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INSTANT PRODUCTS GROUP: MUCHEA LOT 195

Detailed (Level 2) Flora and Vegetation Assessment




This document describes the results of a Level 2 flora and vegetation survey and spring targeted flora survey conducted by Maia Environmental Consultancy (Maia) for Instant Products Group (IPG) at Lot 195 in Muchea.

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Acronyms and Abbreviations

A	Annual
aff.	Affinity
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BoM	Bureau of Meteorology
BVA	Beard vegetation association
BVSA	Beard vegetation system association
CPSM	Centre for Phytophthora Science & Management
CSF	Conservation significant flora
CSR	Conservation significance rating
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation
DER	Department of Environmental Regulation
DIWA	Directory of Important Wetlands in Australia
DoP	Department of Planning
DotE	Department of the Environment
DotEE	Department of the Environment and Energy
DPaW	Department of Parks and Wildlife
DP	Declared plant
DRF	Declared Rare Flora
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
ESCAVI	Executive Steering Committee for Australian Vegetation Information
EW	Environmental Weed
FCT	Floristic community type
Fl	Flowering
Fr	Fruiting
GDA94	Geocentric Datum of Australia, 1994
GIS	Geographic information systems
GoWA	Government of Western Australia
GPS	Global Positioning System
ha	Hectare
HVC	Heddle Vegetation Complex
IBRA	Interim Biogeographic Regionalisation of Australia
IPG	Instant Products Group
IUCN	International Union for Conservation of Nature
km	Kilometre
L2	Level 2 survey
L-t	Long-term
m	Metre
Maia	Maia Environmental Consultancy Pty Ltd
mE	Metres east
MGA50	Map Grid of Australia, zone 50

mm	Millimetre
mN	Metres north
MVT	Maia vegetation type
NVIS	National Vegetation Information System
OC	Opportunistic collection
P	Perennial
P (1-4)	Priority 1 to Priority 4
PEC	Priority ecological community
PPAs	Priority Protection Areas
Project Area	Proposed Clearing Footprint
Q	Quadrat
R	Relevé
RP	Reservation priority
SCP	A Floristic Survey of the Southern Swan Coastal Plain survey
Site	Quadrat and / or relevé
sp.	Species, single
SPAC	Species accumulation curve
spp.	Species, plural
subsp.	Subspecies
SWA	Swan Coastal Plain IBRA bioregion
SWA01	Dandaragan Plateau IBRA subregion
T	Threatened Flora
TEC	Threatened ecological community
TFS	Targeted flora survey
TPFL	DPaW's Threatened (Declared Rare) and Priority Flora database
TP	DPaW's Threatened and Priority Flora List
var.	Variety
WA	Western Australia
WAH	Western Australian Herbarium
WA Herb	Western Australian Herbarium database
WALGA	W.A. Local Government Association
WAOL	Western Australian Organism List
WC Act	*Wildlife Conservation Act 1950*
WGS84	World Geodetic System 1984
WoNS	Weeds of National Significance
x	Hybrid
*****	Before or after a plant name indicates a weed species
?	Query
#	Number
%	Percentage
>	Greater than
≤	Less than or equal to

Executive Summary

Background and Methods

- Instant Products Group (IPG) is planning on constructing a warehouse and transport depot on Lot 195 Great Northern Highway in Muchea which is in the Shire of Chittering in Western Australia. IPG commissioned Maia Environmental Consultancy Pty Ltd (Maia) to carry out a Level 2 flora and vegetation survey and a spring targeted flora survey across the project area.
- The area surveyed in Lot 195 is referred to as the Survey Area and the area proposed for clearing as the Project Area in this report.
- Eight relevés and 6.86 ha of traverses were assessed in the Survey Area in March 2016 (one person day) and nine quadrats and 15.39 ha of traverses were assessed in the Survey Area in October 2016 (four person days). Approximately 55% of the Survey Area was assessed in March and October 2016. A site visit to assess the likelihood of the vegetation being a significant ecological community was also carried out in September 2016.
- Total rainfall received in the area over the three months before the March 2016 survey was above average and before the October 2016 survey was average. The condition of the vegetation in the Survey Area should have been in good to average condition when the surveys were carried out.

Flora

- One hundred and ninety-nine taxa from 130 genera and 52 families were recorded in the Survey Area. Of the 199 taxa, 19% were annual, 81% perennial and 77% of the taxa had flowers, fruit or both flowers and fruit on them when the surveys were carried out.
- No conservation significant flora species listed in the database searches were located in the Survey Area.
- Two confirmed priority (P) flora species (*Acacia drummondii* subsp. *affinis* (P3) and *Haemodorum loratum* (P3)) and two potentially conservation significant flora species (*Haemodorum* ?*loratum* (potential P3) and *Grevillea* ?*drummondii* (potential P4)) were located in the Survey Area.
- These conservation significant flora species will be impacted by clearing for the Project Area. Impact to *Acacia drummondii* subsp. *affinis* will be approximately 3%, 11% to *Haemodorum loratum* and less than 1% to *Grevillea drummondii* (if *Grevillea* ?*drummondii* is confirmed as *Grevillea drummondii*).
- No weeds on any of the national weeds lists or Declared pest plants were located in the Survey Area.
- Twenty-four environmental weeds were recorded in the Survey Area. *Ursinia anthemoides* subsp. *anthemoides* (including *U. anthemoides*), *Pentameris airoides* subsp. *airoides* (including *P. airoides*) and *Hypochaeris radicata* were the most commonly recorded weed species and were also present in the highest numbers in the Survey Area.

Vegetation

- Impact to Beard vegetation association (BVA) 1020 in the Project Area will be less than 0.2% of its pre-European extent in the Swan Coastal Plain bioregion and 0.6% of its current extent. The current extent of BVA 1020 in the SWA bioregion is below the 30% threshold as 28.35% remains. BVA 1020 is considered to have high regional and moderate local conservation significance.
- Impact to the Moondah Heddle vegetation complex (HVC) in the Project Area will be less than 0.05% of its pre-European extent in the Swan Coastal Plain bioregion and 0.1% of its current extent. The current extent of Moondah HVC is above 30% threshold (46.00%) and clearing for the Project will not bring the extent remaining below 30%. Moondah HVC is considered to have high regional and moderate local conservation significance.
- Three vegetation types were mapped in the Survey Area: *Eucalyptus* Mallee Woodland (*Et***MWL** (1)), *Corymbia* and *Eucalyptus* Forest (*CcEm***F** (2)) and *Eucalyptus* and *Corymbia* Forest (*EmCc***F** (3).
- Impact of the Project Area to *Et***MWL** (1) is 2.26 ha, 3.01 ha to *CcEm***F** (2) and 3.27 ha to *EmCc***F** (3). These three MVTs occur outside of the Project Area.

- The condition of most of the vegetation mapped in the Survey Area (approximately 83%) is rated as 3 (vegetation structure altered) and the remainder (17%) as 6-7 (disturbed).

Ecological Communities

- One of the MVTs mapped in the Survey Area (*Et***MWL** (1)) matches most of the criteria for the federally protected Banksia Woodlands of the Swan Coastal Plain threatened ecological community but lacks the characteristic dominant *Banksia* tree / shrub stratum as a result of previous clearing in that area.
- One quadrat from MVT *EmCc***F** (3) grouped with Swan Coastal Plain (SCP) sites from FCT3b which is a state listed TEC (SCP3b) and is described as *Corymbia calophylla---Eucalyptus marginata* woodlands on sandy clay soils. However this quadrat was sampled on a laterite hill with a surface layer of laterite gravel and stones and not on sandy clay soils characteristic of this TEC.
- Five quadrats grouped with SCP sites in FCT21c which is a priority 3 ecological community. Quadrat Q04 and Q09 were sampled in *Et***MWL** (1), Q06 and Q07 were sampled in *CcEm***F** (2) and Q08 in *EmCc***F** (3). FCT21c is described as Low lying *Banksia attenuata* woodlands or shrublands and it is likely that *Et***MWL** (1) is this PEC as it was mapped in lower lying sections of the Survey Area and it had scattered *Banksia attenuata* and *B. menziesii* throughout.

Protected and Significant Areas

- No environmentally sensitive area occurs in the Survey Area, the closest is approximately 1 km east of the Survey Area and it is a buffer around threatened flora.
- The Survey Area is not in any conservation estate. The closest DPaW managed land (Barraca Nature Reserve) is approximately 1 km north-east of the Survey Area.
- The Survey Area does not lie in or close to an EPA Red Book area, the closest (Barracca Nature Reserve) is approximately 1 km north-east of the Survey Area.
- The Survey Area lies in a Schedule 1 area - the Swan Coastal Plain bioregion.
- No bush forever sites occur in the Survey Area, the closest is 79, Polinelli Road Bushland, Bullsbrook, approximately 7 km to the south-east of the Survey Area.

Phytophthora Dieback

- Thirty-one of the species (excluding subspecies) recorded in the Survey Area are listed as species susceptible to Dieback. BVA 1020 mapped in the Survey Area is moderately susceptible to Phytophthora Dieback.

Ecological Linkages

- The vegetation of the Survey Area is not part of one of the ecological linkages in the area.

Recommendations

- The Project Area boundaries should be clearly marked prior to construction and vegetation should only be cleared within these boundaries.
- Areas to be landscaped within the Project Area should retain existing native vegetation whenever possible.
- Every effort should be made to prevent the introduction of new weeds into the area on machinery used for the construction and ongoing works and the spread of existing weeds from the Project Area to the wider area of Lot 195.
- Standard Phytophthora Dieback hygiene practices should be employed to prevent the introduction or spread of the disease into susceptible native vegetation in areas around the Project Area.
- Access to remnant native vegetation outside of the Project Area but within Lot 195 should be restricted in order to prevent the spread of weeds, Phytophthora Dieback and to avoid unnecessary damage to the native vegetation and conservation significant flora.
- Existing fences around the boundaries of Lot 195 should be maintained to prevent grazing animals from adjacent properties accessing remnant vegetation. New fences should also be constructed around the boundary of the Project Area to restrict access to the adjacent remnant vegetation on Lot 195.

Instant Products Group: Muchea Lot 195

Detailed (Level 2) Flora and Vegetation Assessment

1 Project Scope and Location

1.1 Project Scope of Work

Instant Products Group (IPG) is planning on constructing a warehouse and transport depot on Lot 195 Great Northern Highway in Muchea, in the Shire of Chittering in Western Australia (WA) (**Map 11.1, Section 1**). IPG commissioned Maia Environmental Consultancy Pty Ltd (Maia) to carry out a Level 2 (L2) flora and vegetation survey and a spring targeted flora survey (TFS) in a section of Lot 195.

This report presents the results of a brief desktop study carried out before going to site and the results of the field surveys.

The area surveyed within Lot 195 is referred to as the Survey Area and the area proposed for clearing as the Project Area in this report.

The scope of works included the following:

- A review of the literature on flora and vegetation surveys previously carried out in the vicinity of the Survey Area.
- A description of and a map showing the distribution of the floristic communities and vegetation types occurring in the Survey Area.
- A description of and a map showing the condition of the vegetation in the Survey Area.
- Documentation of the flora species (native, introduced and conservation significant) present in the Survey Area.
- A discussion of the conservation significance of the flora and vegetation of the Survey Area (both local and regional).
- An impact assessment for the conservation significant flora species and vegetation types of the Survey Area.

1.2 The Survey and Project Areas

The Survey Area is located in the south-western section of Lot 195 between the Great Northern Highway and Wandena Road approximately six kilometres (km) north-east of the Muchea town site (**Map 11.1, Section 11**). The Project Area comprises:

- Sealed access and parking areas;
- A 10 metre (m) wide driveway and compensation basins;
- Unsealed access and hardstand areas; and,
- Proposed warehouse and transport depot.

The boundaries of the Survey Area and Project Area are shown on **Map 11.1, Section 11.**

The area of already disturbed and uncleared land in both areas is listed in **Table 1.1**.

Table 1.1: The Survey Area and Project Area

Attribute	Area (hectares (ha))
Survey Area overall (including Project Area)	32.55
Project Area	12.37
Project Area - disturbed	3.83
Project Area - undisturbed	8.54

2 BACKGROUND INFORMATION

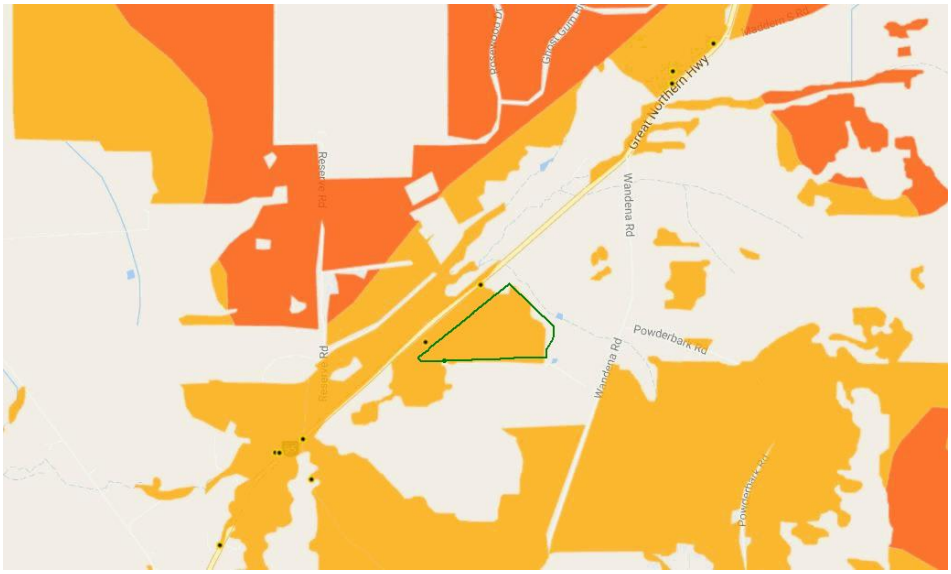
2.1 BIOREGIONAL SETTING

Information on the Interim Biogeographic Regionalisation for Australia (IBRA) bioregion and sub-region, geology, soil landscape units, Beard's pre-European vegetation association (BVAs) and system association (BVSAs), Heddle vegetation complex (HVC), environmentally sensitive areas (ESA), conservation estate, Schedule 1 areas, Environmental Protection Authority (EPA) Red Book areas, significant water bodies rivers and drainage lines, *Phytophthora* Dieback, and previous botanical surveys carried out in the vicinity of the Survey Area is summarised in **Table 2.1**.

