adjoining BaBm vegetation in 'degraded' condition' would be viewed as contiguous and part of the same patch. Therefore the mapped 0.47 ha of BaBm vegetation does <u>not</u> comprise a patch of the TEC.
4. Must incorporate surrounding context	<ul style="list-style-type: none"> • 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) 	<ul style="list-style-type: none"> • Small scale tracks (<30 m wide) exist within the patch. • Land surrounding the patch is a combination of industrial, native vegetation and planted vegetation on the road verges. • This survey was conducted in June (outside of the main flowering season) • For a reconnaissance level survey, the survey timing is appropriate. Subsequent survey in spring may be required. • Partially intact vegetation is present to the east of the site but is separated from the BaBm vegetation within the site by more than 30m. • Intact native vegetation that is likely to meet criteria as banksia woodland exists in the south east on the other side of Farrington Road but is separated by over 30 m.

At the State level, there is no conservation advice for the 'banksia dominated woodlands of the Swan Coastal Plain IBRA region' PEC (P3) so it is unclear whether a condition threshold should be applied when identifying its presence. The DBCA has historically applied good condition as a threshold for the identification of PEC vegetation. Using good condition as a basis for identification, 0.32 ha of the **BaBm** vegetation is considered to represent the State 'banksia dominated woodlands of the Swan Coastal Plain IBRA region' PEC. The area of the banksia woodland PEC within the site is outlined in **Figure 5**.

No other TECs or PECs occur within the site.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



4.3.6 Locally and regionally significant vegetation

A small number of mature eucalypt trees (diameter at breast height larger than 500 mm) including *Corymbia calophylla* (marri) and *Eucalyptus marginata* (jarrah) are present in 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.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



5 Discussion

The vegetation within the site has been subject to significant past disturbance and approximately 79% of the site is in degraded and completely degraded condition.

The most intact native vegetation occurs in the eastern and south-eastern portion of the site where the **BaBm** plant community is present. This vegetation was considered most likely to represent FCT 21c or FCT 23a which are both banksia woodland communities. A relatively small area of **BaBm** vegetation in good and very good condition remains (21.5% of the sites area), which is surrounded by a fringe of degraded vegetation. Despite being mapped as good and very good condition, the **BaBm** vegetation includes notable weed cover and has been subject to recent physical disturbance. Nonetheless it also retains a woodland structure and a moderate level of native species diversity.

The western areas of the site have been subject to intensive disturbance in the form of partial clearing and changes to the landform through the construction and subsequent removal of a sump (as described in **Section 2.6**).

5.1 Threatened and priority flora

No threatened or priority flora species were recorded within the site. The absence of the larger perennial species such as *Jacksonia gracillima*, *Jacksonia sericea* and *Andersonia gracilis* was relatively easy to confirm. However, due to their size and seasonal lifeform, smaller annual or geophytic species such as *Caladenia huegelii*, *Drakaea elastica*, *D. micrantha*, *Poranthera moorokatta* and *Thelymitra variegata* can be more difficult to detect.

The current reconnaissance survey was not undertaken in the main flowering season for these species and thus they would not have been visible at the time of the survey. Some of the patches of plant community **BaBm** also retain a relatively intact understorey layer of native species and low to moderate weed loads. Thus, there is a possibility that these species do occur within the site, despite the historical disturbances to the vegetation. Further survey in the main flowering period of these species would be required to confirm their presence or absence within the site.

5.2 Vegetation condition

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. The method applied to assess vegetation condition was robust, as it combined the standard qualitative, categorical scheme of Keighery (1994), with the additional indicators for diversity and weed cover outlined in DoEE (2016).

A compound condition category ('degraded to completely degraded') was included in the results of this survey for patches of plant community **EmCc** that comprised a number of mature native trees over a highly scattered native shrub understorey dominated by weed species.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Further survey during the growing and flowering season is likely to assist in the detection of annual and geophytic native and non-native species that may influence the final assessment of vegetation condition.

5.3 Floristic community type assignment

The results of the FCT cluster analysis were not conclusive, with the samples within plant community **BaBm** showing high similarity to multiple FCTs. FCT 23a is considered to be the most likely FCT present over the site as sample Q2 and Q3 both clustered with this FCT and these samples represent the best condition vegetation present within the site. However, sample Q1 clustered with FCT 21c – ‘low lying *Banksia attenuata* woodlands or shrublands’ which tends to occur on sands in wetter, lower elevation areas of the Bassendean dune system on the Swan Coastal Plain (Gibson *et al.* 1994). Sample Q1 is the lowest in elevation of the three samples taken within the site. The sites’ position upslope from a sumpland wetland (UFI 14645) suggests that the site could be somewhat transitional between FCT 23a and FCT 21c. Moreover, a number of species that were recorded throughout the **BaBm** vegetation are indicative of a relatively low-lying habitat. These include *Banksia ilicifolia*, *Schoenus subfascicularis*, *Beaufortia elegans*, *Melaleuca thymoides* and *Schoenus curvifolius* (DBC 2019).

Further survey in the main flowering season is likely to record additional flora species that were not visible during the reconnaissance survey and a combined dataset based on a detailed spring survey are likely to provide more conclusive results when statistically compared to the Gibson *et al.* (1994) dataset.

5.4 Threatened and priority ecological communities

Due to the presence of *Banksia attenuata* and *B. menziesii* on deep sands, the **BaBm** community is considered 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 **BaBm** vegetation in good or better condition would be considered to represent this PEC.

With regard to the Commonwealth banksia woodlands TEC, the **BaBm** vegetation includes the key diagnostic feature of a tree layer of *Banksia attenuata* and *B. menziesii*. It also showed high similarity (32-51%) with two FCTs (FCT 21c and FCT 23a) that are both 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 1**). The conservation advice 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 **BaBm** community, 0.13 ha was mapped as very good and 0.19 ha was mapped as good, while 0.18 ha was mapped as degraded. As there are no breaks of 30 m or more to separate the areas of varying condition, these areas were understood as a single patch. Given the area of each the three condition categories present is relatively similar (that is, none of the conditions could be considered ‘representative’ of the whole patch), the whole patch was conservatively assessed as being in very good condition. The DoEE (2016) conservation advice states that a patch of banksia woodland

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



vegetation in very good condition must be greater than 1 ha in size for it to be considered the TEC. Based on this, the **BaBm** vegetation does not meet the minimum patch size threshold.

Vegetation likely to comprise 'banksia woodland' is present in proximity to the site, particularly to the east and south east of the site. However, due to breaks in the vegetation (due to Farrington Road and the presence of highly disturbed/planted vegetation on the road reserve to the east) over 30 m in width, these additional areas of vegetation are not considered to be contiguous with the **BaBm** vegetation within the site and thus do not comprise part of the same patch. As such, the Commonwealth banksia woodland TEC is not considered to be present within the site.

5.5 Local and regional significance

Plant communities **BaBm** and **EmCc** contain a number of foraging species for black cockatoos (especially Carnaby's black cockatoo). In addition, a small number of mature *Corymbia calophylla*, *Eucalyptus marginata* and **Eucalyptus* sp. trees with a diameter at breast height larger than 500 mm are present within the site. Due to their size these trees have the potential to provide some foraging, roosting and nesting values for black cockatoos, along with other ecological services.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



6 Conclusions

Over half of the site is highly disturbed and modified, with approximately 0.89 ha of the site containing 'completely degraded', non-native vegetation. The remaining 0.60 ha of the site includes native vegetation that is present in 'degraded' to 'very good' condition.

No threatened or priority flora species were recorded within the site. The current reconnaissance survey was not undertaken in the main flowering season (spring) and further survey would be required to confirm the presence or absence of some threatened and priority flora species with potential to occur in the site.

The site contains 0.84 ha of banksia woodland vegetation (plant community **BaBm**), that is considered to most likely represent FCT 23a. This vegetation does not meet the threshold minimum patch size of the EPBC Act listed banksia woodlands TEC. However, the **BaBm** vegetation in 'good' and 'very good' condition (0.32 ha) is considered to represent the State listed PEC 'Banksia dominated woodlands of the Swan Coastal Plain IBRA region' (P3).

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



7 References

7.1 General references

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

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

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

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

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

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

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

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

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

Department of the Environment and Energy (DoEE) 2016, *Banksia Woodlands of the Swan Coastal Plain in Community and Species Profile and Threats Database*, Canberra.

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

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

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

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

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



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

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

Gibson, N., Keighery, B., Keighery, G., Burbidge, A. and Lyons, M. 1994, *A Floristic survey of the southern Swan Coastal Plain*, Department of Conservation and Land Management and the Conservation Council of Western Australia, Perth.

Government of WA 2000, *Bush Forever - Volume 1: Policies, principles and processes*, Perth.

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

Gozzard, J. 2011, *Sea to scarp - geology, landscape, and land use planning in the southern Swan Coastal Plain*, Geological Survey of Western Australia.

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

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

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

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

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

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

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

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

Perth Biodiversity Project (PBP) 2013, *2013 Native Vegetation extent by Vegetation complexes on the Swan Coastal Plain south of Moore River* Western Australian Local Government Association, Perth.

Reconnaissance Flora and Vegetation Assessment

Lot 1001 Murdoch Drive Murdoch



Purdie, B., Tille, PJ, and Schoknecht, NR 2004, *Soil-landscape mapping in south-Western Australia: an overview of methodology and outputs*. Resource Management Technical Report 280, DoA.

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

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

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

Threatened Species Scientific Committee (TSSC) 2016, *Approved Conservation Advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community*.

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

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

7.2 Online references

Bureau of Meteorology (BoM) 2019, *Climate Averages*, viewed 28 June 2019, <<http://www.bom.gov.au/climate/data/>>.

Department of the Environment (DoEE) 2019a, *Protected Matters Search Tool*, viewed 20 June 2019, <<https://www.environment.gov.au/epbc/protected-matters-search-tool>>.

Department of the Environment (DoEE) 2019b, *Threatened Ecological Communities*, viewed 20 June 2019, <<http://www.environment.gov.au/biodiversity/threatened/communities/about>>.

Department of the Environment (DoEE) 2019c, *Weeds of National Significance*, viewed 12 July 2019, <<http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>>.

Department of Biodiversity, Conservation and Attractions (DBCA) 2019b, *NatureMap*, viewed 12 July 2019 <<https://naturemap.dbca.wa.gov.au/>>.

West Australian Land Information Authority (WALIA) 2019, *Landgate Map Viewer*, viewed 28 June 2019, <<http://landgate.wa.gov.au>>.

Western Australian Herbarium 2019, *FloraBase – the Western Australian Flora*, Department of Biodiversity, Conservation and Attractions (DBCA), viewed 15 July 2019 <<https://florabase.dpaw.wa.gov.au/>>.

Figures



Figure 1: Site Location

Figure 2: Environmental Features

Figure 3: Plant Communities

Figure 4: Vegetation Condition

Figure 5: Priority Ecological Community



Figure 1: Site Location

Project: Reconnaissance Flora and Vegetation Assessment
 Lot 1001 Murdoch Drive Murdoch
Client: Rhyian Pty Ltd

Plan Number: EP19-068(04)-F09
Drawn: KNM
Date: 05/07/2019
Checked: SCP
Approved: TAA
Date: 19/07/2019

Scale: 1:2,500@A4
 GDA 1994 MGA Zone 50



While Emmerge Associates makes every attempt to ensure the accuracy and completeness of data, Emmerge accepts no responsibility for externally sourced data used

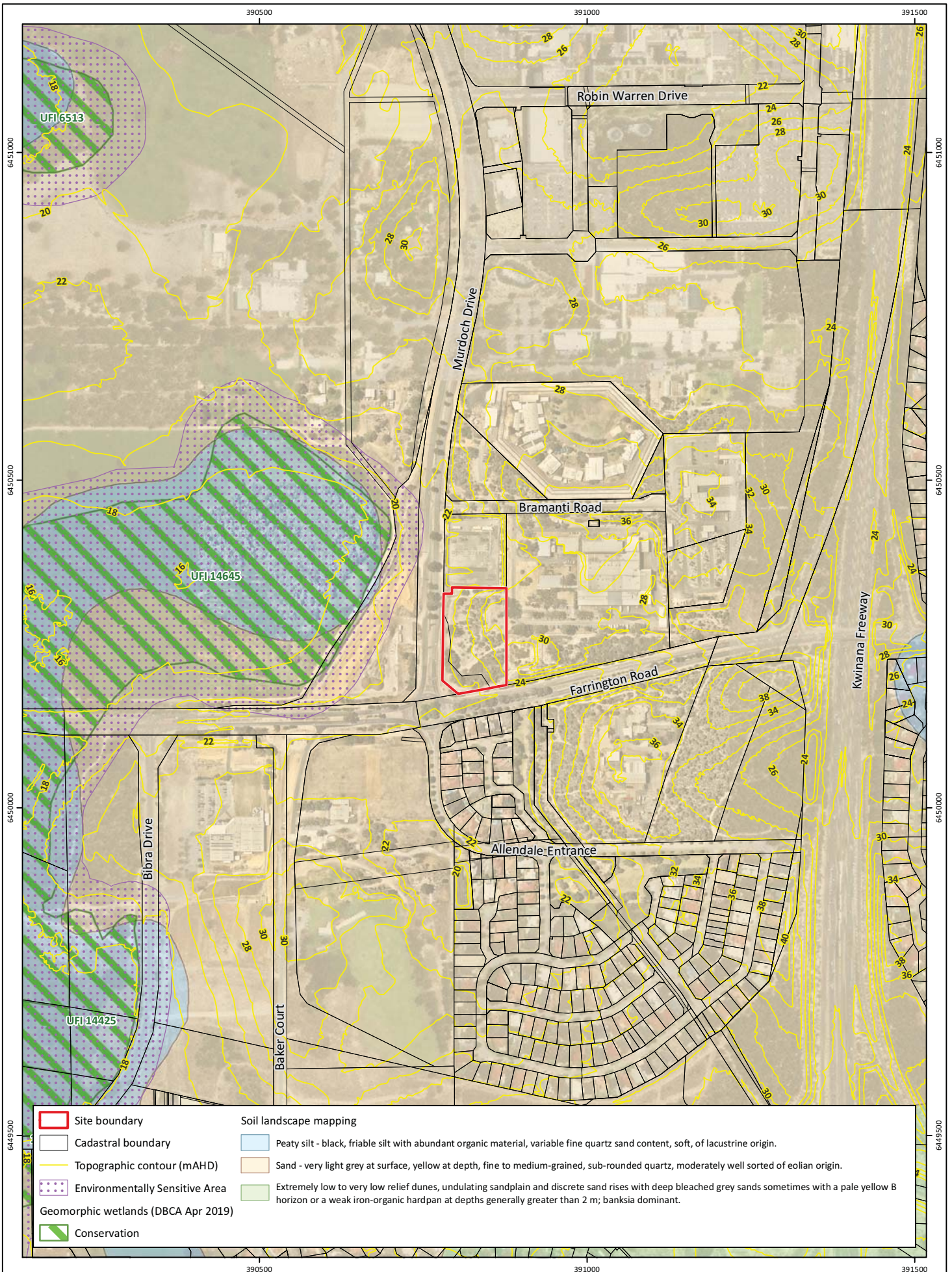
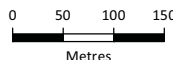


Figure 2: Environmental Features

Project: Reconnaissance Flora and Vegetation Assessment
 Lot 1001 Murdoch Drive Murdoch

Client: Rhyian Pty Ltd

Plan Number: EP19-068(04)-F10
Drawn: KNM
Date: 05/07/2019
Checked: SCP
Approved: TAA
Date: 19/07/2019



Scale: 1:7,500@A4
 GDA 1994 MGA Zone 50

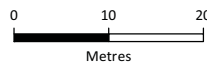




Site boundary	Plant communities	
Cadastral boundary	BaBm	Low open woodland of <i>Banksia menziesii</i> , <i>Banksia attenuata</i> , <i>Banksia ilicifolia</i> , <i>Eucalyptus marginata</i> and <i>Nuytsia floribunda</i> over open shrubland of <i>Kunzea glabrescens</i> , <i>Xanthorrhoea preissii</i> and <i>Allocasuarina humilis</i> over low shrubland of <i>Acacia pulchella</i> var. <i>glaberrima</i> , <i>Stirlingia latifolia</i> , <i>Eremaea pauciflora</i> var. <i>pauciflora</i> and <i>Hibbertia</i> spp. over forbland of <i>Desmodcladus flexuosus</i> , <i>Patersonia occidentalis</i> and <i>Lomandra</i> spp. and open grassland of <i>*Ehrharta calycina</i> and <i>*Briza maxima</i> .
Survey location	EmCc	Scattered <i>Eucalyptus marginata</i> and <i>Corymbia calophylla</i> trees over weeds.
	Planted	Open woodland of planted <i>*Eucalyptus</i> spp. over shrubland of <i>Stirlingia latifolia</i> and <i>Kunzea glabrescens</i> over weeds.
	Cleared	Heavily disturbed areas comprising weeds with occasional native shrubs and forbs and planted vegetation.