Table 2.1: Background information

Background information on the Survey Area	
IBRA bioregion and subregion (**Map 11.2A, Section 11**)	The Survey Area is in the Swan Coastal Plain (SWA) bioregion and Dandaragan Plateau (SWA01) subregion. The following ecosystems at risk are listed for SWA01: • *Banksia attenuata* woodland over species rich dense shrublands threatened ecological community (TEC) (Endangered); • Heath dominated by one or more of *Regelia megacephala*, *Kunzea praestans* and *Allocasuarina campestris* on slopes and ridges of chert hills of the Coomberdale Floristic Region TEC (Endangered); • Diatomite Lakes of the Dandaragan Plateau; • Plant assemblages of the Wannamal Lake System; • Critical weight range mammals (extant species include *Trichosurus vulpecula hypoleucus*, *Dasyurus geoffroii*; subregionally extinct species, includes *Bettongia penicillata*, *Bettongia lesueur*, *Myrmecobius fasciatus*). Source: Department of the Environment and Energy (DotEE) (2012; 2016a) and Desmond (2001)
Soil landscape mapping units (**Map 11.2B, Section 11**)	The soil landscape of the Survey Area comprises three units: • Gentle slopes of deeply bleached sands with very low woodland and shrubland with scattered low trees (*Banksia prionotes*, *Casuarina* species (spp.), *Adenanthos* spp. and a few stunted *Eucalyptus marginata*) (**222Re_1b**). • Drainage depressions on the Dandaragan Plateau. Generally duplex, some uniform fine, yellow to yellowish brown alluvial soils. *Eucalyptus* (now *Corymbia calophylla*) *calophylla* and *E. wandoo* with occasional *Eucalyptus marginata*. *Melaleuca* ssp., reeds and *Eucalyptus rudis* in wet areas (**222Re10**). • Gentle slopes from the Dandaragan plateau to the Pinjarra plain. Loamy sands overlying sandy loams to sandy clay loam at about 1 m. Woodland of *Eucalyptus calophylla* (now *Corymbia calophylla*) with occasional *Eucalyptus marginata* (**222Re12**). Source: Department of Agriculture and Food Western Australia (DAFWA) (2014a, 2014b).
Geology (**Map 11.2C, Section 11**)	The surface geology of the Survey Area is mapped as one unit: • **Czl** - Pisolitic, nodular or vuggy ferruginous laterite; some lateritic soils; ferricrete; magnesite; ferruginous and siliceous duricrusts and reworked products, calcrete, kaolinised rock, gossan; residual ferruginous saprolite. Source: Stewart *et al.* (2008).

Background information on the Survey Area	
Native vegetation – current extent (**Map 11.2D, Section 11**)	The current extent of native vegetation in the SWA is 579,161.92 hectares (ha) and 38.58% of its pre-European extent currently remains, while 113,609.44 ha and 29.63% of SWA01's pre-European extent currently remains. Source: DAFWA (2014c); Government of Western Australia (GoWA), 2015.
Background information on the Survey Area	
Pre-European vegetation associations and system associations (**Map 11.3A and B, Section 11**)	The Survey Area is located in Beard's Darling Plateau physiographic region in the Darling Botanical District of the South West Province of WA. One BVA / BVSA occurs in the Survey Area: • BVA 1020 / BVSA 1020.1 (Mosaic: Medium forest; jarrah-marri / Medium woodland; marri-wandoo). The pre-European and current extent of the BVA / BVSA in the SWA bioregion and SWA01 subregion are listed in **Table 7.3** along with the amount in reserves and the prioritisation for reservation of the BVA in the SWA01 subregion. Source: Beard (1981), GoWA (2015), DAFWA (2012a; 2012b).
Heddle vegetation complexes (**Map 11.3 C and D, Section 11**)	The Survey Area is located in one HVC: • Moondah HVC - Low closed to low open forest of *Banksia attenuata – B. menziesii - Eucalyptus todtiana - B. prionotes* on slopes, open woodland of *E. calophylla* (now *Corymbia calophylla*) – *Banksia* spp. in valley. The pre-European and current extent of this HVC in the SWA bioregion and SWA01 subregion is also listed in **Table 7.4** along with the amount in reserves. Source: Heddle *et al.* (1980), W.A. Local Government Association (WALGA) (2013).
Environmentally sensitive areas (ESA), conservation estate, Schedule 1 areas, EPA Red Book areas and bush forever sites (**Map 11.4, Section 11**)	The closest ESA is approximately 0.75 km east of the Survey Area – and it is a buffer in place around threatened flora. The closest conservation estate is 1.3 km north-east of the Survey Area – Barraca Nature Reserve. This nature reserve is listed under the International Union for Conservation of Nature (IUCN) (I-IV) terrestrial land (reserved) for protection and is DPaW-managed land. It is also the closest EPA Red Book Area. The Survey Area lies in a Schedule 1 Area - the Swan Coastal Plain bioregion. No Bush Forever Site occurs in the Survey Area; the closest is Site 79, Polinelli Road Bushland, Bullsbrook, approximately 6.7 km to the south-east of the Survey Area (not shown on **Map 11.4**). Source: Department of Parks and Wildlife (DPaW) (2014a, 2016a), Department of Environment Regulation (DER) (2014, 2015), GoWA (2000).
Significant water bodies, rivers and drainage lines (**Map 11.4, Section 11**)	No Ramsar wetland, wetlands on the Directory of Important Wetlands (DIWA), Department of Planning Aboriginal Wetlands or geomorphic wetlands occur in or close to the Survey Area. Chandala Swamp is the closest DIWA wetland and it is 6.2 km north-west of the Survey Area. The closest geomorphic wetland is approximately 1 km north-east of the Survey Area. The closest watercourse is located 0.38 km north-west of the Survey Area, it is Rocky Creek and is a non-perennial watercourse. Source: Department of the Environment (DotE) (2010), DotEE (2016b), Department of Planning (DoP) (2016), Geoscience Australia (2006), DPaW (2014b).

Background information on the Survey Area	
Phytophthora Dieback	*Phytophthora* is a pathogen that travels from the root of the plant via a microscopic water mould in the soil, soil water or through root-to-root contact and causes Phytophthora Dieback (Department of Environment and Conservation (DEC), 2006). Once infected, the root systems of the plants are destroyed thus starving the plants of water and nutrients leading to the eventual death of the plant. Dieback can lead to loss of biodiversity, extinctions of threatened flora and fauna, reduced species richness of plants, loss of key understorey species and loss of habitat and food sources for fauna. Approximately 40% (2,300 species) of flora species recorded in the South-west botanical province are susceptible to Phytophthora Dieback (DEC, 2006). Several *Phytophthora* species are present in native vegetation in the south-west of WA, the most destructive being *Phytophthora cinnamomi*. Project Dieback has created a publicly available map showing locations of soil samples with a positive reading for *Phytophthora cinnamomi* in the south-west of WA (Project Dieback, 2014a). **Figure 2.1** indicates the susceptibility of vegetation within and around the Survey Area to *Phytophthora cinnamomi* dieback. BVA 1020 of the Project Area is rated as having moderate susceptibility (light orange colour on **Figure 2.1**). Two positive *Phytophthora cinnamomi* points are located between the Great Northern Highway and the western boundary of the Survey Area (as of 30 June 2016) (black dots on **Figure 2.1**).  **Figure 2.1: Vegetation susceptibility to *Phytophthora cinnamomi* dieback (Project Dieback, 2014a). Green polygon (Survey Area) added by Maia.** Priority Protection Areas (PPAs) are areas representing significant biodiverse ecosystems and communities vulnerable to Phytophthora Dieback within the south-west of WA identified for state level Phytophthora Dieback management and investment (Project Dieback, 2014b). The goal is to protect and conserve the most significant examples of biodiverse ecosystems and communities in the south-west, which are vulnerable to or threatened by Phytophthora Dieback (Project Dieback, 2014b). **Figure 2.2** shows the PPAs in the vicinity of the Survey Area. No PPAs occur in the Survey Area. A 10 km buffer around Chandala Nature Reserve, an Uninfested High Value Hotspot PPA, falls over the Survey Area (light yellow shading).

Background information on the Survey Area	
	 **Figure 2.2: Priority Protection Areas, Assets and Management Boundaries (Project Dieback, 2014b). Green polygon (Survey Area) added by Maia.**
Previous botanical surveys carried out in the vicinity of the Survey Area	Great Northern Highway, Muchea North and Chittering Survey Area (Phoenix Environmental, 2015): • Thirty-two quadrats and 17 relevés were assessed in October 2014 and September 2015. Targeted flora surveys were also carried out over the two sections • Two hundred and seventy-three taxa including 51 weed species were recorded; • Seven conservation significant flora (CSF) were recorded - *Darwinia foetida* (Threatened – Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act), Endangered under the Western Australian *Wildlife Conservation Act 1950* (WC Act)), *Stylidium squamellosum* (Priority (P) 2), *Acacia drummondii* subsp. *affinis* (P3), *Haemodorum loratum* (P3), *Verticordia serrata* var. *linearis* (P3), *Eucalyptus caesia* (P4) and *Verticordia lindleyi* subsp. *lindleyi* (P4); • Three of the 51 weed species recorded were Declared plants (DPs) (**Asparagus asparagoides*, **Echium plantagineum* and **Moraea miniata*); • Nineteen vegetation associations (VAs) were defined in the Survey Area. Nine of the VAs were considered to be locally conservation significant due to the presence of CSF. Regionally, five VAs were listed as vulnerable, six as depleted and eight as of least concern – those listed as vulnerable were considered to be regionally significant as less than 30% of the pre-European extent remains. Lot 9001 and Lot 2, Chittering (360 Environmental, 2016): • Five quadrats and one relevé were assessed in November 2015; • Sixty-six taxa including one weed species (**Gladiolus caryophyllaceus*) were recorded; • No CSF species were recorded; • Four VAs were defined in the survey area. One of these VAs was considered to be very similar to the 'Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands' (P3 priority ecological community (PEC)). PT Lot M1313 Great Northern Highway Muchea (Emerge Associates, 2013): • Seven sampling points in October 2012; • One hundred and four taxa including 32 weed species • No CSF species were recorded; • Eight vegetation communities. One of these considered similar to Low-lying Banksia attenuata woodlands or shrublands PEC.

2.2 RAINFALL

The closest weather station recording climate statistics is Muchea (station number 9275) approximately 6 km to the south-west of the Survey Area (BoM, 2017a), followed by Pearce RAAF (station number 9053) approximately 13 km to the south of the Survey Area. Long-term mean monthly and annual rainfall are available for Pearce and total monthly and annual rainfall for 2015 and 2016 for both stations (**Table 2.2)**.

Table 2.2: Long-term, 2015 and 2016 rainfall (mm) – Muchea and Pearce RAAF (BoM, 2016b)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Muchea (site number 9275)													
L-t (mm)	Data not available on BoM, 2016b as station only opened May 2011												
2015 (mm)	1.6	41.8	52.8	43.0	75.8	64.6	99.8	100.6	52	9.6	9.2	24.4	575.2
2016 (mm)	31.0	0.6	124.0	67.0	104.8	93.6	136.2	118.0	48.4	49.0	6.6	8.6	787.8
Pearce RAAF (site number 9053); long-term data collected between 1937 and 2016													
L-t (mm)	8.9	12.0	16.5	35.3	85.0	131.7	133.5	104.5	69.2	36.0	23.2	10.8	653.0
2015 (mm)	1.2	32.6	26.8	54.6	58.4	64.6	97.8	93.4	32.8	13.4	9.6	15.4	500.6
2016 (mm)	20.2	1.0	101.8	68.2	90.2	94.2	113.6	134.2	50.2	44.6	7.4	13.8	739.4

Note: mm = millimetres, L-t = long-term average rainfall.

Rainfall in the three months before the autumn survey (December 2015 to February 2016) at Pearce RAAF was just above the long-term average for the same three months (36.6 mm compared with the long-term average of 31.7 mm) (**Table 2.2**). Slightly more rainfall was recorded at Muchea in the three months before the survey compared to Pearce RAAF (56 mm compared with 36.6 mm).

Rainfall in the three months preceding the spring survey (July to September 2016) at Pearce RAAF was just below the long-term average for the same three months (298.0 mm compared with the long-term average of 307.2 mm) (**Table 2.2**). Slightly more rainfall was recorded at Muchea in the three months prior to the survey compared to Pearce RAAF (302.6 mm compared with 298.0 mm).

WA rainfall deciles for 1 December 2015 to 29 February 2016 (the three months before the autumn survey) are shown in **Figure 2.3** and 1 July to 30 September 2016 (the three months before the spring survey) in **Figure 2.4** (BoM, 2017b). The Survey Area (black dot on both figures) lies in an area mapped as above average rainfall for the three months before the March 2016 survey and in an area of average rainfall prior to the October 2016 survey.

The condition of the vegetation in the Survey Area at the time of the March and October 2016 surveys is expected to reflect rainfall at the site in the months before the survey was carried out and it should have been in good to average condition.

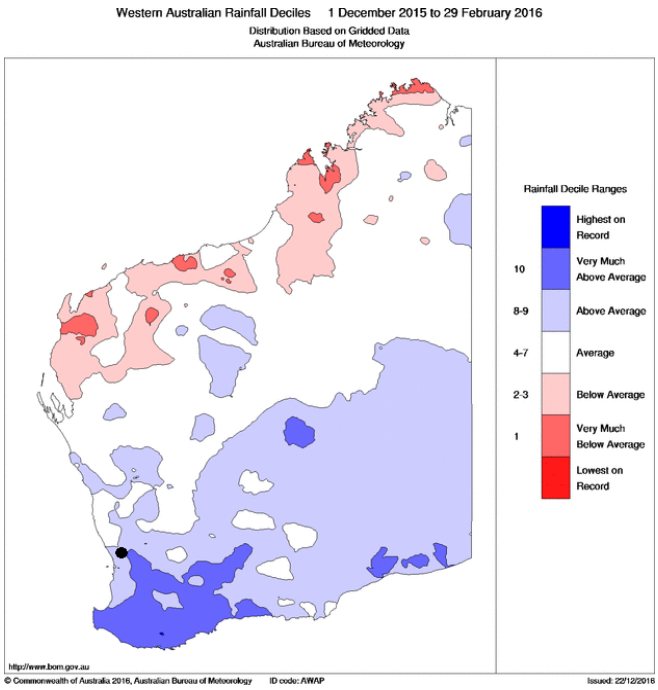


Figure 2.3: Western Australian rainfall deciles 1 December 2015 to 29 February 2016 (BoM, 2017b)

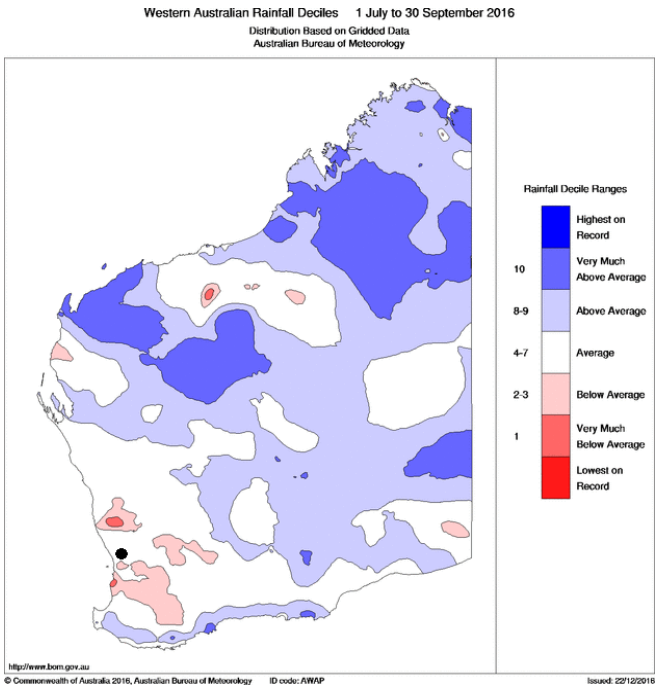


Figure 2.4: Western Australian rainfall deciles 1 July to 30 September 2016 (BoM, 2017b)

3 SEARCHES, SURVEY AND REPORTING METHODS AND LIMITATIONS

3.1 DATABASE AND LITERATURE SEARCHES

Information on the flora species and ecological communities occurring in the Survey Area was gathered from the sources listed in **Table 3.1**. The area over which these searches were carried out is shown on **Map 11.5 (Section 11)**.

Table 3.1: Databases used/searched

Database	Reference or reference number	Buffer (km)
EPBC Act Protected Matters Search Tool	DotEE (2017a)	5
DPaW's NatureMap	DPaW (2007-)	5
DPaW 's Threatened and Priority Flora database (TPFL)	DPaW (2016b, Reference #21-0316FL)	5
DPaW 's Threatened and Priority Flora List (TP List)	DPaW (2016b, Reference #21-0316FL)	5
The Western Australian Herbarium (WA Herb)– for Threatened and Priority flora species opportunistically collected in the area of interest (DPaW, 2016b)	DPaW (2016b, Reference #21-0316FL)	5
DPaW 's Threatened Ecological Communities database	DPaW (2016c, Reference #05-0416EC)	5
Co-ordinates used for EPBC Act and NatureMap searches: 31^0 32' 20" S and 116^0 0' 55" E. The search results are included as **Figures A1.1 and A1.2 (Appendix 1)**. **Co-ordinates for DPaW Threatened Flora searches:**406304 mE and 6510223 mN (GDA94, MGA50). **Co-ordinates for DPaW Threatened Ecological Community search:** 406304 mE and 6510223 mN (GDA94, MGA50).		

The following lists were searched/referenced to determine whether any weeds identified in the EPBC Act Protected Matters and NatureMap searches and in the results of previous surveys carried out within the database search boundary were any of the following (Australian Government, 2017):

- Weeds of National Significance (WoNS);
- On the National Environmental Alert List;
- On the Sleeper Weed List;
- A Species Targeted for Eradication;
- A Species Targeted for Biological Control; or
- A Declared plant in WA (DAFWA, 2017a).

3.2 Survey Methods, Timing and Team

3.2.1 Survey Methodology

The survey methodology was designed with reference to the following:

- Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA and DPaW, 2015);
- EPA Guidance Statement 10, Level of Assessment for Proposals Affecting Natural Areas within the System 6 Region and Swan Coastal Plain portion of the System 1 region (EPA, 2006);
- EPA Guidance Statement 51, Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004); and,
- EPA Position Statement 3, Terrestrial Biological Surveys as an element of Biodiversity Protection (EPA, 2002);

Before undertaking the surveys the botanists familiarised themselves with the CSF species previously located in the Survey Area and surrounds.

The first phase of the combined detailed L2 and TFS was carried out in the Survey Area by one botanist on March 22, 2016 (one person day). The second phase of the combined detailed L2 and TFS was carried out by two botanists on October 25 and 26, 2016 (four person days). A site visit was also carried out by two botanists on September 24, 2016 to assess the likelihood of the vegetation being a significant ecological community.

In March 2016, eight relevés (approximately 10 m x 10 m) were assessed and approximately 11.64 ha of traverses were walked in the Survey Area. In October 2016 the botanists assessed nine 10 m x 10 m quadrats and approximately 18.6 ha of traverses in the Survey Area. Relevé and quadrat locations are collectively known as sites from here on unless stated otherwise.

While most of the survey effort was focused on the Project Area, some traverses were walked and relevés sampled in the Survey Area (and outside of the Survey Area in Lot 195), to determine if CSF and vegetation types found in the Project Area also occurred outside.

Site locations are shown on **Map 11.6 (Section 11)** and the information collected at each is provided in **Table A2.1, Appendix 2**. Site locations were selected before the March and October surveys using aerial photographs and Survey Area boundaries. Sites were placed to capture the habitats visible on the aerial imagery. The final placement of the sites was selected by the botanists while at site and the following information was recorded at each site:

- Location details including Global Positioning System (GPS) co-ordinates.
- Site parameters such as soil description, topography and general habitat description, rock type and cover.
- A photograph of the site.
- Vegetation condition using the scale and criteria in EPA and DPaW (2015).
- Notes on any disturbance to the vegetation in the area.
- Fire history.
- A description of the vegetation structure including the height, cover and dominant species within each stratum.
- A name, height and cover and any other significant recording details for each species located at the site.

While walking traverses in the Survey Area, each botanist surveyed a band of vegetation approximately 10 m wide. All traverses walked in March and October 2016 are shown on **Map 11.6 (Section 11)**. CSF species previously located in the Survey Area, known to occur in the surrounding area, novel species and introduced species were targeted while walking these traverses. When known or suspected CSF or weed species were located while walking traverses the botanists recorded their location on a GPS and their numbers were counted or estimated when numbers were large (e.g. some of the weed species). The botanists also recorded information when any apparently different vegetation type was encountered while walking between sites and while walking traverses, noted any changes in vegetation condition and any disturbance to the vegetation, and collected specimens of and recorded the names of any taxa not already collected at sites.

Threatened and Priority Flora Report forms for CSF species located in the Survey Area will be submitted to the Flora Administrative Officer at DPaW.

3.2.2 Survey Timing

Project assessment timelines required the first phase of the L2 survey to be carried out in March 2016 and the second phase in October 2016. The purpose of the first phase survey was to collect preliminary information on the flora and vegetation of the Survey Area and to target any autumn flowering species that could be in the Survey Area. The second phase was timed to gather follow-up information on the flora and vegetation and to target spring flowering species that could be in the Survey Area. Fourteen CSF have been located within 5 km of the Survey Area and the main flowering months are September, October and November when 11, 11 and 9 (respectively) of these 14 CSF have been recorded flowering (**Table 3.2**).

Table 3.2: Conservation significant flora located within 5 km of the Survey Area and typical flowering times

Conservation significant species - NatureMap records	Rank	A / P	Months when reproductive material on plants (FloraBase records (WAH, 1998-))											
			J	F	M	A	M	J	J	A	S	O	N	D
Acacia anomala	T	P								■	■			
Grevillea althoferorum subsp. *fragilis*	T	P									■	■	■	
Grevillea curviloba subsp. *incurva*	T	P	■					■		■	■	■	■	■
Thelymitra stellata	T	P										■	■	
Hibbertia glomerata subsp. *ginginensis*	P1	P							■	■	■	■		■
Drosera sewelliae	P2	P									■	■		
Grevillea candolleana	P2	P								■	■			
Stylidium squamellosum	P2	P										■	■	
Acacia drummondii subsp. *affinis*	P3	P					■	■	■	■	■		■	■
Adenanthos cygnorum subsp. *chamaephyton*	P3	P	■						■		■	■	■	■
Verticordia serrata var. *linearis*	P3	P	■								■	■		■
Hypolaena robusta	P4	P									■	■	■	
Synaphea grandis	P4	P					■			■	■	■	■	
Verticordia lindleyi subsp. *lindleyi*	P4	P	■	■	■	■	■					■	■	■
Total		**14 P**	**4**	**1**	**1**	**1**	**3**	**2**	**3**	**6**	**11**	**11**	**9**	**6**

Note: Column 2 – T= Threatened species, P1 – P4 = Priority 1 to Priority 4 species; Column 3 – A = annual, P = perennial. Flowering times and annual or perennial from Western Australian Herbarium (WAH) (1998-).

3.2.3 Survey Coverage

Information on the area surveyed and coverage achieved in the Survey Area is presented in **Table 3.3**. Survey coverage achieved at quadrats is the area of the quadrat surveyed (10 m x 10 m), while survey coverage achieved along traverses walked in the Survey Area and Project Area is calculated using the length of traverses walked buffered by 10 m.

Survey coverage calculations do not include the following:

- Overlapping traverse buffers (duplicate areas have been removed and the area is included once only).
- Double up of traverse and quadrat data – when a traverse walked coincided with or overlayed a quadrat location the traverse area was used in order to avoid duplication.
- Relevés were also excluded as the area is approximated and they are not bounded like a quadrat.

Table 3.3: Survey Area and Project Area coverage

Survey time	Attribute	Number of sites	Area surveyed (ha)				
			Project Area	Survey Area	Outside Project Area within Survey Area	Outside Project and Survey Areas	Total
March 2016	Relevés	8	-	-	-	-	-
	Traverses	-	3.63	6.86	3.23	4.78	11.64
	Total area (ha)		3.63	6.86	3.23	4.78	11.64
	Coverage achieved (%)		29.35	21.07	16.00	-	-
October 16	Quadrats	9	0.08	0.09	0.01	-	0.09
	Traverses	-	11.53	15.30	3.77	3.28	18.57
	Total area (ha)		11.61	15.39	3.78	3.28	18.66
	Coverage achieved (%)		93.82	47.28	18.73	-	-
Both surveys	Quadrats	9	0.08	0.09	0.01	-	0.09
	Traverses	-	11.73	17.72	5.99	6.93	24.65
	Total		11.81	17.81	6.00	6.93	24.74
A) Total area surveyed in Survey Area (ha)			17.81				
Area of Survey Area (ha)			32.55				
Coverage achieved in Survey Area (%)			54.71				
B) Total area surveyed in Project Area (ha)			11.81				
Area of Project Area (ha)			12.37				
Coverage achieved in Project Area (%)			95.44				
C) Total area surveyed outside of Project Area[9] (ha)			6.00				
Area outside of Project Area[9] (ha)			20.18				
Coverage achieved outside of Project Area[9] (%)			29.73				

Note: [9] = the area outside the Project Area within the Survey Area.

Approximately 29% of the Project Area and 21% of the Survey Area was assessed in March 2016 and approximately 94% of the Project Area and 47% of the Survey Area in October 2016.

Approximately 55% of the Survey Area was assessed over March and October 2016 (green rows in **Table 3.3**), 95% of the Project Area (blue rows in **Table 3.3**) and 30% of the area outside of the Project Area within the Survey Area (orange rows in **Table 3.3**).

3.2.4 Project Team

This flora and vegetation assessment has been carried out by the personnel listed in **Table 3.4**.

Table 3.4: Project team

Project team				
Name	**Qualification**	**Project role**	**DPaW flora license number**	**Threatened flora collecting permit number (expiry)**
Christina Cox	PhD	Report review	Not applicable	
Scott Hitchcock	BSc	Project manager, botanist, survey & report	SL011397 (exp. April 2016) and SL011785 (exp. April 2017)	127-1516 (Mar 2017)
Rochelle Haycock	BSc	Botanist, survey & report	SL011786 (exp. April 2017)	07-1617 (Jul 2017)
Cate Tauss	BSc Hons	Plant taxonomist	Not applicable	
Kelli McCreery (One Tree Botanical)	MSc	Swan Coastal Plain statistical analyses	Not applicable	

3.3 Taxonomy and Nomenclature

Where possible at least one specimen of every taxon encountered during the March and October 2016 surveys was collected for taxonomic verification in Perth (photographs of large bulky species that could not be collected were provided to the taxonomist). Multiples of flowering or fruiting specimens were collected to assist with identification or to differentiate between priority and non-priority subspecies. Cate Tauss (consultant taxonomist) identified specimens collected from the Survey Area using relevant taxonomic keys and reference specimens at the WA Herbarium; she also liaised with relevant experts at the WA Herbarium as necessary.

Species names used in this report are those adopted by the WA Herbarium and they have been checked against current FloraBase records (WAH, 1998-). Undescribed species and affinities are referred to in the report and listed in the species list as “sp.” (species) and “aff.” (affinity), subspecies as subsp. and varieties as var..

3.4 Statistical Analyses

3.4.1 Pattern Analysis

Two separate analyses were performed. The first (local) analysis was carried out on data collected from the nine quadrats assessed in October 2016 and the results were used to map the vegetation types of the Survey Area. Version 3.12 of the multivariate statistical analysis package PATN (Belbin, 1989; Belbin, 2004) was used to analyse flora taxa presence and absence data, excluding singletons and weeds, in the local analysis. A Pearson complete linkage analysis with the Bray Curtis association measure was used to define sites with similar species composition.