Figure 3: Plant Communities

Plan Number:
EP19-068(04)-F11
Drawn: KNM
Date: 05/07/2019
Checked: SCP
Approved: TAA
Date: 19/07/2019



Scale: 1:800@A4
GDA 1994 MGA Zone 50

Project: Reconnaissance Flora and Vegetation Assessment
Lot 1001 Murdoch Drive Murdoch
Client: Rhyian Pty Ltd



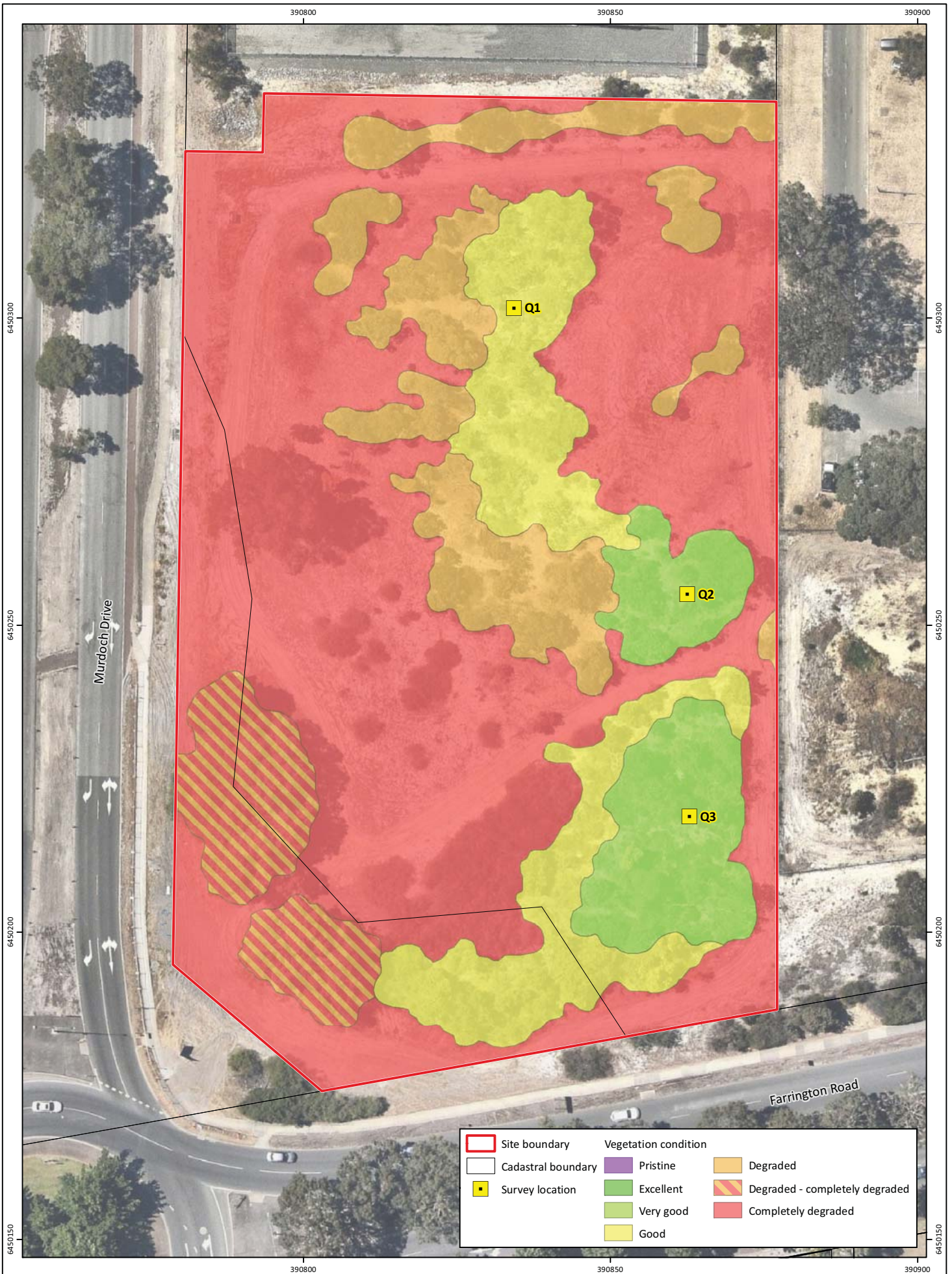


Figure 4: Vegetation Condition

Project: Reconnaissance Flora and Vegetation Assessment
 Lot 1001 Murdoch Drive Murdoch
Client: Rhyian Pty Ltd

Plan Number: EP19-068(04)--F12
Drawn: KNM
Date: 05/07/2019
Checked: SCP
Approved: TAA
Date: 19/07/2019



0 10 20
 Metres
Scale: 1:800@A4
 GDA 1994 MGA Zone 50








	Site boundary
	Cadastral boundary
	'Banksia dominated woodlands of the Swan Coastal Plain IBRA region' PEC (State, P3)

Figure 5: Priority Ecological Community

Project: Reconnaissance Flora and Vegetation Assessment
 Lot 1001 Murdoch Drive Murdoch
Client: Rhyian Pty Ltd

Plan Number: EP19-068(04)--F13
Drawn: KNM
Date: 05/07/2019
Checked: SCP
Approved: TAA
Date: 26/07/2019



0 10 20
 Metres
Scale: 1:800@A4
 GDA 1994 MGA Zone 50



Appendix A

Additional Information



Conservation Significant Flora and Vegetation

Threatened and priority flora

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

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

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

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

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

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

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

Additional Background Information

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

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

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

Threatened and priority ecological communities

'Threatened ecological communities' (TECs) are recognised as ecological communities that are rare or under threat and therefore warrant special protection. Selected TECs are afforded statutory protection at a Commonwealth level under section 181 of the EPBC Act. TECs nominated for listing under the EPBC Act are considered by the Threatened Species Scientific Committee and a final decision is made by the Commonwealth Minister for the Environment 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.

Additional Background Information

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

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

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

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

An ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined may be listed as a 'priority ecological community' (PEC). PECs are categorised as priority category 1, 2 or 3 as described in **Table 3**. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for 'near threatened', or that have been recently removed from the threatened list, are placed in 'priority 4'. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in 'priority 5' (DEC 2009). Listed PECs are published by DBCA (DBCA 2017).

Additional Background Information

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

Priority code	Description
P1	<p>Priority One</p> <p>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.</p>
P2	<p>Priority Two</p> <p>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.</p>
P3	<p>Priority Three</p> <p>Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(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;</p> <p>(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.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
P4	<p>Priority Four</p> <p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring.</p>
P5	<p>Priority Five</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Weeds

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

Declared Pests

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

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

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

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

Additional Background Information

Table 5: Control categories of declared pest species listed under the BAM Act (DAFWA 2016).

Category	Description
C1	<p>Exclusion</p> <p>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.</p>
C2	<p>Eradication</p> <p>Present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.</p>
C3	<p>Management</p> <p>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.</p>

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.

References

General references

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

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

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

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

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

Online references

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

Department of Primary Industries and Regional Development (DPIRD) 2019, The Western Australian Organism List (WAOL), <<https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol>>.

Appendix B

Conservation Significant Flora Species and Likelihood of
Occurrence Assessment



Table Appendix B1: Conservation significant flora species known or likely to occur within 10 km of the site

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
<i>Grevillea thelemanniana</i>	T	CE	P	Sand, sandy clay. Winter-wet low-lying flats.	May-Nov	Unlikely
<i>Synaphea</i> sp. Fairbridge Farm	T	CE	P	Low woodland on grey, clayey sand with lateritic pebbles (Pinjarra Plain) near winter wet flats.	Sep-Nov	Unlikely
<i>Andersonia gracilis</i>	T	E	P	White/grey sandy, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Sept-Nov	Possible
<i>Caladenia huegelii</i>	T	E	PG	Grey or brown sand, clay loam.	Sept-Oct	Possible
<i>Calytrix breviseta</i> subsp. <i>breviseta</i>	T	E	P	Seasonally wet sandy-clay soil on swampy flats	Oct-Nov	Unlikely
<i>Diuris purdiei</i>	T	E	PG	Grey-black sand, moist.	Sept-Oct	Unlikely
<i>Drakaea elastica</i>	T	E	PG	White or grey sand in dense vegetation in low-lying winter-wet areas.	Oct-Nov	Possible
<i>Eremophila glabra</i> subsp. <i>chlorella</i>	T	E	P	Sandy clay. Winter-wet depressions.	Jul-Nov	Unlikely
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	T	E	P	Sand, sandy loam. Winter-wet heath.	Aug-Sep	Unlikely
<i>Lepidosperma rostratum</i>	T	E	P	Peaty sand and clay amongst low heath, in winter-wet swamps.	May-June	Unlikely
<i>Macarthuria keigheryi</i>	T	E	P	Low-lying winter-wet damp grey/white sands in open patches.	Sep-Dec/ Feb-Mar	Unlikely
<i>Thelymitra dedmaniarum</i>	T	E	PG	Red brown sandy loam with dolerite and granite outcrops.	Oct-Nov	Unlikely
<i>Thelymitra stellata</i>	T	E	PG	Sandy loam, clay or gravel over laterite or gravel.	Sep-Nov	Unlikely
<i>Diuris drummondii</i>	T	V	PG	In low-lying depressions in peaty and sandy clay swamps.	Nov-Jan	Unlikely
<i>Diuris micrantha</i>	T	V	PG	Dark grey-black sandy clay-loam in winter wet depressions or swamps. Often in shallow standing water.	Aug/Sep-early Oct	Unlikely
<i>Drakaea micrantha</i>	T	V	PG	Open sandy patches often adjacent to winter-wet swamps.	Sep-early Oct	Possible
<i>Eleocharis keigheryi</i>	T	V	P	Clay or sandy loam in freshwater creeks and transient waterbodies such as seasonally wet clay pans.	Aug-Dec	Unlikely

Table Appendix B1: Conservation significant flora species known or likely to occur within 10 km of the site (continued)

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle variant (G.J. Keighery 5026)	P1	-	P	Grey or black sand over clay in swampy areas and winter wet lowlands.	May or Aug	Unlikely
<i>Haloragis scoparia</i>	P1	-	P	Clay in winter-wet areas.	May	Unlikely
<i>Hydrocotyle striata</i>	P1	-	A	Sand and clay in springs and creeklines.	Nov	Unlikely
<i>Ptilotus sericostachyus</i> subsp. <i>roseus</i>	P1	-	P	Unknown. Seem to be associated with wetlands/rivers.	Sep-Dec	Unlikely
<i>Acacia benthamii</i>	P2	-	P	Sand, typically on limestone breakaways	Aug-Sep	Unlikely
<i>Bossiaea modesta</i>	P2		P	Soils derived from granite. Damp areas close to stream.	Oct-Dec	Unlikely
<i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>	P2		P	Grey white yellow sands on flats and seasonally wet areas.	Sep	Unlikely
<i>Poranthera moorokatta</i>	P2		A	Sandy or clay soils. Dampland or low sandy dunes.	Sep-Nov	Possible
<i>Thelymitra variegata</i>	P2		PG	Sandy clay, sand, laterite.	Jun-Sep	Possible
<i>Thysanotus</i> sp. <i>Badgingarra</i> (E.A. Griffin 2511)	P2		P	Grey sand with lateritic gravel.	Dec	Unlikely
<i>Acacia horridula</i>	P3		P	Gravelly soils over granite, sand, rocky hillsides.	May-Aug	Unlikely
<i>Angianthus micropodioides</i>	P3		A	Saline sandy soils on edge of rivers, depressions and clay pans	Nov-Dec/Jan-Feb	Unlikely
<i>Babingtonia urbana</i>	P3		P	Grey sand, sometimes with lateritic gravel.	Jan-Mar	Possible
<i>Byblis gigantea</i>	P3		P	Sandy-peat swamps. Seasonally wet areas.	Sep-Jan	Unlikely
<i>Cyathochaeta teretifolia</i>	P3	-	P	Grey sand, sandy clay in swamps and creek edges.	Oct-Jan	Unlikely
<i>Dampiera triloba</i>	P3		P	Sand/loam/peaty clay. Often low-lying habitats but also recorded on dry sand.	Aug-Dec	Possible
<i>Dillwynia dillwynioides</i>	P3		P	Winter wet depressions on sandy soils.	Aug-Dec	Unlikely
<i>Hibbertia spicata</i> subsp. <i>leptotheca</i>	P3		P	Sand. Near-coastal limestone ridges, outcrops & cliffs	Aug-Dec/Jan	Unlikely

Table Appendix B1: Conservation significant flora species known or likely to occur within 10 km of the site (continued)

Species	Level of significance		Life strategy	Habitat	Flowering period	Likelihood of occurrence
	State	EPBC Act				
<i>Jacksonia gracillima</i>	P3		P	Sand, often adjacent to winter wet areas	Sep-Dec	Possible
<i>Phlebocarya pilosissima</i> subsp. <i>pilosissima</i>	P3		P	White or grey sand, lateritic gravel.	Aug-oct	Possible
<i>Pimelea calcicola</i>	P3		P	Sand, limestone, coastal ridges	Sep-Nov	Unlikely
<i>Schoenus benthamii</i>	P3		P	White, grey sands, sandy clay in winter wet flats and swamps	Oct-Nov	Unlikely
<i>Schoenus capillifolius</i>	P3		A	Brown mud in claypans	Oct-Nov	Unlikely
<i>Stylidium aceratum</i>	P3		A	Sandy soils in swamp heathland.	Oct-Nov	Unlikely
<i>Stylidium maritimum</i>	P3		P	Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	Sep-Nov	Unlikely
<i>Stylidium paludicola</i>	P3		P	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland	Oct-Dec	Unlikely
<i>Styphelia filifolia</i>	P3		P	Brown over pale yellow sand.	Feb-Apr	Possible
<i>Aponogeton hexatepalus</i>	P4		P	Mud. Freshwater: ponds, rivers, claypans.	Jul-Oct	Unlikely
<i>Dodonaea hackettiana</i>	P4		P	Sand, outcropping limestone.	Jul-Oct	Unlikely
<i>Drosera occidentalis</i>	P4		P	Sandy & clayey soils in swamps & wet depressions.	Nov-Dec	Unlikely
<i>Hydrocotyle lemnoides</i>	P4		A	Floating in swamps.	Aug-Oct	Unlikely
<i>Jacksonia sericea</i>	P4		P	Calcareous and sandy soils on Swan Coastal Plain	Dec-Feb	Possible
<i>Kennedia beckxiana</i>	P4		P	Sand or loam on granite hills and outcrops.	Sep-Dec	Unlikely
<i>Microtis quadrata</i>	P4		PG	Sand, loam or peat in winter wet areas	Oct-Dec	Unlikely
<i>Stylidium longitubum</i>	P4		A	Seasonal wetlands.	Oct-Dec	Unlikely
<i>Tripterococcus</i> sp. <i>Brachylobus</i> (A.S. George 14234)	P4		P	Winter-wet areas on grey sand.	Oct-Feb	Unlikely
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	P4		P	Sand and sandy clay in winter wet areas.	May or Nov-Jan	Unlikely

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

Appendix C

Conservation Significant Communities and Likelihood of
Occurrence Assessment



Table Appendix C1: Significant communities known or likely to occur within 10 km of the site

Code	Community name	TEC/ PEC	Level of significance	
			State	EPBC Act
Multiple	Claypans of the Swan Coastal Plain	TEC	-	Critically Endangered
SCP 07	Herb rich saline shrublands in clay pans	TEC	-	Critically Endangered (Clay pans of the Swan Coastal Plain)
Coastal Saltmarsh	Subtropical and temperate coastal saltmarsh	TEC	Priority 3	Vulnerable
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 21a	Central <i>Banksia attenuata</i> – <i>Eucalyptus marginata</i> woodlands	PEC	Priority 3	Endangered (Banksia woodlands of the Swan Coastal Plain)
SCP 21c	Low lying <i>Banksia attenuata</i> woodlands or shrublands	TEC/ PEC	Priority 3	
SCP 24	Northern Spearwood shrublands and woodlands	TEC/ PEC	Priority 3	
SCP 23a	Central <i>Banksia attenuata</i> – <i>B. menziesii</i> woodlands	TEC/ PEC	Priority 3	
SCP 28	Spearwood <i>Banksia attenuata</i> or <i>Banksia attenuata</i> – <i>Eucalyptus</i> woodlands	TEC/ PEC	Priority 3	

*Communities considered to be potentially present within the site shaded green.