The second (regional) analysis was carried out by Kelli McCreery (One Tree Botanical) with the quadrat data used in the local analysis as well as data from plots surveyed by Gibson *et al.* (1994) when carrying out a floristic survey of the southern Swan Coastal Plain (SCP survey).

For the regional analysis the nine quadrats assessed in October 2016 were compared with plots surveyed for the SCP survey (Gibson *et al.,* 1994), using multivariate analysis run on the programme ‘R’ (R Development Core Team,

2007). The SCP survey data set was used to be consistent with current ecological community listings at both the state and federal levels.

To ensure as much consistency as possible between the datasets, the methods used in the regional analysis were the same as those used by Gibson *et al.* (1994). However, plant taxonomy has changed since 1994, and to ensure that the datasets were comparable the names of the species collected from the nine quadrats assessed in spring 2016 were reverted back to what they would have been in 1994. The taxa reconciliations used for this project are presented in **Table A3.1 (Appendix 3)**.

To test for any methodological differences in the parameters set for the multivariate analysis, a test run was carried out using only the SCP dataset (Gibson *et al,* 1994), to ensure that the results for the grouping were consistent with the original findings of that study. Then each of the nine quadrats assessed in October 2016 was run individually with the SCP dataset, to reduce any disruption created by adding all nine sites to the original dataset.

The SCP floristic analysis was based purely on presence-absence of species within a 10 m x 10 m plot without any allowance for height and cover of the species. Therefore all height and cover data recorded from the nine plots assessed in October 2016 were converted to presence-absence to be comparable with the SCP dataset. Agglomerative methods used Bray-Curtis distance and Ward's clustering. Dendrograms resulting from the analyses are included in **Appendix 3** and the results of the analysis in **Table 6.4, Section 6**. The results are discussed with respect to the location of the Survey Area quadrats in the main group (clade) in which they occur in the analysis using wards clustering method.

3.4.2 Species Accumulation Curve

Species accumulation curves (SPAC) are used to measure the estimated sampling adequacy of an area. In essence, as sampling intensity increases the incidence of new taxa recorded will decrease and eventually all species in a Survey Area will be recorded. This is represented by the total records (vertical axis) becoming asymptotic (levelling out) and remaining level as new sample sites are added. One SPAC was generated for the data collected from quadrats using the software package EstimateS and the methodology outlined in Colwell (2006). The results of the species accumulation analysis are used to estimate the percentage of the flora of the area that was sampled. This estimate is calculated using the last Sobs (Mao Tau) result divided by the last Chao2 Mean listed in the results table (where: Sobs is the total number of species observed in a sample or set of samples; Sobs (Mao Tau) is the number of samples expected in the pooled quadrat samples given the empirical data; and, the Chao2 Mean is the Chao2 richness estimator (mean among runs) (Colwell, 2006)). By dividing the species richness observed (Sobs (Mao Tau) by the species richness predicted (Chao2 Mean) the sampling effort can be estimated.

3.5 Vegetation Descriptions and Mapping

Aerial photography captured through Bing Maps (Microsoft Corporation, 2016) in March 2014 was used to map the vegetation types at a scale of 1:500 in ArcGIS 10.4.1.

The results of the local pattern analysis carried out on quadrat data were used to define floristic communities while the growth form, height classes and cover characteristics of dominant species were used to describe the vegetation types of the Survey Area.

Vegetation types are described using the current National Vegetation Information System (NVIS) methodology at the association level (Level 5). At this level up to three strata and a maximum of three taxa per stratum are used to describe the association (Executive Steering Committee for Australian Vegetation Information (ESCAVI), 2003). The NVIS structural formation terminology is outlined in **Appendix 4**; it utilises growth forms (**Table A4.1**), height classes (**Table A4.2**) and foliage cover characteristics (**Table A4.3**).

Site sheets are included in Appendix 2 (**Table A2.1**) and the vegetation type descriptions on the site sheets use the sub-association level (Level 6), where up to eight sub-strata and a maximum of five taxa per stratum are used to describe the sub-association (ESCAVI, 2003).

3.6 Vegetation Condition

Vegetation condition was mapped using data collected from sites and notes recorded while walking traverses. Field assessments of vegetation condition were updated as necessary once the plant identifications had been confirmed and the number and ratings of the weed species determined (DPaW, 2012). The vegetation condition scale used is that for the South West and Interzone Provinces indicated in EPA and DPaW (2015) and included in **Table 3.5**.

Table 3.5: Vegetation condition scale (EPA and DPaW, 2015)

Vegetation condition	South West and Interzone Botanical Provinces
1	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
2	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
3	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
5	
6	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
7	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 and shrubs.

3.7 Conservation Significant Flora –Plant Numbers

The currently known total number of plants for each of the CSF species located in the Survey Area was derived using the following information:

- FloraBase records (WAH, 1998-);
- Maia's March and October 2016 survey records; and,

Plant numbers included in this report are Maia's best estimates derived from the information available to Maia.

Most of the records on FloraBase for the CSF species did not list plant numbers but a frequency or abundance was stated. For these records Maia used a standard number of plants for each (**Table 3.6**). Where either no plant number information was available or it could not be extrapolated from available information a count of 1 was applied for the record.

Table 3.6: Plant frequency or abundance ratings and corresponding plant numbers

Frequency / abundance	Number of plants
Rare	1
Uncommon	1
Isolated plants	1
Very sparse	1
Scattered	2
Occasional	2
Very scattered	2
Sparse	2
Some	3
Several	5
Few	5
Many	5
Frequent	5
Common	10
Dominant	10
Abundant	20
Very common	50

3.8 Survey Limitations

Guidance Statement 51 (EPA, 2004) states that reports produced on flora and vegetation surveys for environmental impact assessment in WA should contain a section describing the methods used and also one identifying the limitations of the survey methods used. A suggested list of constraints (limitations) that these may cover is provided in Guidance Statement 51. Each of these constraints is discussed with respect to the surveys in **Table 3.7**.

Table 3.7: Survey limitations

Limitation	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material)	**No limitation**
	A desktop study was carried out and the results of the database and literature searches are provided in **Table 2.1**. The EPBC Act Protected Matters search tool, DPaWs TPFL, TP, TEC and NatureMap databases and the WA Herb were used. Relevant environmental geographic information system (GIS) layers were downloaded through Landgate's Slip Enabler and DotEE's Find Environmental Data and the results are listed in **Table 2.1**. Beard's pre-European vegetation mapping, native vegetation extent and the Government of Western Australia's vegetation statistics were also used along with Heddle's vegetation complexes (Heddle *et al.*, 1980, WALGA, 2013). Selected publicly available information on floristic surveys conducted in the vicinity of the Survey Area was used e.g. Phoenix Environmental (2015) and 360 Environmental (2016) and regionally with Gibson *et al.* (1994).
The scope (i.e. what life forms, etc., were sampled)	**No limitation**
	Terrestrial vascular flora species of the Survey Area.
Proportion of flora collected and identified (based on sampling, timing and intensity)	**No limitation**
	One hundred and ninety-nine taxa (199) were recorded from 52 families and 130 genera and 24 (12%) of the 199 taxa were weeds. Nine taxa could not be identified beyond genus. Flowering material was used to identify 46% of the species list, fruiting material 22% and both flowering and fruiting material 10% i.e. 77% of the species list was identified from fertile material. Where possible at least one specimen of each species encountered during the survey was collected and species were re-collected when flowering or fruiting material was located. The survey was carried out in autumn and spring and the rainfall in the three months before the autumn survey was above average and it was average before the spring survey. The spring survey was timed to coincide with flowering times of most of the CSF species that have been recorded within 5 km of the Survey Area. Nine quadrats, eight relevés and approximately 18 ha were assessed by traverses within the Survey Area: 95% of the Project Area was assessed and approximately 30% of the remaining vegetation in the Survey Area. An additional 7 ha of traverses were walked outside of but adjacent to the Survey Area.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed?)	**Minor limitation**
	A combined L2 flora and vegetation and TFS was conducted over the Survey Area in autumn and spring. Relevés were assessed in autumn and quadrats in spring and a targeted flora survey was carried out over the Survey Area in both seasons. The coverage achieved was excellent. All known and suspected CSF species located were counted and recorded on a GPS. Further work may be needed to confirm the identification of the *Haemodorum* ?*loratum* (potential P3) and *Grevillea* ?*drummondii* (potential P4) collected from the Project Area if more vegetation clearing is planned in the surrounding area in the future.
Mapping reliability	**Minor limitation**
	The vegetation was mapped at a scale of 1:500 using aerial photography captured in March 2014 and sourced from Bing Maps Aerial (Microsoft Corporation, 2016). Information on vegetation type boundaries, habitat changes and disturbance boundaries were noted while walking traverses in the Survey Area. As the vegetation types were described and mapped using the results of the pattern analysis, the

Limitation	Comment
	level of disturbance within the Survey Area has most likely influenced the results and may not be representative of undisturbed vegetation outside of the Survey Area. The datum for Bing Aerial imagery is World Geodetic System 1984(WGS84). All data collected and mapped by Maia is in datum GDA94. Therefore any data displayed on maps might be out by 1 to 2 m. The mapping reliability is considered to be adequate for a L2 survey.
Timing, weather, season, cycle	**No limitation**
	BoM's rainfall deciles maps for 1 December 2015 to 29 February 2016 and 1 July to 30 September 2016 show the Survey Area is in an area that received above average rainfall in the three months before the autumn survey and average rainfall in the three months before the spring survey. Annual species comprised 19% of the species list and over both surveys 77% of the species list was identified from specimens collected with reproductive material on them. The spring survey was timed to coincide with the time when most of the CSF previously located in the Survey Area and surrounds tend to flower.
Disturbances (fire, flood, accidental human intervention etc.)	**No limitation**
	No disturbances occurred in the weeks before the survey or while it was being carried out. There was no evidence of any recent fires in the Survey Area.
Intensity (in retrospect, was the intensity adequate?)	**No limitation**
	95% of the Project Area was surveyed by the botanists and approximately 30% of the remainder of the Survey Area. Excellent coverage was achieved over the area that could be impacted and traverses were walked in adjacent areas to determine whether CSF located in the Project Area also occurred outside of the Project Area in these adjacent areas.
Resources	**No limitation**
	Adequate resources were employed during the survey. One person day was spent on the autumn survey and four person days on the spring survey.
Access problems	**No limitation**
	There were no access problems as the Survey Area was accessible directly from Great Northern Highway.
Experience levels (e.g. degree of expertise in plant identification to taxon level)	**No limitation**
	Scott Hitchcock and Rochelle Haycock have conducted many surveys throughout WA over the past 8 to 10 years. In addition to this, specimens for the majority of species recorded during the survey were collected for formal identification using the resources of the WA Herbarium in Perth. The specimens were identified by Cate Tauss, a taxonomist with more than 25 years of experience in the taxonomy of the flora of WA. Cate also liaised with experts at the WA Herbarium as necessary. Kelli McCreery has 20 years' experience in botanical surveys across WA including numerous surveys on the Swan Coastal Plain. Kelli also has 20 years' experience conducting phytosociological numerical analyses in Western Australia.

4 RESULTS - DATABASE SEARCHES

4.1 CONSERVATION SIGNIFICANT FLORA

CSF species produced by the database and literature searches are listed in **Table A1.1 (Appendix 1)** and their locations are shown by listing (threatened or priority) on **Map 11.7 (Section 11).**

4.1.1 Threatened Flora

4.1.1.1 *ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT* 1999

Some flora species are protected by Australian Government legislation based on the perceived levels of threat to the species population at a national level. These species are placed within one of six conservation categories (**Table A5.1, Appendix 5**) and four of these categories are specially protected under the EPBC Act (DotEE, 2016c).

The results of a search carried out using the EPBC Act Protected Matters Search Tool (DotEE, 2017a) listed 17 species, or the species habitat, protected by the EPBC Act that may, are likely or are known to occur within 5 km of the Survey Area – one Critically Endangered species, 12 Endangered species and four Vulnerable species (**Table A1.1, Appendix 1**).

Three of these 17 species were listed in the NatureMap and DPaW search results as occurring within 5 km of the Survey Area – *Acacia anomala*, *Grevillea curviloba* subsp. *incurva* and *Thelymitra stellata*. One additional species that was not included in the EPBC Act Protected Matters Search Tool results but is listed as Endangered under the EPBC Act, *Grevillea althoferorum* subsp. *fragilis*, was listed in the NatureMap and DPaW search results as occurring within 5 km of the Survey Area.

4.1.1.2 *WILDLIFE CONSERVATION ACT 1950*

In WA a number of species are protected by the WC Act the term Threatened Flora is applied to extant Declared Rare Flora (DRF) and Presumed Extinct Flora to presumed extinct DRF. These species are listed under Schedule 1 and 2 of the WC Act and the most recent threatened flora/DRF list was published on January 6, 2017 (GoWA, 2017). Extant threatened flora species can be listed as critically endangered, endangered or vulnerable (DPaW, 2015) and these categories are defined in **Table A5.2, Appendix 5**).

In January 2017, 83 threatened species were listed on FloraBase in the Swan Coastal Plain bioregion and 25 for the Dandaragan Plateau / SWA01 subregion (WAH, 1998-).

The results of a search carried out using NatureMap (DPaW, 2007-) listed four species protected by the WC Act that have been recorded within 5 km of the Survey Area - *Acacia anomala* (Vulnerable), *Grevillea althoferorum* subsp. *fragilis* (Critically Endangered), *Grevillea curviloba* subsp. *incurva* and *Thelymitra stellata* (Endangered). The TPFL database search results also listed these four species while the WA Herb search results listed three (not *Thelymitra stellata*) (**Table A1.1, Appendix 1**).

4.1.2 Priority Flora

Because of the large WA flora, many species are known from only a few collections, or a few sites, and have not been adequately surveyed or are adequately known are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened list for other than taxonomic reasons and these species can be placed on a priority species list (listed as P1 to P4). Categories and definitions for priority flora species are included in **Table A5.3 (Appendix 5)**.

The most recent Priority Flora List was published on November 11, 2015 (Jones, 2015).