Appendix D

Species List



Flora Species List - Lot 1001 Murdoch Drive Murdoch

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

Family	Status	Species
Aizoaceae	*	<i>Carpobrotus edulis</i>
Anarthriaceae		<i>Lyginia imberbis</i>
Araceae	*DP	<i>Zantedeschia aethiopica</i>
Asparagaceae		<i>Laxmannia squarrosa</i> <i>Lomandra ?caespitosa</i> <i>Lomandra hermaphrodita</i> <i>Lomandra preissii</i> <i>Lomandra suaveolens</i> <i>Thysanotus manglesianus</i> <i>Thysanotus ?sparteus</i>
Asteraceae	*	<i>Ursinia anthemoides</i>
Casuarinaceae		<i>Allocasuarina humilis</i>
Colchicaceae		<i>Burchardia congesta</i>
Cyperaceae		<i>Lepidosperma pubisquameum</i> <i>Mesomelaena pseudostygia</i> <i>Schoenus curvifolius</i> <i>Schoenus subfascicularis</i>
Dasypogonaceae		<i>Dasypogon bromeliifolius</i>
Dilleniaceae		<i>Hibbertia cuneiformis</i> <i>Hibbertia huegelii</i> <i>Hibbertia hypericoides</i> <i>Hibbertia subvaginata</i>
Droseraceae		<i>Drosera erythrorhiza</i> <i>Drosera sp.</i>

Flora Species List - Lot 1001 Murdoch Drive Murdoch

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

Family	Status	Species
Ericaceae		<i>Conostephium pendulum</i> <i>Leucopogon conostephioides</i>
Euphorbiaceae	*	<i>Euphorbia terracina</i>
Fabaceae		<i>Acacia huegelii</i> <i>Acacia pulchella</i> var. <i>glaberrima</i> <i>Acacia stenoptera</i> <i>Bossiaea eriocarpa</i> <i>Daviesia nudiflora</i> <i>Daviesia triflora</i> <i>Gompholobium tomentosum</i> <i>Hovea pungens</i> <i>Hovea trisperma</i> <i>Jacksonia furcellata</i>
Geraniaceae	*	<i>Erodium botrys</i>
	*	<i>Geranium molle</i>
	*	<i>Pelargonium capitatum</i>
Goodeniaceae		<i>Dampiera linearis</i>
Haemodoraceae		<i>Anigozanthos</i> sp. <i>Conostylis aculeata</i> <i>Phlebocarya ciliata</i>
Hemerocallidaceae		<i>Dianella revoluta</i>
Iridaceae	*	? <i>Freesia</i> sp.
	*	<i>Gladiolus caryophyllaceus</i> <i>Patersonia occidentalis</i>
Lamiaceae		<i>Hemiandra pungens</i>
Loranthaceae		<i>Nuytsia floribunda</i>

Flora Species List - Lot 1001 Murdoch Drive Murdoch

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

Family	Status	Species
Myrtaceae		
		<i>Beaufortia elegans</i>
		<i>Calothamnus quadrifidus</i>
		<i>Calytrix flavescens</i>
	*PL	<i>Chamelaucium uncinatum</i>
		<i>Eremaea pauciflora</i> var. <i>pauciflora</i>
	*PL	<i>Eucalyptus caesia</i>
		<i>Eucalyptus marginata</i>
	*PL	<i>Eucalyptus utilis</i>
	*PL	<i>Eucalyptus</i> sp.
		<i>Hypocalymma robustum</i>
		<i>Kunzea glabrescens</i>
		<i>Melaleuca seriata</i>
		<i>Melaleuca thymoides</i>
		<i>Scholtzia involucrata</i>
Orchidaceae		
		<i>Eriochilus ?dilatatus</i>
		<i>Pterostylis ?vittata</i>
Oxalidaceae		
	*	<i>Oxalis pes-caprae</i>
Poaceae		
	*	<i>Briza maxima</i>
	*	<i>Ehrharta calycina</i>
	*	<i>Eragrostis curvula</i>
Proteaceae		
		<i>Banksia attenuata</i>
		<i>Banksia ilicifolia</i>
		<i>Banksia menziesii</i>
		<i>Persoonia saccata</i>
		<i>Petrophile linearis</i>
		<i>Stirlingia latifolia</i>
Restionaceae		
		<i>Desmocladius flexuosus</i>
Stylidiaceae		
		<i>Stylidium ?neurophyllum</i>
		<i>Stylidium repens</i>
Thymelaeaceae		
		<i>Pimelea sulphurea</i>

Flora Species List - Lot 1001 Murdoch Drive Murdoch

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

Family	Status	Species
Xanthorrhoeaceae		<i>Xanthorrhoea preissii</i>
Zamiaceae		<i>Macrozamia riedlei</i>

Appendix E

Species x Plant Community Matrix



Flora Species x Plant Community Matrix - Lot 1001 Murdoch Drive Murdoch

Species	Plant community and sample ID									
	BaBm			EmCc			Planted		Parkland cleared	
	Q1	Q2	Q3	Opp	Opp	Opp	Opp	Opp	Opp	
* ? <i>Freesia</i> sp.		X								
<i>Acacia huegelii</i>			X							
<i>Acacia pulchella</i> var. <i>glaberrima</i>	X	X	X							
<i>Acacia stenoptera</i>		X	X							
<i>Allocasuarina humilis</i>	X	X	X							
<i>Anigozanthos</i> sp.		X								
<i>Banksia attenuata</i>	X	X	X							
<i>Banksia ilicifolia</i>	X	X	X	X						
<i>Banksia menziesii</i>	X	X	X							
<i>Beaufortia elegans</i>	X	X	X							
<i>Bossiaea eriocarpa</i>	X	X	X							
* <i>Briza maxima</i>	X	X	X					X		X
<i>Burchardia congesta</i>	X		X							
<i>Calothamnus quadrifidus</i>			X							
<i>Calytrix flavescens</i>		X								
* <i>Carpobrotus edulis</i>	X	X		X				X		X
* <i>Chamelaucium uncinatum</i>			X	X				X		X
<i>Conostephium pendulum</i>		X								
<i>Conostylis aculeata</i>	X									
<i>Corymbia calophylla</i>									X	
<i>Dampiera linearis</i>	X	X								
<i>Dasyogon bromeliifolius</i>		X	X							
<i>Daviesia nudiflora</i>		X								
<i>Daviesia triflora</i>		X	X							
<i>Desmodcladus flexuosus</i>	X	X	X							
<i>Dianella revoluta</i>	X	X							X	
<i>Drosera erythrorhiza</i>		X								
<i>Drosera</i> sp.			X							
* <i>Ehrharta calycina</i>	X	X	X					X		X

Flora Species x Plant Community Matrix - Lot 1001 Murdoch Drive Murdoch

Species	Plant community and sample ID									
	BaBm			EmCc			Planted		Parkland cleared	
	Q1	Q2	Q3	Opp	Opp	Opp	Opp	Opp	Opp	
* <i>Eragrostis curvula</i>				X						
<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	X	X	X							X
<i>Eriochilus ?dilatatus</i>	X									
* <i>Erodium botrys</i>				X						
* <i>Eucalyptus caesia</i>								X		
<i>Eucalyptus marginata</i>	X	X								
* <i>Eucalyptus</i> sp.									X	
* <i>Eucalyptus utilis</i>									X	
* <i>Euphorbia terracina</i>							X			
* <i>Geranium molle</i>										
* <i>Gladiolus caryophyllaceus</i>					X					
<i>Gompholobium tomentosum</i>	X	X	X							
<i>Hemiandra pungens</i>	X	X	X							
<i>Hibbertia cuneiformis</i>	X	X	X							
<i>Hibbertia huegelii</i>					X					
<i>Hibbertia hypericoides</i>	X	X	X							
<i>Hibbertia subvaginata</i>	X		X							
<i>Hovea pungens</i>					X					
<i>Hovea trisperma</i>										
<i>Hypocalymma robustum</i>	X	X	X							
<i>Jacksonia furcellata</i>	X	X	X							
<i>Kunzea glabrescens</i>	X		X						X	
<i>Laxmannia squarrosa</i>		X	X							
<i>Lepidosperma pubisquamum</i>										X
<i>Leucopogon conostephioides</i>	X	X								
<i>Lomandra ?caespitosa</i>	X									
<i>Lomandra hermaphrodita</i>		X								
<i>Lomandra preissii</i>		X								
<i>Lomandra suaveolens</i>	X	X								

Flora Species x Plant Community Matrix - Lot 1001 Murdoch Drive Murdoch

Species	Plant community and sample ID										
	BaBm			Opp			EmCc			Planted	Parkland cleared
	Q1	Q2	Q3	Q3	Opp	Opp	Opp	Opp	Opp	Opp	
<i>Lyginia imberbis</i>			X		X						
<i>Macrozamia riedlei</i>		X									
<i>Melaleuca seriata</i>	X										
<i>Melaleuca thymoides</i>		X	X								
<i>Mesomelaena pseudostygia</i>	X	X	X								
<i>Nuytsia floribunda</i>			X		X						
* <i>Oxalis pes-caprae</i>			X		X						
<i>Patersonia occidentalis</i>	X	X	X								
* <i>Pelargonium capitatum</i>					X						
<i>Persoonia saccata</i>	X										
<i>Petrophile linearis</i>		X	X								
<i>Phlebocarya ciliata</i>		X	X								
<i>Pimelea sulphurea</i>			X								
<i>Pterostylis ?vittata</i>		X									
<i>Schoenus curvifolius</i>			X								
<i>Schoenus subfascicularis</i>	X										
<i>Scholtzia involucreta</i>		X	X								
<i>Stirlingia latifolia</i>	X	X	X						X		
<i>Stylidium ?neurophyllum</i>		X									
<i>Stylidium repens</i>			X								
<i>Thysanotus ?sparteus</i>	X										
<i>Thysanotus manglesianus</i>	X	X	X								
* <i>Ursinia anthemoides</i>	X	X	X					X		X	
<i>Xanthorrhoea preissii</i>	X	X	X						X		
* <i>Zantedeschia aethiopica</i>	X									X	

Appendix F

Sample Data



Sample Name: Q1

Project number: EP19-068

Date: 24/06/2019

Author: SKP,

Status: Non-permanent

Q1: Page 1 of 3

Quadrat and landform details

Sample type: Quadrat	Size: other
NW corner easting: 390835	NW corner northing: 6450302
Altitude (m): 22	Geographic datum/zone: GDA94/Zone 50
Soil water content: damp	Landform: mid-slope
Time since fire: > 5 yrs	Disturbance: moderate - weeds, adj clearing
Soil type/texture: sand/	Bare ground (%): 10
Rocks (%) and type: No rocks	Soil colour: grey/
Litter: 20% (leaves,twigs,bark)	Vegetation condition: good-

Strata	Cover (%)	Height (m)	
Upper:	10 to 30	<10	
Mid:	30 to 70	1 to 2	Structure intact, juvenile banksias
Ground layer 1:	10 to 30	<0.5	
Ground layer 2:	10 to 30	<0.5	

Vegetation description

Low woodland *Banksia attenuata*, *Banksia menziesii* and *Eucalyptus marginata* over shrubland *Allocasuarina humilis*, *Acacia pulchella* and *Hibbertia hypericoides* over low open herbland *Patersonia occidentalis*, *Desmocladius flexuosus*, *Mesomelaena pseudostygia* and *Dianella revoluta* over low open tussock grassland pasture weeds.



Sample Name:

Q1

Project no.: EP19-068

Date: 24/06/2019

Author: SKP,

Status Non-permanent

Q1: Page 2 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	<i>Acacia pulchella</i> var. <i>glaberrima</i>	4
	<i>Allocasuarina humilis</i>	5
	<i>Banksia attenuata</i>	5
	<i>Banksia ilicifolia</i>	opp
	<i>Banksia menziesii</i>	15
	<i>Bossiaea eriocarpa</i>	0.5
*	<i>Briza maxima</i>	3
	<i>Burchardia congesta</i>	1
*	<i>Carpobrotus edulis</i>	1
	<i>Conostylis aculeata</i>	1
	<i>Dampiera linearis</i>	1
	<i>Daviesia nudiflora</i>	opp
	<i>Desmocladius flexuosus</i>	2
	<i>Dianella revoluta</i>	3
*	<i>Ehrharta calycina</i>	10
	<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	0.5
	<i>Eriochilus ?dilatatus</i>	0.5
	<i>Eucalyptus marginata</i>	5
*	<i>Gladiolus caryophyllaceus</i>	0.5
	<i>Gompholobium tomentosum</i>	0.5
	<i>Hibbertia cuneiformis</i>	2
	<i>Hibbertia hypericoides</i>	3
	<i>Hibbertia subvaginata</i>	0.5
	<i>Hypocalymma robustum</i>	1
	<i>Jacksonia furcellata</i>	5
	<i>Kunzea glabrescens</i>	5
	<i>Lepidosperma pubisquameum</i>	opp
	<i>Leucopogon conostephioides</i>	0.5
	<i>Lomandra ?caespitosa</i>	1
	<i>Lomandra suaveolens</i>	0.5
	<i>Melaleuca seriata</i>	0.5
	<i>Mesomelaena pseudostygia</i>	3
	<i>Nuytsia floribunda</i>	opp
	<i>Patersonia occidentalis</i>	2
	<i>Persoonia saccata</i>	1
	<i>Schoenus subfascicularis</i>	0.5

Sample Name: Q1

Project no.: EP19-068

Date: 24/06/2019

Author: SKP,

Status Non-permanent

Q1: Page 3 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	<i>Stirlingia latifolia</i>	1
	<i>Thysanotus ?sparteus</i>	0.5
	<i>Thysanotus manglesianus</i>	0.5
*	<i>Ursinia anthemoides</i>	0.5
	<i>Xanthorrhoea preissii</i>	3
*	<i>Zantedeschia aethiopica</i>	0.5

Sample Name: Q2

Project number: EP19-068

Date: 24/06/2019

Author: SKP,

Status: Non-permanent

Q2: Page 1 of 3

Quadrat and landform details

Sample type: Quadrat	Size: other
NW corner easting: 390862	NW corner northing: 6450255
Altitude (m): 24	Geographic datum/zone: GDA94/Zone 50
Soil water content: damp	Landform: mid-slope
Time since fire: > 5 yrs	Disturbance: moderate - weeds, adj clearing
Soil type/texture sand/	Bare ground (%): 20
Rocks (%) and type: No rocks	Soil colour: grey/white
Litter: 20% (leaves,twigs,)	Vegetation condition: very good-good

Strata	Cover (%)	Height (m)	
Upper:	10 to 30	<10	
Mid:	30 to 70	1 to 2	Structure intact, juvenile banksias
Ground layer 1:	10 to 30	<0.5	
Ground layer 2:	10 to 30	<0.5	

Vegetation description

Low woodland *Banksia* spp. and *Eucalyptus marginata* over shrubland *Allocasuarina humilis*, *Acacia pulchella*, *Eremaea pauciflora* var. *pauciflora*, *Jacksonia furcellata* and *Hibbertia hypericoides* over low open herbland *Patersonia occidentalis*, *mesomelaena pseudostygia*, [INSERT SPECIES]over low open land [INSERT SPECIES]



Sample Name:

Q2

Project no.: EP19-068

Date: 24/06/2019

Author: SKP,

Status Non-permanent

Q2: Page 2 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	* ? <i>Freesia</i> sp.	0.5
	<i>Acacia pulchella</i> var. <i>glaberrima</i>	5
	<i>Allocasuarina humilis</i>	5
	<i>Anigozanthos</i> sp.	0.5
	<i>Banksia attenuata</i>	10
	<i>Banksia ilicifolia</i>	1
	<i>Banksia menziesii</i>	10
	<i>Beaufortia elegans</i>	1
	<i>Bossiaea eriocarpa</i>	0.5
	* <i>Briza maxima</i>	3
	<i>Calytrix flavescens</i>	0.5
	* <i>Carpobrotus edulis</i>	1
	*, PL <i>Chamelaucium uncinatum</i>	opp
	<i>Conostephium pendulum</i>	0.5
	<i>Dampiera linearis</i>	0.5
	<i>Dasypogon bromeliifolius</i>	0.5
	<i>Daviesia triflora</i>	1
	<i>Desmocladius flexuosus</i>	1
	<i>Dianella revoluta</i>	0.5
	<i>Drosera erythrorhiza</i>	1
	* <i>Ehrharta calycina</i>	5
	<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	5
	* <i>Erodium botrys</i>	opp
	<i>Eucalyptus marginata</i>	5
	* <i>Gladiolus caryophyllaceus</i>	0.5
	<i>Gompholobium tomentosum</i>	1
	<i>Hemiandra pungens</i>	0.5
	<i>Hibbertia cuneiformis</i>	1
	<i>Hibbertia huegelii</i>	opp
	<i>Hibbertia hypericoides</i>	3
	<i>Hovea trisperma</i>	0.5
	<i>Jacksonia furcellata</i>	3
	<i>Laxmannia squarrosa</i>	0.5
	<i>Leucopogon conostephioides</i>	0.5
	<i>Lomandra hermaphrodita</i>	0.5
	<i>Lomandra preissii</i>	0.5