In January 2017, 340 priority species were listed for the Swan Coastal Plain / SWA bioregion on FloraBase (WAH, 1998-). Of these 340 species, 108 occur in the Dandaragan Plateau / SWA01 subregion.

Database and literature searches produced a list of 10 priority species with records within 5 km of the Survey Area: one P1 species, three P2 species, three P3 species and three P4 species (**Table A1.1, Appendix 1**).

4.2 Introduced Flora

4.2.1 Weeds of National Significance

A number of lists of weeds of national interest are currently recognised (e.g. WoNS). The nature of the weeds and the resulting actions required for their control determine on which list a weed species may appear. Some weeds are of particular concern and, as a result, have been listed for priority management or in legislation. The weed lists are available on the Australian Government's website (Australian Government, 2017). These lists are: WoNS, National Environmental Alert, Sleeper Weeds, Six Species Targeted for National Eradication and Species Targeted for Biological Control.

- Nine WoNS were listed in the Protected Matters Search Tool results and one possible WoNS due to hybridisation (**Figure A1.1, Appendix 1** and **Table A1.2, Appendix 1**) – *Asparagus asparagoides*, *Chrysanthemoides monilifera* (including *C. monilifera* subsp. *monilifera*), *Genista linifolia*, *Lantana camara*, *Lycium ferocissimum*, *Rubus* fruticosus aggregate, *Salix* spp., *Salvinia molesta* and *Tamarix aphylla*. *Genista* sp. x *Genista monspessulana* was also listed in the EPBC Act Protected Matters Search Tool results and *Genista monspessulana* is a WoNS. The species or species habitat was listed as either 'may' or 'likely' to occur within the search area (**Figure A1.1, Appendix 1)**. Four of these species are also species targeted for biological control (underlined above). One of the 10 species was listed in the NatureMap search results as having records within 5 km of the Survey Area – *Genista linifolia* (**Figure A1.2, Appendix 1**).

4.2.2 Plant Pests Declared in Western Australia

To protect WA agriculture DAFWA regulates harmful plants under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act (DAFWA, 2017a). Under the BAM Act all declared pests are placed in one of three control categories and these are explained in **Table A6.1, Appendix 6** (DAFWA, 2017b).

- Six declared plants and one possible declared plant were listed in the results of the EPBC Act Protected Matters Search Tool search as potentially having habitat in the search area (may or likely to be in the search area but not known to be in the search area) - *Asparagus asparagoides* (C3)*, Chrysanthemoides monilifera* (including *C. monilifera* subsp. *monilifera*) (C2), *Lantana camara* (C3), *Salix* spp. (C1 or C3), *Salvinia molesta* (C2) and *Tamarix aphylla* (C3). *Rubus* fruticosus aggregate is a potential Declared plant.
- One declared plant species was listed in the results of the NatureMap search as occurring within 5 km of the Survey Area – *Chondrilla juncea* (DPaW, 2007-). *Chondrilla juncea* is listed with a C2 eradication category in the Shire of Chittering.

4.2.3 Environmental Weeds

The NatureMap search (DPaW, 2007-) listed three environmental weed (EW) species (in addition to those mentioned above) with records in the search area. The EPBC Protected Matters Search Tool (DotEE, 2017a) listed four EW species (in addition to those already discussed above) or the species' habitat which may occur within the search area (**Table A1.2, Appendix 1**).

DPaW prioritises weeds in each region based on their invasiveness, ecological impact, potential and current distribution and feasibility of control. The resulting priorities focus on weeds considered to be high impact, rapidly

invasive and still at a population size that can feasibly be eradicated or contained to a manageable size. Summaries of the species' ecological impact and invasiveness rankings are provided to help landholders, community groups and private enterprises manage weeds that might impact on the natural environment (DPaW, 2016d). Current regional impact and invasiveness ratings for the different regions are available on DPaW's website (DPaW, 2016d).

DPaW suggests that priorities regarding weeds are:

1. Early Detection/Rapid Response; Any new infestations and/or introductions of any weed species in an area, no matter their impact and/or invasiveness, should be eradicated immediately;
2. Eradication of those species which are still in small enough populations for this target to be achieved; and,
3. Management of high impact, rapidly-moderately invasive species that are impacting on high value conservation assets (DPaW, 2016d).

A regional rankings summary spreadsheet is not currently available for DPaW's Swan region as it is being revised (DPaW, 2016d); however, the previous Swan DPaW region rankings summary spreadsheet (DPaW, 2012) is used to provide an indication of the prioritisation of the 18 weed species listed in the database search results as the Survey Area falls in the Swan region. One of the 18 weeds was ranked as Very High, five as High, three as Medium and seven as Low. In addition to these one was listed as needing further assessment and one weed as an alert species (**Table A1.2, Appendix 1**).

4.3 Threatened and Priority Ecological Communities

Some ecological communities are protected by Australian Government legislation (the EPBC Act) based on the perceived levels of threat to the community or species population at a national level. They are listed as threatened ecological communities – TECs – and can be listed as Critically Endangered, Endangered or Vulnerable (**Table A5.4, Appendix 5**).

- One federally protected TEC was listed in the EPBC Act Protected Matters Search Tool results (DotEE, 2017a). The Banksia Woodlands of the Swan Coastal Plain ecological community was listed as Endangered on 16 September 2016 (DotEE, 2017b) and the search results indicate that the community is likely to occur within the database search area. Its indicative distribution is shown in **Figure A1.3, Appendix 1**.

Some TECs are listed as significant under the WC Act. The WA Minister for Environment may list an ecological community as being threatened if the community is presumed to be totally destroyed or at risk of becoming totally destroyed. Ecological communities with insufficient information available to be considered a TEC, or which are rare but not currently threatened, are placed on a Priority list and are referred to as PECs; listed as Priority 1 to 5). The criteria and categories for these TECs and PECs are detailed in **Table A5.5** and **A5.6** in **Appendix 5**. The most recent WA TEC list is correct to October 6, 2016 and includes 17 TECs listed for the Swan Coastal Plain bioregion (DPaW, 2016e).

- Three TECs were listed in the results of the DPaW ecological community search carried out over the database search area (reference 05-0416EC) - 'Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)' (Critically Endangered), '*Banksia attenuata* woodlands over species rich dense shrublands' (Endangered) and 'Shrublands and woodlands on Muchea limestone' (Endangered). These TECs are not mapped in the Survey Area; the closest location is 3.9 km south-west of the Survey Area ('Shrublands and woodlands on Muchea limestone' (**Map 11.8, Section 11**).

The most recent PEC list is dated November 30, 2016 (DPaW, 2016f) and includes 32 PECs listed in DPaW's Swan region.

- Two PECs were listed in the results of the DPaW ecological community search carried out over the database search area (reference 05-0416EC) - '*Banksia* woodland of the Gingin area restricted to soils dominated by yellow to orange sands' (P2) and 'Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands' (P3). These two PECs are not mapped in the Survey Area; the closest location is 0.7 km south of the Survey Area ('Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands' (**Map 11.8, Section 11**).

5 Results – Flora of the Survey Area

5.1 General Flora

Summary information on the flora of the Survey Area is included in **Table 5.1** and a list of the flora taxa recorded is included as **Table A7.1, Appendix 7**.

Table 5.1: General flora of the Survey Area

Factor	March 2016	October 2016	Total for both surveys
Number of taxa	94	161	199
Number of families	32	47	52
Number of genera	65	113	130
Perennials (%)	96.8	76.9	80.8
Annuals (%)	3.2	23.1	19.2
Flowering (%)	29.0	44.4	46.0
Fruiting (%)	22.6	19.4	21.7
Flowering and fruiting (%)	9.7	5.6	9.6
All reproductive material (%)	61.3	69.4	77.3
Most common families	Proteaceae (18 taxa), Fabaceae and Myrtaceae (15 taxa each) and Ericaceae (5 taxa)	Fabaceae (15 taxa), Asteraceae (14 taxa) and Proteaceae (13 taxa)	Fabaceae (22 taxa), Proteaceae (21 taxa) and Myrtaceae (16 taxa)
Most common genera	*Daviesia* (6 taxa), *Banksia* (5 taxa) and *Hibbertia* (4 taxa)	*Drosera* and *Haemodorum* (5 taxa each), *Lomandra*, *Hibbertia* and *Stylidium* (4 taxa each)	*Daviesia* (6 taxa), *Acacia*, *Banksia*, *Drosera*, *Gompholobium* and *Haemodorum* (5 taxa each)

The identity of nine taxa could not be confirmed beyond genus due to a lack of flowering or fruiting material – *Acacia* ?*applanata*, *Calectasia* sp., *Cassytha* sp., *Grevillea* ?*drummondii* (potential P4), *Haemodorum* sp., *Haemodorum* ?*loratum* (potential P3), *Haemodorum* ?*venosum*, *Lepidosperma* ?*costale* and *Pithocarpa* sp.. *Haemodorum* ?*loratum* (potential P3), and *Haemodorum* ?*venosum* were not included in the counts, as they are likely to be species already in the species list. An additional five taxa were also not included in the counts as they are likely to be already in the species list as a subspecies: *Pentameris airoides**, *Pericalymma ellipticum*, *Pimelea suaveolens, Stylidium diuroides* and *Ursinia anthemoides* *.

The species accumulation analysis indicated that 96.15% of the flora estimated to be in the Survey Area was recorded. However, this estimation is based on the 109 taxa recorded in the nine quadrats assessed; it does not include the 24 weed taxa, 28 additional taxa recorded at relevés and 38 taxa opportunistically collected while walking transects in the Survey Area. The results of the species accumulation analyses are included in **Table A7.2 (Appendix 7)** and the graph is shown in **Figure 5.1**.

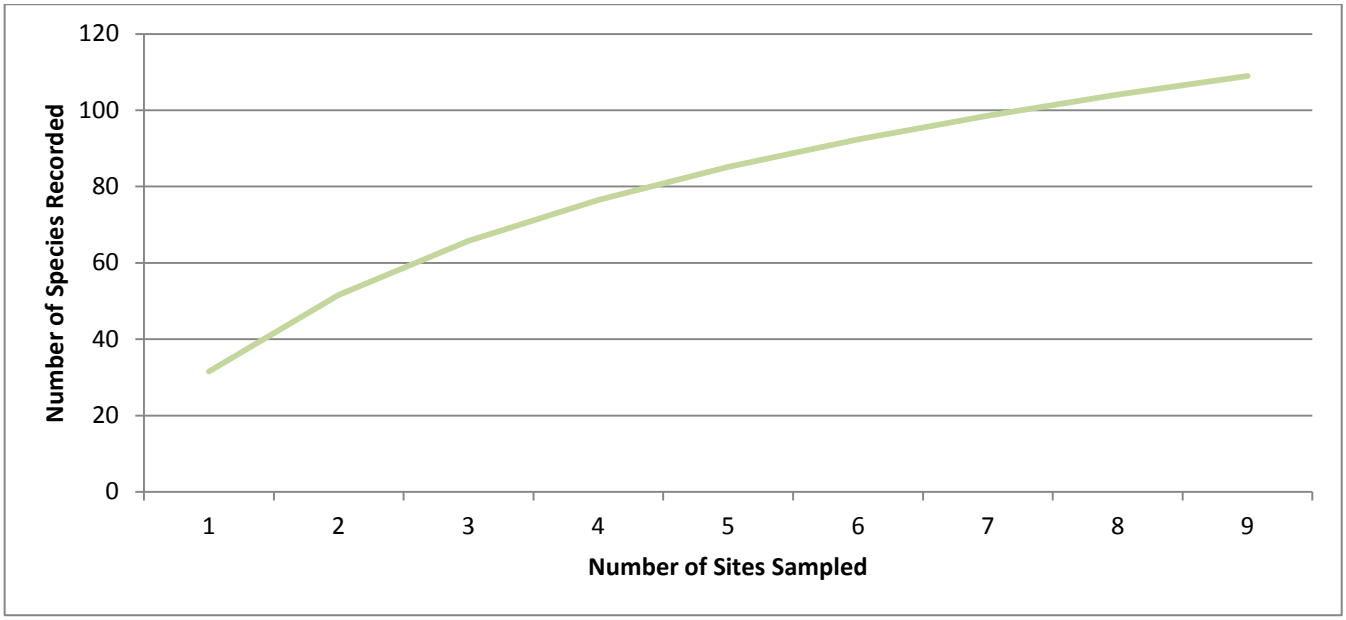


Figure 5.1: Species accumulation curve – quadrat data

On a number of sites assessed and species located basis, the number of taxa recorded in the Survey Area is comparable with that recorded by 360 Environmental (2016) in the vicinity of the Survey Area and more diverse than that recorded by Phoenix Environmental (2015) and Emerge Associates (2013).

5.2 Range Extensions

Species have a typical range which is indicated by their known distribution records. Sometimes species are recorded in areas where they have not been found previously and these species are described as range extensions. A range extension can reflect a paucity of surveys in a particular area or non-lodgement of flora records to the WA Herbarium.

Using 100 km as the minimum distance from an existing record to define a range extension, no range extension species were collected from the Survey Area.

5.3 Conservation Significant Flora

5.3.1 Threatened Flora

- No species protected by the EPBC Act were located in the Survey Area.
- No species protected by the WC Act were located in the Survey Area.

5.3.2 Priority Flora

In October 2016 Maia recorded two confirmed priority species in the Survey Area – *Acacia drummondii* subsp. *affinis* and *Haemodorum loratum* (both P3).

One potential P4 species, *Grevillea* ?*drummondii,* was located in March 2016 but not in October 2016 and one potential P3 species, *Haemodorum* ?*loratum,* was located in October 2016. The specimens collected were sterile and their identification could not be confirmed.

A description for and photographs of these confirmed or potential CSF species are provided in **Table 5.2**. An estimate of the current number of plants for each species is listed in **Table 5.3** and their locations are shown on **Map 11.9, Section 11)**. The coordinates have been supplied to IPG as electronic data.

5.4 Endemic Flora

Endemics are defined as taxa restricted to an area within 100 km radius and near-endemics as having most populations located within a 100 km radius with one to two outlying, disjunct populations (Markey & Dillon, 2008; Meissner & Coppen, 2014).

No regional endemics were listed in the results of the NatureMap search (DPaW, 2007-). One potential regional endemic, *Grevillea* ?*drummondii* (potential P4), was located in the Survey Area. Using *G. drummondii* records on FloraBase (rather than those on Australia's Virtual Herbarium; AVH, 2017) the approximate distribution of *Grevillea drummondii* is 85 km by 95 km (including the query locations recorded in the Survey Area).

The non-CSF taxa recorded in the Survey Area were checked against the FloraBase distribution map (WAH, 1998-) to determine if any were regional endemics and none were considered to be.

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Table 5.2: Descriptions for and photographs of conservation significant flora species located in the Survey Area

Species description and habitat	Photographs	
***Acacia drummondii* subsp. *affinis* (P3) - Fabaceae** *A. drummondii* subsp. *affinis* is an erect shrub growing from 0.3 m to 1 m high. Its flowers are yellow and they are produced from July to August. It is found growing on lateritic gravelly soils (WAH, 1998-). The plants were sterile in October 2016 they were found on a laterite hill and a sandy footslope of the Survey Area.	 **Growth habit** Photography by B.R. Maslin. Image used with the permission of the Western Auatralian Herbarium, Department of Parks and Wildlife (https://florabase.dpaw.wa.gov.au/help/copyright). Accessed on January 30th 2017.	 **Close-up of phyllodes (leaves) and flowers** Photography by S. Nevill. Image used with the permission of the Western Auatralian Herbarium, Department of Parks and Wildlife (https://florabase.dpaw.wa.gov.au/help/copyright). Accessed on January 30th 2017.
***Haemodorum loratum* (P3) - Haemodoraceae** *H. loratum* is a bulbaceous, perennial herb, growing from 0.45 to 1.2(-2) m high. Its flowers are black/brown-black/green and they are produced in November. It is found growing in grey or yellow sand and gravel (WAH, 1998-). The plants were flowering in October 2016 and they were found on a laterite hill and on sandy footslopes of the Survey Area. *Haemodorum* ?*loratum* was also collected from the Survey Area.	 **Growth habit**	 **Flower**

Species description and habitat	Photographs
***Grevillea* ?*drummondii* (potential P4) - Proteaceae** *G. drummondii* is a spreading to erect shrub growing to 0.3 m high (Keighery, 1998). It has narrowly obovate to oblong elliptic leaves between 10-70 mm long and 3-20 mm wide which are sometimes covered with straight hairs and sometimes with no hairs. It flowers between June and October and the flowers are terminal, yellow to red, approximately 10-20 mm long and erect to curved in shape. It occurs on the Darling Range and surrounds in Marri or Jarrah woodland in lateritic clay loams (Keighery, 1998). *G. drummondii* is a variable species and only sterile material has been collected from the Survey Area. Flowering or fruiting collections will need to be made to confirm the identity of the collections from the Survey Area. Plants were found on laterite slopes and on a white sandy footslope in the Survey Area.	 **Top left clockwise – flowers, buds, growth habit and stems and leaves** Photography by P.G. Armstrong. Image used with the permission of the Western Australian Herbarium, Department of Parks and Wildlife (https://florabase.dpaw.wa.gov.au/help/copyright). Accessed on Wednesday, 1 February 2017.

Note: P3 and P4 = Priority 3 and Priority 4 species. Photographs © 2017 Maia Environmental Consultancy unless stated otherwise.

Table 5.3: Number of plants of conservation significant species recorded in the Survey Area

Species	Rank	Project Area	Survey Area	Outside Project Area within Survey Area	Outside Project and Survey Areas	Total recorded	Known non-impact plants from other surveys	FloraBase records	Total known in WA	Impact(%) to known plants in WA
Acacia drummondii subsp. *affinis*	P3	4	4	0	0	4		116	120	3.33
Haemodorum loratum	P3	39	55	16	15	70	228	60	359[m]	10.86
Haemodorum ?loratum	?P3	1	1	0	0	1			-	-
Grevillea drummondii	P4	0	0	0	0	0		508	510[m]	0.20
Grevillea ?drummondii	?P4	1	2	1	0	2			-	-

Note: P3 and P4 = Priority 3 and Priority 4 species. [m] The total number of plants known in WA for query species (?) is included with the non-query species.

5.5 Introduced Flora

The introduced / weed species located in the Survey Area are listed in **Table 5.4** and the locations are shown on **Map 11.10, Section 11**. Coordinates for all weeds located have been supplied to IPG as electronic data.

5.5.1 Weeds on National Weeds Lists

- No weeds on any of the national weeds lists were located in the Survey Area.

5.5.2 Plants Declared in Western Australia

- No declared plants were located in the Survey Area.

5.5.3 Environmental Weeds

Twenty-four weed species were recorded in March and October 2016.

The most commonly recorded weeds were *Ursinia anthemoides* subsp*. anthemoides* (including *U. anthemoides*), *Pentameris airoides* subsp. *airoides* (including *P. airoides*) and *Hypochaeris radicata*. These three species also had the highest number of plants in the Survey Area.

Weed rankings on the previous Swan Coastal Plain DPaW region rankings summary spreadsheet (DPaW, 2012) are included for the weed species located in the Survey Area (**Table 5.4**). The objective for weeds given a medium rank is to control to reduce or containment, for weeds given a low rank the objective is containment at key sites only and those given a negligible rank require no action to be undertaken but may include monitoring (DPaW, 2012).

None of the weed species listed in **Table 5.4** were ranked as high in DPaW's Swan Region weed rankings summary spreadsheet, one was ranked as medium, 12 as low and 11 as negligible (DPaW, 2012).

Table 5.4: Weeds located in the Survey Area and DPaW Swan region rankings

Species (Common name)	Weed type	Number of records	Number of plants	DPaW rank
Gladiolus caryophyllaceus (Wild Gladiolus)	EW	45	64	Medium
Arctotheca calendula (Capeweed)	EW	11	28	Low
Briza maxima (Blowfly Grass)	EW	59	3,882	Low
Briza minor (Shivery Grass)	EW	11	181	Low
Ehrharta calycina (Perennial Veldt Grass)	EW	53	542	Low
Eragrostis curvula (South African Lovegrass)	EW	1	1	Low
Hypochaeris glabra (Smooth Catsear)	EW	1	1	Low
Hypochaeris radicata (Flat Weed)	EW	117	8,240	Low
Lolium perenne (Perennial Ryegrass)	EW	3	13	Low
Ornithopus compressus (Yellow Serradella)	EW	5	5	Low
Pelargonium capitatum (Rose Pelargonium)	EW	1	1	Low
Petrorhagia dubia (Velvety Pink)	EW	1	1	Low
Wahlenbergia capensis (Cape Bluebell)	EW	50	517	Low
Dischisma arenarium (Dischisma)	EW	1	1	Negligible
Erodium botrys (Long Storksbill)	EW	1	1	Negligible

Species (Common name)	Weed type	Number of records	Number of plants	DPaW rank
Galium divaricatum (Slender Goosegrass)	EW	1	1	Negligible
Hordeum leporinum (Barley Grass)	EW	2	20	Negligible
Lysimachia arvensis (Pimpernel)	EW	2	2	Negligible
Orobanche minor (Broom Rape)	EW	13	49	Negligible
Parentucellia latifolia (Red Bartsia)	EW	9	99	Negligible
Pentameris airoides and *Pentameris airoides* subsp. *airoides* (False Hairgrass)	EW	136	23,770	Negligible
Romulea rosea (Guilford Grass)	EW	2	15	Negligible
Sonchus oleraceus (Common Sowthistle)	EW	1	1	Negligible
Ursinia anthemoides and *Ursinia anthemoides* subsp. *anthemoides* (Ursinia)	EW	155	46,261	Negligible

Note: EW = environmental weed.

6 RESULTS – VEGETATION OF THE SURVEY AREA

6.1 VEGETATION TYPES – LOCAL PATTERN ANALYSIS

Pattern analysis divided the local data into two super groups at approximately 0.76 similarity scale. Supergroup one was characterised by *Eucalyptus todtiana* while supergroup two was characterised by *Eucalyptus marginata* subsp. *thalassica* and *Corymbia calophylla*. The data was further divided into three floristic groups (vegetation types) at approximately the 0.50 similarity scale**.**

The quadrat and association / group dendrograms for the local analysis are included as **Figures A3.1** and **A3.2, Appendix 3**. The statistical methodology (PATN recipe) used to run the pattern analysis is included as **Figure A3.3**, **Appendix 3**. The site by species matrix for the local analysis used to describe the vegetation of the Survey Area is included as **Table A3.2, Appendix 3**.

Data collected at each site is included in **Appendix 2**.

The Maia vegetation types (MVTs) of the Survey Area are described in **Table 6.1** and shown on **Map 11.11 (Section 11)** and with the CSF species on **Map 11.12 (Section 11)**.

Broad floristic formation descriptions are included at the top of each vegetation type description in **Table 6.1** followed by the full vegetation type description. In order to be comparable with the broad floristic formation descriptions, vegetation type descriptions have been written using the dominant cover class as the indicator and not the dominant stratum e.g. Mallee Woodland of *Eucalyptus todtiana* with a Low Shrubland of *Eremaea pauciflora* var. *pauciflora, Hibbertia hypericoides* subsp. *hypericoides* +/- Tall Open Shrubland of *Banksia menziesii* and *B. attenuata*.

The codes used for the vegetation types include the first letter of the genus and species of the dominant taxon or taxa in the vegetation type along with the first letters of the dominant stratum of the broad floristic formation in bold font e.g. *CcEm***F** is an Open Forest of *Corymbia calophylla* +/- *Eucalyptus marginata* subsp. *thalassica* with an Open Shrubland of *Xanthorrhoea preissii* and a Low Open Shrubland of *Hibbertia hypericoides* subsp. *hypericoides.* These codes have also been suffixed with a number based on the position of the vegetation type in the dendrogram, from top to bottom. For example, *Et***MWL** (1) is at the top of the dendrogram and *EmCc***F** (3) is at the bottom (**Figure A3.1, Appendix 3**). These numbers also indicate the proximity of the groups in the dendrogram i.e. 1 is adjacent to 2 but distant from 3.

The significance of these vegetation types is discussed in **Section 7**.

Table 6.1: Vegetation types of the Survey Area

*Et***MWL** (1)**:** *Eucalyptus* Mallee Woodland.

This vegetation type occurs in the lower lying areas with a surface layer of white sand in the western section of the Survey Area. Large previously cleared areas with some regeneration of native species were noted in it. Most of the area is represented by a mallee woodland of *Eucalyptus todtiana* with occasional scattered *Banksia attenuata* or *B. menziesii* tall shrubs or juveniles. A similar vegetation type was noted in an adjacent lot south of the Survey area with a dominant *Banksia* tree and tall shrub stratum and this may represent a less disturbed patch of this vegetation type.

The condition of the vegetation at one of the three quadrats assessed in this vegetation type was rated as 2 (vegetation structure intact), at another it was rated as 3 (vegetation structure altered) and at the third as 4 (vegetation structure significantly altered). The average condition rating for this vegetation type is 3 (vegetation structure altered) and the main disturbance noted was previous clearing.

Type description	Associated species / species richness	Sites
Mallee Woodland of *Eucalyptus todtiana* with a Low Shrubland of *Eremaea pauciflora* var. *pauciflora* and *Hibbertia hypericoides* subsp. *hypericoides* +/- Tall Scattered Shrubs of *Banksia menziesii* and *B. attenuata*	*Anigozanthos humilis* subsp. *humilis, Austrostipa compressa*, *Burchardia congesta*, *Cassytha racemosa*, *Drosera erythrorhiza*, ***Ehrharta calycina*,*** ***Gladiolus caryophyllaceus****, ***Hypochaeris radicata****, *Lomandra caespitosa*, *Melaleuca trichophylla*, ***Pentameris airoides*,*** *Podotheca gnaphalioides* Average overall species richness = 38.3 (± 6.6) and native species richness = 28.3 (± 6.6).	Q01, Q04, Q09

*CcEm***F** (2)**:** *Corymbia* and *Eucalyptus* Forest.

This vegetation type occurs on the mid to lower slopes and crest of a low relief hill with a surface layer of white to grey sand and loam. Some areas in this vegetation type have been cleared previously and they either lack a tree stratum or there are scattered trees over mixed shrub regrowth. While large areas of disturbance have been mapped as degraded smaller discrete patches of disturbance were difficult to map and have been incorporated into areas mapped as this vegetation type.

Of the four quadrats sampled in this vegetation type, vegetation condition was rated as 3 (vegetation structure altered) at three of them and at one as 4 (vegetation structure significantly altered). The average condition rating for this association was 3 (vegetation structure altered) and the main disturbance noted was previous clearing and / or logging.

Type description	Associated species / species richness	Sites
Open Forest of *Corymbia calophylla* +/- *Eucalyptus marginata* subsp. *thalassica* with an Open Shrubland of *Xanthorrhoea preissii* and a Low Open Shrubland of *Hibbertia hypericoides* subsp. *hypericoides*	*Alexgeorgea nitens*, *Crassula colorata* var. *acuminata*, *Desmocladus fasciculatus*, *Drosera erythrorhiza*, ***Ehrharta calycina****, ***Gladiolus caryophyllaceus****, ***Hypochaeris radicata****, *Lomandra sericea*, *Mesomelaena pseudostygia*, *Microtis media* subsp. *media*, *Parentucellia latifolia*, *Podotheca gnaphalioides*, *Tricoryne elatior*, ***Ursinia anthemoides* subsp. *anthemoides**** Average overall species richness = 36.8 (± 8.5) and native species richness = 29.5 (± 7.8).	Q03, Q05, Q06, Q07

*EmCc***F** (3)**:** *Eucalyptus* and *Corymbia* Forest

This vegetation type was recorded on laterite crests and slopes in the centre to north-eastern section of the Survey Area. Although most of this vegetation type appeared to have been disturbed, the average native species richness was higher than in the other vegetation types in the Survey Area.

Vegetation condition at both quadrats sampled in this vegetation type was rated as 3 (vegetation structure altered) and the main disturbance was from previous vegetation clearing. Relatively large patches with no tree stratum were common and wood piles and gravel pits were also noted throughout this vegetation type.