Sample Name:

Q2

Project no.: EP19-068

Date: 24/06/2019

Author: SKP,

Status Non-permanent

Q2: Page 3 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	<i>Lomandra suaveolens</i>	0.5
	<i>Lyginia imberbis</i>	opp
	<i>Macrozamia riedlei</i>	1
	<i>Melaleuca thymoides</i>	1
	<i>Mesomelaena pseudostygia</i>	2
	<i>Patersonia occidentalis</i>	2
*	<i>Pelargonium capitatum</i>	opp
	<i>Petrophile linearis</i>	1
	<i>Phlebocarya ciliata</i>	1
	<i>Pterostylis ?vittata</i>	0.5
	<i>Scholtzia involucreta</i>	3
	<i>Stirlingia latifolia</i>	2
	<i>Stylidium ?neurophyllum</i>	0.5
	<i>Thysanotus manglesianus</i>	0.5
*	<i>Ursinia anthemoides</i>	1
	<i>Xanthorrhoea preissii</i>	2

Sample Name: Q3

Project number: EP19-068

Date: 24/06/2019

Author: SKP,

Status: Non-permanent

Q3: Page 1 of 3

Quadrat and landform details

Sample type: Quadrat	Size: other
NW corner easting: 390862	NW corner northing: 6450219
Altitude (m): 29	Geographic datum/zone: GDA94/Zone 50
Soil water content: damp	Landform: mid-slope
Time since fire: > 5 yrs	Disturbance: moderate - weeds, adj clearing
Soil type/texture sand/	Bare ground (%): 5
Rocks (%) and type: No rocks	Soil colour: grey/white
Litter: 10% (twigs,leaves,)	Vegetation condition: very good-

Strata	Cover (%)	Height (m)	
Upper:	10 to 30	<10	Structure intact, juvenile banksias, dense u/s layer
Mid:	30 to 70	1 to 2	
Ground layer 1:	30 to 70	<0.5	
Ground layer 2:	10 to 30	<0.5	

Vegetation description

low woodland [INSERT SPECIES]over shrubland [INSERT SPECIES]over low herbland [INSERT SPECIES]over low open land [INSERT SPECIES]



Sample Name:

Q3

Project no.: EP19-068

Date: 24/06/2019

Status Non-permanent

Author:

0

Q3: Page 2 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	<i>Acacia huegelii</i>	0.5
	<i>Acacia pulchella</i> var. <i>glaberrima</i>	5
	<i>Acacia stenoptera</i>	0.5
	<i>Allocasuarina humilis</i>	5
	<i>Banksia attenuata</i>	10
	<i>Banksia ilicifolia</i>	5
	<i>Banksia menziesii</i>	10
	<i>Beaufortia elegans</i>	0.5
	<i>Bossiaea eriocarpa</i>	0.5
*	<i>Briza maxima</i>	3
	<i>Burchardia congesta</i>	2
	<i>Burchardia congesta</i>	0.5
	<i>Calytrix flavescens</i>	0.5
	<i>Chamelaucium uncinatum</i>	2
	<i>Conostephium pendulum</i>	0.5
	<i>Dasypogon bromeliifolius</i>	1
	<i>Daviesia triflora</i>	0.5
	<i>Desmocladius flexuosus</i>	8
	<i>Drosera</i> sp.	0.5
*	<i>Ehrharta calycina</i>	10
	<i>Eremaea pauciflora</i> var. <i>pauciflora</i>	3
*	<i>Geranium molle</i>	0.5
*	<i>Gladiolus caryophyllaceus</i>	1
	<i>Gompholobium tomentosum</i>	1
	<i>Hemiandra pungens</i>	1
	<i>Hibbertia huegelii</i>	0.5
	<i>Hibbertia hypericoides</i>	7
	<i>Hibbertia subvaginata</i>	0.5
	<i>Hovea pungens</i>	0.5
	<i>Hypocalymma robustum</i>	1
	<i>Kunzea glabrescens</i>	3
	<i>Laxmannia squarrosa</i>	0.5
	<i>Lyginia imberbis</i>	0.5
	<i>Melaleuca thymoides</i>	1
	<i>Mesomelaena pseudostygia</i>	3
	<i>Nuytsia floribunda</i>	2

Sample Name:

Q3

Project no.: EP19-068

Date: 24/06/2019

Author: SKP,

Status Non-permanent

Q3: Page 3 of 3

Species Data

* denotes non-native species

Status	Confirmed name	Cover (%)
	* <i>Oxalis pes-caprae</i>	opp
	<i>Patersonia occidentalis</i>	2
	<i>Petrophile linearis</i>	1
	<i>Phlebocarya ciliata</i>	1
	<i>Pimelea sulphurea</i>	0.5
	<i>Schoenus curvifolius</i>	0.5
	<i>Scholtzia involucreta</i>	1
	<i>Stirlingia latifolia</i>	3
	<i>Stylidium repens</i>	0.5
	<i>Thysanotus manglesianus</i>	0.5
	* <i>Ursinia anthemoides</i>	1
	<i>Xanthorrhoea preissii</i>	1
	<i>Calothamnus quadrifidus</i>	opp
	* <i>Carpobrotus edulis</i>	opp
	* <i>Ehrharta calycina</i>	opp
	* <i>Eragrostis curvula</i>	opp
*PL	<i>Eucalyptus caesia</i>	opp
	<i>Eucalyptus marginata</i>	opp
*PL	<i>Eucalyptus sp.</i>	opp
*PL	<i>Eucalyptus utilis</i>	opp
	* <i>Euphorbia terracina</i>	opp
D	<i>Zantedeschia aethiopica</i>	opp