Type description	Associated species / species richness	Sites
Tall Woodland / Open Forest of *Eucalyptus marginata* subsp. *thalassica* and / or *Corymbia calophylla* with a Low mixed Shrubland (*Xanthorrhoea acanthostachya*, *Lechenaultia biloba*, *Hibbertia hypericoides* subsp. *hypericoides*)	*Acacia pulchella* var. *reflexa*, *Banksia bipinnatifida* subsp. *multifida, Banksia dallanneyi* subsp. *sylvestris, Chamaescilla corymbosa*, *Daviesia decurrens* subsp. *decurrens*, *Gompholobium knightianum*, *Haemodorum venosum*, *Hibbertia commutata*, ***Hypochaeris radicata****, ***Orobanche minor****, *Ptilotus stirlingii*, *Stylidium ciliatum, Synaphea aephynsa*, ***Ursinia anthemoides*** **subsp*. anthemoides***,* *Xanthorrhoea preissii* Average overall species richness = 48.5 (± 3.5) and native species richness = 41.5 (± 2.1).	Q02, Q08

6.2 Vegetation Type Cover

The area and cover of each vegetation type mapped in the Survey and Project Area is listed in **Table 6.2**.

Vegetation type *CcEm***F** (2) was mapped over the largest area in the Survey Area (49.42%), *EmCc***F** (3) over 24.77% and *Et***MWL** (1) over 8.32%. Vegetation type *EmCc***F** (3) was mapped over the largest area in the Project Area (26.43%) followed by *CcEm***F** (2) (24.33%) and *Et***MWL** (1) over the smallest area (18.26%).

Table 6.2: Area (ha) and cover (%) of vegetation types mapped in the Survey and Project Area

Vegetation type	Survey Area		Project Area	
	ha	%	ha	%
*Et***MWL** (1)**:** *Eucalyptus* Mallee Woodland. Mallee Woodland of *Eucalyptus todtiana* with a Low Shrubland of *Eremaea pauciflora* var. *pauciflora* and *Hibbertia hypericoides* subsp. *hypericoides* +/- Tall Scattered Shrubs of *Banksia menziesii* and *B. attenuata*	2.71	8.32	2.26	18.26
*CcEm***F** (2)**:** *Corymbia* and *Eucalyptus* Forest. Open Forest of *Corymbia calophylla* +/- *Eucalyptus marginata* subsp. *thalassica* with an Open Shrubland of *Xanthorrhoea preissii* and a Low Open Shrubland of *Hibbertia hypericoides* subsp. *hypericoides*	16.09	49.42	3.01	24.33
*EmCc***F** (3)**:** *Eucalyptus* and *Corymbia* Forest Tall Woodland / Open Forest of *Eucalyptus marginata* subsp. *thalassica* and / or *Corymbia calophylla* with a Low mixed Shrubland (*Xanthorrhoea acanthostachya, Lechenaultia biloba, Hibbertia hypericoides* subsp. *hypericoides*)	8.06	24.77	3.27	26.43
Disturbed	5.69	17.48	3.83	30.98
Total area / cover	32.55	100.00	12.37	100.00

6.3 Vegetation Condition

Using the data collected at quadrats and information collected by botanists while walking traverses in the Survey Area, the condition of most of the vegetation mapped is rated as 3 (vegetation structure altered) (82.52%) and 6-7 (disturbed) (17.48%). DPaW ranks for the weed species located in the quadrats were considered while assessing vegetation condition and although many of the weed species were widely distributed and dominant in some areas (e.g. *Ursinia anthemoides* and *Hypochaeris radicata*), none are considered to be aggressive weed species according to the Swan Coastal Plain DPaW region rankings summary spreadsheet (DPaW, 2012). Additional information on vegetation condition in the Survey Area and Project Area is included in **Table 6.3** and the distribution of each condition class is shown on **Map 11.13** (**Section 11**).

Table 6.3: Vegetation condition

Vegetation condition	Comment	Survey Area		Project Area	
		ha	%	ha	%
3 (vegetation structure altered)	The structure of the vegetation in these areas had been altered by previous clearing and there were areas of native regrowth throughout. The cover and diversity of weed species in the areas mapped as 3 was relatively high, although none were considered to be aggressive. 	26.86	82.52	8.54	69.02
6-7 Disturbed	Areas of disturbed vegetation generally without a tree stratum or with scattered trees over mixed shrub regrowth and wood piles littered throughout were mapped as 6-7. These areas have been mapped when large enough to be seen on the aerial photograph but some patches are relatively small and their boundaries can't be seen. This map unit also includes areas ranked as Degraded e.g. existing tracks and firebreaks. 	5.69	17.48	3.83	30.98
Total		32.55	100.00	12.37	100.00

6.4 Regional Analysis

The results of the regional analysis have most likely been influenced by: a) the location of the Survey Area close to the boundary of the Swan Coastal Plain and Jarrah Forest bioregions, b) the level of previous disturbance across the Survey Area, and c) the lack of SCP sites close to the Survey Area (pers. comm. Kelli McCreery).

When the Survey Area quadrats were analysed together with the SCP data, the Survey Area quadrats grouped as an outlier to FCT28 of Gibson *et al.* (1994). Because of this each Survey Area quadrat data was added individually to the SCP data and nine separate analyses were run. The results of these individual analyses are included in **Table 6.4** and the separate dendrograms are included as **Figures A3.4 to A3.12, Appendix 3.** The relevant Survey Area quadrat is coloured red in amongst the black SCP quadrats on the horizontal axis of the **Appendix 3** figures.

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Table 6.4: Regional analysis

Maia quadrat	MVT	Main clade (ward)	SCP sites	FCT description	Maia 2016 species richness	SCP mean species richness	Conclusions	Notes
Q01	*Et***MWL** (1)	FCT28, FCT28, FCT28, FCT28, FCT28	NEER-8, YAN-4, 8, 9., SEAB-6	FCT28: Spearwood *Banksia attenuata* or *Banksia attenuata* - *Eucalyptus* woodlands.	34	55	Strongly FCT28.	SCP sites from Neerabup, Yanchep and Seabird are the closest. Sites from FCT28 are also in Bullsbrook (9 km due south of the Survey Area).
Q02	*EmCc***F** (3)	FCT3b (TEC WA), FCT3b (TEC WA)	BURNRD-2, YARL-03	FCT3b: *Eucalyptus calophylla* (now *Corymbia calophylla*) - *Eucalyptus marginata* woodlands on sandy clay soils.	43	61	Outlier to FCT3b (Yarloop and Pinjarra East).	FCT3b is a WA TEC. Burns Road sites are on the far eastern side of SCP (east of Pinjarra) as are Yarloop sites. FCT20b is a WA TEC
Q03	*CcEm***F** (2)	FCT28, FCT28	NEER-03, NEER-04	FCT28: Spearwood *Banksia attenuata* or *Banksia attenuata* - *Eucalyptus* woodlands.	27	55	FCT28	Slight outlier to sites in FCT28.
Q04	*Et***MWL** (1)	FCT21c (P3), FCT21c (P3), FCT21c (P3)	YULE-2, TWIN--7, TWIN-8	FCT21c: Low Lying *Banksia attenuata* woodlands or shrublands (PEC P3).	35	40	FCT21c	Twin Swamps NR sites 20 km due south (TWIN--7 & 8) so proximity makes sense. Yule Brook eastern side of SCP (just east of Brixton Street Wetlands, Kenwick).
Q05	*CcEm***F** (2)	FCT06	CARD-04, CARD-10, CARD-11	FCT06: Weed dominated wetlands on heavy soils	32	27	FCT06 (with some influence from 20b)	Weedy sites sometimes come out as FCT06 regardless of their original structure. Cardup SCP sites on far eastern side of SCP.
Q06	*CcEm***F** (2)	FCT21c (P3) FCT21c (P3) FCT21c (P3)	YULE-3, TWIN-7, TWIN-8	FCT21c: Low Lying *Banksia attenuata* woodlands or shrublands (PEC P3).	40	40	FCT21c (FCT20b secondary)	Yule and Twin Swamps are all far eastern SCP sites. Twin Swamps 20 km due south of

Maia quadrat	MVT	Main clade (ward)	SCP sites	FCT description	Maia 2016 species richness	SCP mean species richness	Conclusions	Notes
								Project Area.
Q07	*CcEm***F** (2)	FCT21c (P3)	YULE-3	FCT21c: Low Lying *Banksia attenuata* woodlands or shrublands. (PEC P3).	46	40	FCT21c (FCT20c secondary)	Yule-3 is a far eastern SCP site.
Q08	*EmCc***F** (3)	FCT21c (P3)	YULE-3, BULL-1,4,9-11.	FCT28: Spearwood *Banksia attenuata* or *Banksia attenuata* - *Eucalyptus* woodlands.	50	40	FCT21c (FCT28 secondary)	FCT21c (Yule Brook) with secondary influence FCT28 (Bullsbrook).
Q09	*Et***MWL** (1)	FCT21c (P3)	YULE-3	FCT21c: Low Lying *Banksia attenuata* woodlands or shrublands. (PEC P3).	46	40	FCT21c (FCT20c secondary)	This quadrat is in a bit of a depression.

Note: MVT = Maia vegetation type, FCT = floristic community type, SCP = Swan Coastal Plain site (Gibson *et al.*, 1994), PEC = priority ecological community, TEC = threatened ecological community; P3 = priority 3.

6.5 Maia Vegetation Types in Beard Vegetation Associations and Heddle Vegetation Complexes

Maia vegetation types mapped in the BVAs and HVCs are listed in **Table 6.5**. All of the MVTs are represented by either a BVA, HVC or both. Grey cells in **Table 6.5** indicate where one or more of the species in Beard's or Heddle's description also occur in Maia's.

Table 6.5: Maia vegetation types mapped in Beard vegetation associations and Heddle vegetation complexes

MVT	BVA (NVIS Level 5) and HVC and MVTs mapped within them (indicated by a ✓)	
	BVA 1020: Mosaic: Medium forest; jarrah-marri / Medium woodland; marri-wandoo	**HVC Moondah:** Low closed to low open forest of *Banksia attenuata – B. menziesii - Eucalyptus todtiana - B. prionotes* on slopes, open woodland of *E. calophylla* (now *Corymbia calophylla*) – *Banksia* spp. in valley.
*Et***MWL** (1)		✓
*CcEm***F** (2)	✓	✓
*EmCc***F** (3)	✓	✓

Note: MVT = Maia vegetation association, BVA = Beard vegetation association, HVC = Heddle vegetation complex

6.6 Ecological Communities

6.6.1 EPBC Act Listed Threatened Ecological Communities

One MVT, *Et***MWL** (1), could be the federally protected TEC "Banksia Woodlands of the Swan Coastal Plain ecological community" listed under the EPBC Act.

The ecological community occurs on the Swan Coastal Plain and is characterised by a prominent tree layer of *Banksia* with scattered eucalypts (DotEE, 2017b).

For EPBC Act referral, assessment and compliance purposes, the national ecological community is limited to patches that meet the key diagnostic characteristics, condition thresholds and minimum patch size (DotEE, 2017b). The thresholds relevant to the Survey Area are summarised in **Table A8.11, Appendix 8**. A brief discussion of each step and its relevance to MVT *Et***MWL** (1) is also included in **Table A8.11, Appendix 8**.

MVT *Et***MWL** (1) meets most of the criteria for the TEC, however, it lacks the characteristic dominant *Banksia* stratum and was dominated instead by *Eucalyptus todtiana* mallees. *Eucalyptus todtiana* is listed as an associated species for the ecological community. Woodland dominated by *Banksia attenuata* was noted in a relatively undisturbed patch of vegetation in an adjacent lot to the south of the Survey Area, however, this vegetation was not mapped by Maia.

The vegetation comprising MVT *Et***MWL** (1) has been disturbed in the past and there is either no shrub understorey or the shrubs are regrowth. Quadrats sampled in MVT *Et***MWL** (1) grouped with SCP sites from FCT21c and FCT28 in the regional analysis and both FCTs are included in the TEC. Due to the disturbance history it is likely that this association is a modified / degraded form of the ecological community.

6.6.2 WC Act Listed Threatened Ecological Communities

One quadrat from MVT *EmCc***F** (3) (Q02) grouped as an outlier from two SCP sites of FCT3b, which is a state listed TEC "SCP3b: *Corymbia calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain". Quadrat Q02 was sampled on a low lateritic hill with a surface layer of laterite gravel and stones

with an underlying brown sandy-loam soil. Species richness at Q02 was lower than the average species richness for FCT3b (43 species compared to an average of 61) and the low shrub layer was *Xanthorrhea acanthostachya* while the low shrub layer in FCT3b contained *X. preissii*.

There were signs of earlier vegetation clearing (wood piles and bare areas) in the vicinity of this quadrat and this disturbance may have influenced the species composition and the result of the floristic analysis. It is unlikely that this quadrat represents the TEC based on the habitat in which it was recorded in and the composition and structure of the lower stratum.

6.6.3 Priority Ecological Communities

Five quadrats (Q04, Q06, Q07, Q08 and Q09) grouped with SCP sites from FCT21c which is a P3 PEC "Low lying *Banksia attenuata* woodlands or shrublands ('community type 21c'). This PEC is described as occurring on lower lying wetter sites. Quadrats Q04 and Q09 are in *Et***MWL** (1) which is mapped on the lower sandy slopes of a low relief hill and may be this PEC. However, quadrats Q06 and Q07 are in *CcEm****F*** (2) which occurs on sandy areas higher in the landscape and Q08 is in *EmCc***F** (3), which is mapped on lateritie hill slopes and crests of the Survey Area, and are probably not this PEC.

6.7 Phytophthora Dieback

Thirty-one of the species (not including the subspecies) recorded in the Survey Area in March and October 2016 are listed as species susceptible to *Phytophthora cinnamomi* (Centre for Phytophthora Science & Management (CPSM), 2014) and are highlighted green in **Table A7.1, Appendix 7**. None of the CSF species located during these surveys are listed as being susceptible.

The remnant vegetation in the Survey Area is mapped as being susceptible to Phytophthora Dieback and BVA 1020 is mapped as having moderate susceptibility to Phytophthora Dieback (Project Dieback, 2014a). Dead banksias were noted in the Survey Area and this could have been a result of natural senescence or dieback.