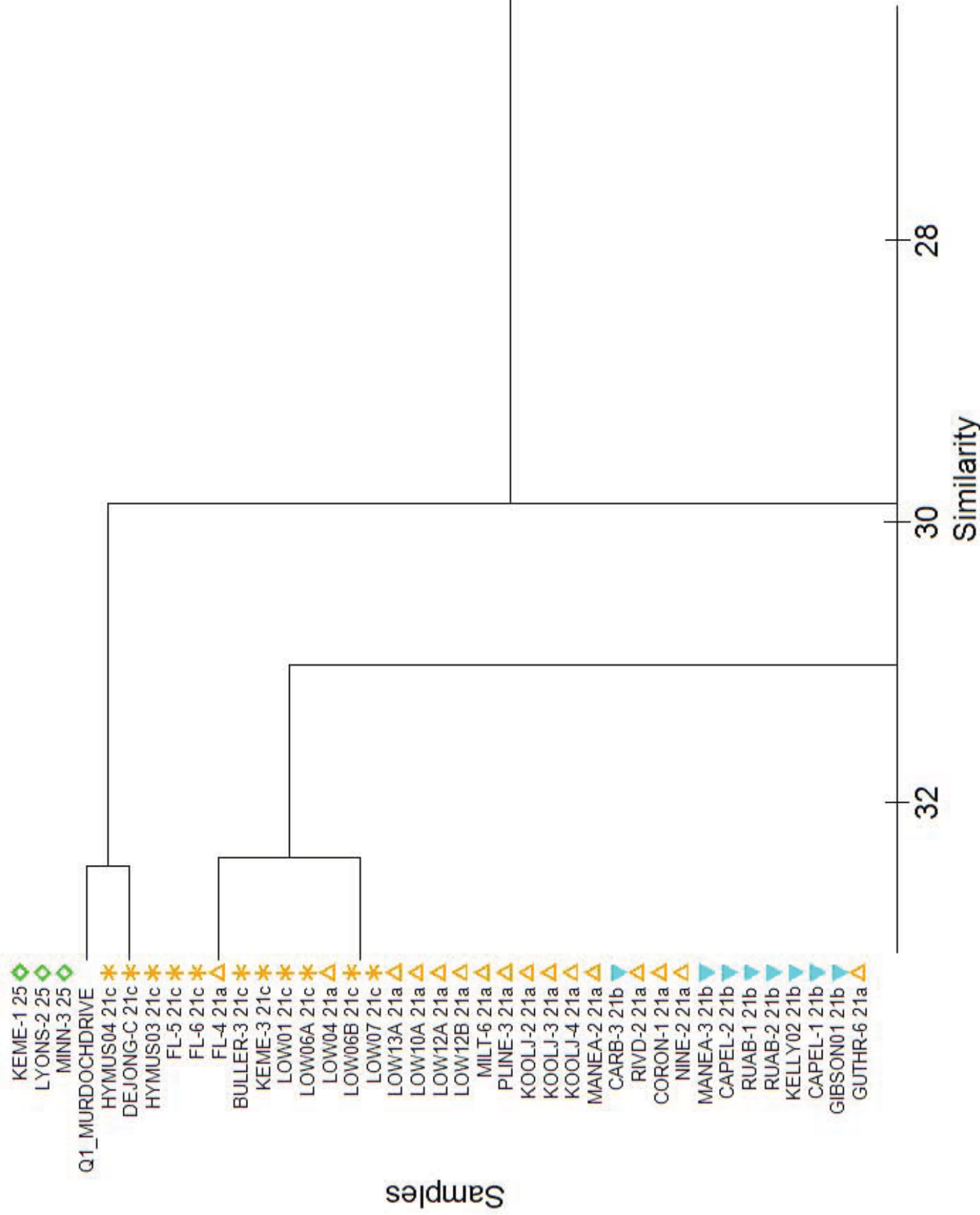
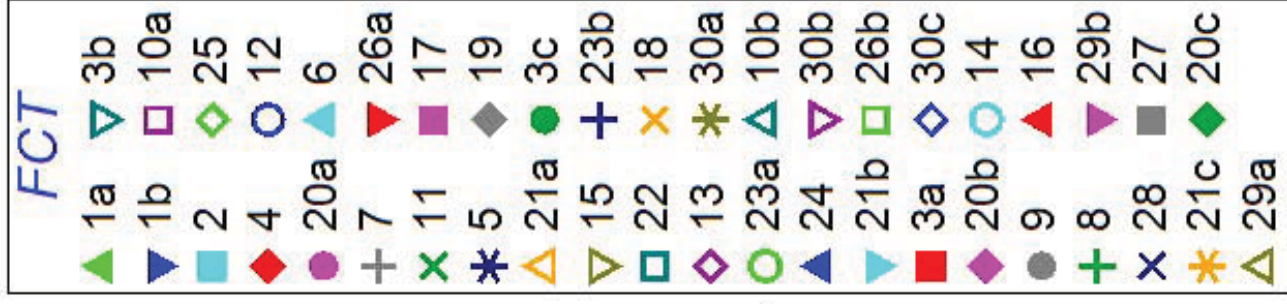
Appendix G

Cluster Dendrograms



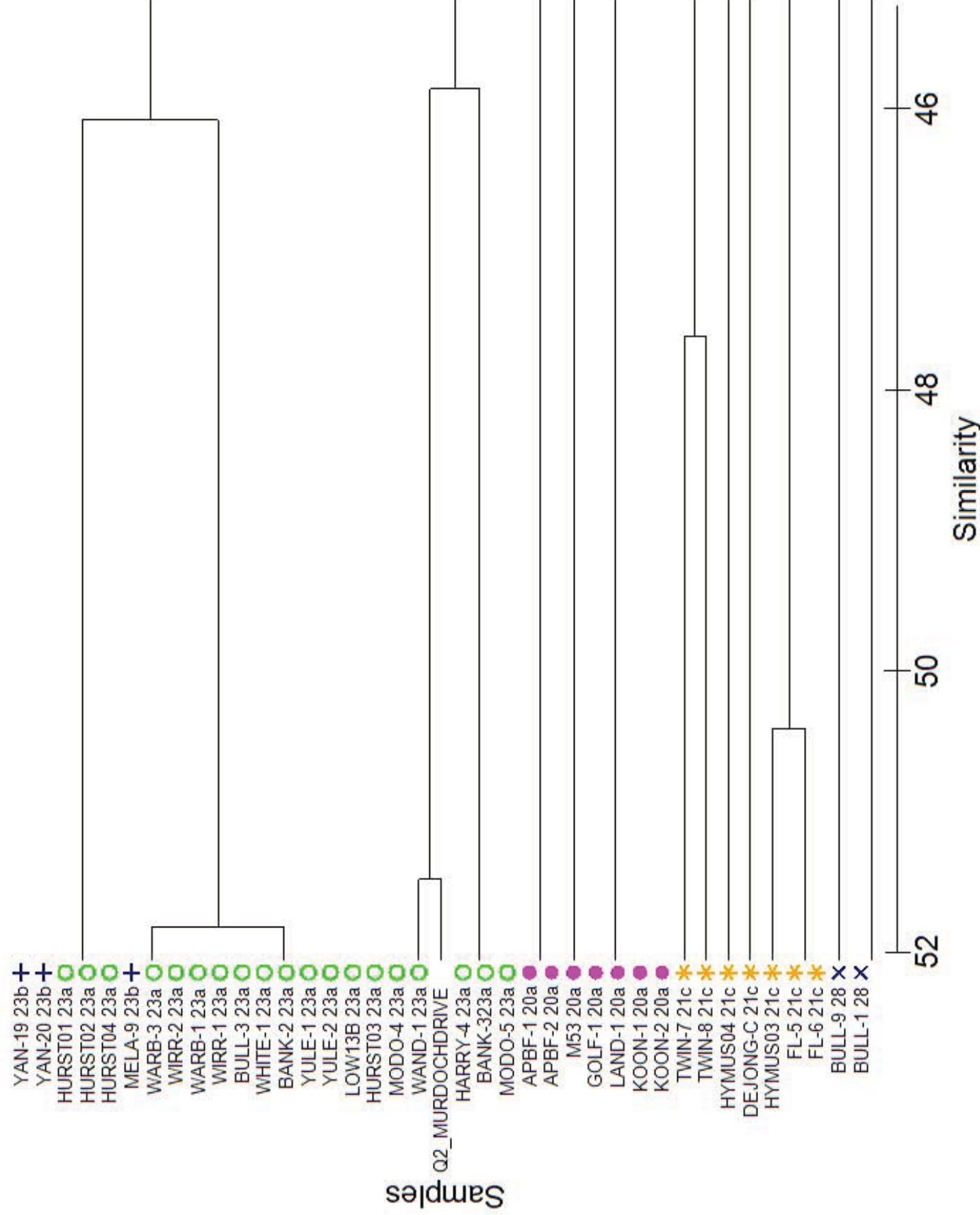
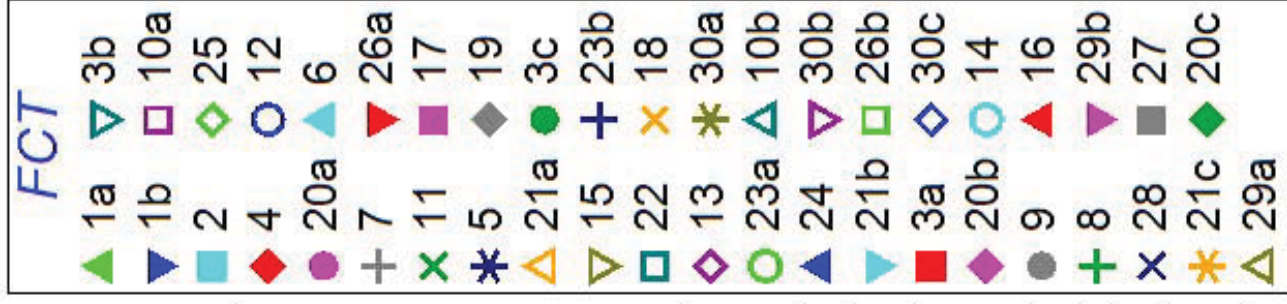
Group average

Resemblance: S17 Bray Curtis similarity



Group average

Resemblance: S17 Bray Curtis similarity



Group average

Resemblance: S17 Bray Curtis similarity