7 SIGNIFICANCE

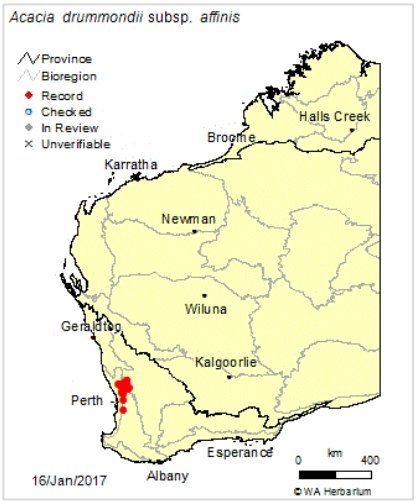
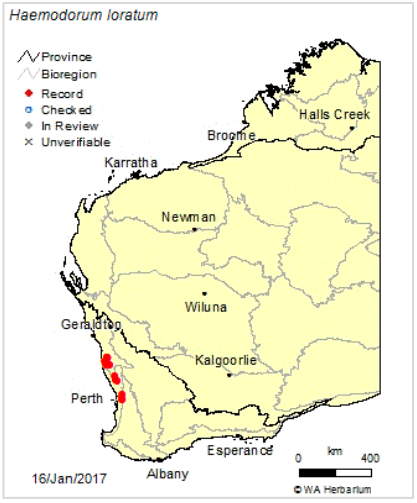
A brief discussion of the conservation significance of the flora and vegetation of the Survey Area follows. Significance is assessed at both regional and local scales (EPA, 2004).

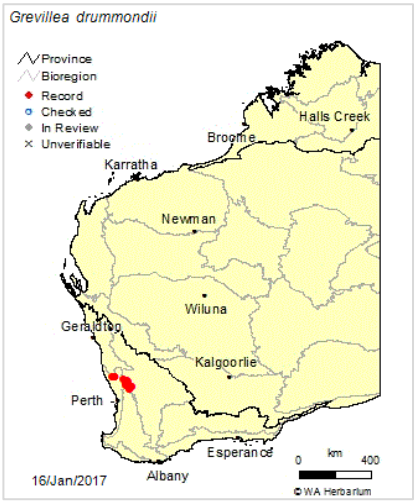
7.1 CONSERVATION SIGNIFICANCE - FLORA

7.1.1 Regional Significance

The regional conservation significance of the three confirmed or potential CSF species recorded in the Survey Area is indicated by its current priority rank. Their regional distribution is noted in **Table 7.1**, and an indication of the number of records currently occurring in protected areas is also included.

Table 7.1: Conservation significant flora species

Current status	Current distribution
Acacia drummondii subsp. *affinis* (P3) has 36 records on FloraBase (WAH, 1998-) from collections from the Avon Wheatbelt, Jarrah Forest and Swan Coastal Plain bioregions (DPaW, 2007-). Plant frequency information varied from scattered to locally common and plant numbers ranged from one to 21 plants (WAH, 1998-). Six of the records are on IUCN DPaW-managed land and two locations are on non-IUCN DPaW-managed land (WAH, 1998-). Therefore eight of the 36 records (22%) are on DPaW-managed land.	
Haemodorum loratum (P3) has 20 records on FloraBase (WAH, 1998-) from collections from the Geraldton Sandplains and Swan Coastal Plain bioregions (DPaW, 2007-). Plant numbers are not provided in some of the records and instead are noted as frequent and plant numbers range from one to 10 plants (WAH, 1998-). Five of the 20 records (25%) are on IUCN DPaW-managed land (WAH, 1998-).	

Current status	Current distribution
Grevillea drummondii (P4) has 25 records on FloraBase (WAH, 1998-) from collections from the Avon Wheatbelt, Geraldton Sandplains, Jarrah Forest and Swan Coastal Plain bioregions (DPaW, 2007-). When noted, plant frequency varies from scattered to common and plant numbers from one to 300 (WAH, 1998-). Three of the records are on IUCN DPaW-managed land and two records on non-IUCN DPaW-managed land (WAH, 1998-). Therefore five of the 25 records (20%) are on DPaW-managed land. This species is considered to be a regional endemic.	

Note: P3 – P4 = Priority 3 to Priority 4 species. Images used with the permission of the Western Australian Herbarium, Department of Parks and Wildlife (https://florabase.dpaw.wa.gov.au/help/copyright). Accessed on Wednesday, Monday 23 January 2017.

7.1.2 Local Significance

The local conservation significance of the two confirmed and one potential priority species recorded in the Survey Area is discussed below. Conservation significance ratings (CSR) (low, moderate or high) are based on: the number of locations at which plants were recorded in the Survey Area, the number or cover of plants at each location, the priority rank of the species, their distribution within the Survey Area (limited or widespread), and, the area/cover of the vegetation association/s in which they occur.

Acacia drummondii subsp. *affinis* (P3) was recorded at two locations in the Survey Area and two plants were recorded at each location. It was located on a laterite hill with sandy-loam soils and on a footslope with white sand, in two vegetation types – *CcEm***F** (2) and *EmCc***F** (3). Given the limited distribution of this species in the Survey Area, the numbers in which it was located, and the number and cover of the vegetation types in which it occurs it is rated as having moderate local CSR.

Haemodorum loratum (P3) was recorded at 37 locations (56 plants) in the Survey Area and between one to four plants were recorded at each location (including one *Haemodorum* ?*loratum* at one location). It was located on a laterite hill with sandy-loam soils and on the footslopes with white sand, in two vegetation types - *CcEm***F** (2) and *EmCc***F** (3) – and in a degraded area. Given the moderate distribution of this species in the Survey Area, the numbers in which it was located, and the number and cover of the vegetation types in which it occurs it is rated as having low local CSR.

Grevillea ?*drummondii* (potential P4) was recorded at two locations in the Survey Area and one plant was recorded at each location. It was located on a laterite hill in one vegetation type – *EmCc***F** (3). Given the limited distribution of this species in the Survey Area, the low numbers in which it was located, and the number and cover of the vegetation types in which it occurs – and using the precautionary principle and accepting that it is the P4 species - it is rated as having moderate local CSR.

The regional and local conservation significance assessment is summarised in **Table 7.2**.

Table 7.2: Summary of regional and local significance – conservation significant flora species

Species	Regional significance – priority rank	Local significance
Acacia drummondii subsp. *affinis*	3 (moderate)	Moderate
Haemodorum loratum	3 (moderate)	Low
Grevillea drummondii	4 (low)	Moderate

7.2 Conservation Significance - Vegetation

The regional and local significance of the vegetation of the Survey Area is discussed in the following subsections.

7.2.1 Beard's pre-European Vegetation Mapping

One BVA / BVSA is mapped in the Survey Area – BVA 1020 / BVSA 1020.1 (they are the same). The extent, distribution and protection of BVA 1020 / BVSA 1020.1 in the Swan Coastal Plain (SWA) bioregion and Dandaragan Plateau (SWA01) subregion is listed in **Table 7.3** along with its prioritisation for reservation in the subregion. Native vegetation in the Swan Coastal Plain bioregion has been extensively cleared and approximately 28% of BVA 1020 / BVSA 1020.1 currently remain. The EPA (2006) considers an ecological community to be underrepresented if there is less than 30% of its original distribution remaining. A small percentage (less than 2%) of the pre-European extent of this BVA / BVSA is currently protected on IUCN DPaW Managed Land.

Table 7.3: Beard vegetation association 1020 / BVSA 1020.1 extent, distribution and protection in Swan Coastal Plain and Dandaragan Plateau subregion

BVA / BVSA (DAFWA, 2012a)	Description	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Current Extent Protected (IUCN 1-4) (%) (proportion of pre-European extent)	Current Extent in all DPaW-managed land (%) (proportion of current extent)	Prioritisation for Reservation (Desmond, 2001)
1020 / 1020.1	Mosaic: Medium forest; jarrah-marri / Medium woodland; marri-wandoo	**Swan Coastal Plain bioregion**					
		5,295.68	1,501.37	28.35	1.79	6.31	-
		Dandaragan Plateau subregion					
		5,262.92	1,497.21	28.45	1.80	6.32	High

Notes: Source = GoWA (2015), unless noted otherwise; BVA = Beard vegetation association; SWA = Swan Coastal Plain bioregion; SWA01 = Dandaragan Plateau subregion.

The attributes, sources and scoring systems used to assess the regional significance of BVA 1020 are listed in **Table A8.1**, **Appendix 8**. The results of the regional significance assessment are listed in **Table A8.2**, **Appendix 8**. Using this scoring system BVA 1020 is rated as having high regional significance.

The attributes, sources and scoring systems used to assess the local significance of BVA 1020 are listed in **Table A8.3**, **Appendix 8**. The results of the local significance assessment are listed in **Table A8.4**, **Appendix 8**. Using this scoring system BVA 1020 is rated as having moderate local significance.

7.2.2 Heddle Vegetation Complexes

One HVC is mapped in the Survey Area – Moondah. The extent, distribution and protection of the Moondah HVC are listed in **Table 7.4**. The extent remaining in the SWA bioregion is 40.18% and in the SWA01 subregion 46%. These are above the 30% level of retention of each complex recommended by the EPA (EPA, 2006).

Table 7.4: Moondah Heddle vegetation complex extent, distribution and protection in SWA and SWA01 regions

HVC	Description	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Current extent protected (IUCN 1-4) (%)	Current extent in DPaW-managed land (%)
Moondah	Low closed forest and low open forest	**Swan Coastal Plain bioregion**				
		17,244.49	6,928.16	40.18	10.11	12.04
		Dandaragan Plateau subregion				
		12,167.46	5,596.77	46.00	9.77	12.51

Notes 1: HVC = Heddle vegetation complex; SWA = Swan Coastal Plain bioregion; SWA01 = Dandaragan Plateau subregion; Current extent protected = Current extent protected (IUCN 1-4) for conservation (proportion of pre-European extent).

Notes 2: The regional areas for HVC were calculated using the following methods and GIS datasets:

- HVC (WALGA, 2011) was intersected with IBRA subregions (DotEE, 2012) to calculate the pre-European areas in the Swan Coastal Plain bioregion and the Dandaragan Plateau subregion;
- The current extent was calculated by intersecting HVC from WALGA (2013) with native vegetation extent (DAFWA, 2012b) and IBRA subregions (DotE, 2012);
- The percent remaining was calculated by dividing the current extent by the pre-European extent and multiplying by 100;
- The current extent protected was calculated by intersecting HVC (WALGA, 2011) with all DPaW-managed lands (DPaW, 2016a) and IBRA subregions (DotE, 2012); and
- The percent in DPaW-managed lands was calculated by dividing the current extent protected by the current extent remaining and multiplying by 100.

The attributes, sources and scoring systems used to assess the regional significance of the Moondah HVC are listed in **Table A8.5**, **Appendix 8**. The results of the regional significance assessment are listed in **Table A8.6**, **Appendix 8**. Using this scoring system, the Moondah HVC is rated as having High regional CSR.

The attributes, sources and scoring systems used to assess the local significance of the Moondah HVC are listed in **Table A8.7**, **Appendix 8**. The results of the local significance assessment are listed in **Table A8.8**, **Appendix 8**. Using this scoring system, the Moondah HVC is rated as having moderate local CSR.

Table 7.5 summarises the regional and local significance of the BVA and HVC mapped in the Survey Area.

Table 7.5: Summary of regional and local significance –vegetation association and vegetation complex

Vegetation	Regional significance	Local significance
BVA		
1020	High	Moderate
HVC		
Moondah	High	Moderate

7.2.3 Local Significance – Maia Vegetation Types

The attributes and scoring system used to assess the local significance of the MVTs mapped in the Survey Area are listed in **Table A8.9 (Appendix 8)** and the results of the significance assessment are listed in **Table A8.10 (Appendix 8)**.

Information on the main attributes assessed along with the results of the significance assessment for the MVTs is presented in **Table 7.6**.

The local significance rating calculated using the conservation significance scoring system is moderate for all three MVTs.

7.3 Ecological Communities

One federally protected TEC was listed in the EPBC Act Protected Matters Search Tool results (DotEE, 2017a). The *Banksia* Woodlands of the Swan Coastal Plain ecological community (DotEE, 2017b) and the search results indicated that community is likely to occur in the database search area. One of the MVTs mapped in the Survey Area (*Et***MWL** (1)) matches most of the criteria for the ecological community, however, it does not have the characteristic dominant *Banksia* tree / shrub stratum most likely due to previous clearing.

No state-listed TECs are mapped in the Survey Area, the nearest is approximately 3.9 km to the south of the Survey Area ('Shrublands and woodlands on Muchea limestone' (Endangered TEC)). One quadrat from MVT *EmCc***F** (3) (Q02) grouped with SCP sites from FCT3b which is a state-listed TEC (SCP3b) and is described as *Corymbia calophylla* --- *Eucalyptus marginata* woodlands on sandy clay soils. However this quadrat was sampled on a laterite hill with a surface layer of laterite gravel and stones over brown sandy-loam soil and not on sandy clay soils characteristic of this TEC and is therefore not likely to be the TEC.

No PECs are currently known to occur in the Survey Area. Five quadrats (Q04, Q06, Q07, Q08 and Q09) grouped with SCP sites from FCT21c which is a P3 PEC. Quadrat Q04 and Q09 were sampled in *Et***MWL** (1), Q06 and Q07 were sampled in *CcEm***F** (2) and quadrat Q08 in *EmCc***F** (3). FCT21c is described as Low lying *Banksia attenuata* woodlands or shrublands and it is likely that *Et***MWL** (1) is this PEC as it was mapped in lower lying sections of the Survey Area and had scattered *Banksia attenuata* and *B. menziesii* throughout. The remaining two MVTs were recorded higher in the landscape and did not contain the charactersitic *Banksia* species so it is unlikely that either of these two vegetation types are this PEC.

7.4 Ecological Linkages

The Survey Area does not lie in an area indicated as an ecological linkage by the Perth Biodiversity Project (2003) or by the Shire of Chittering in 2008 (WALGA, 2017). While the vegetation adjacent to two sides of Lot 195 is mostly cleared and the Great Northern Highway runs along the third side and separates the vegetation along the north-western boundary from larger native vegetation remnants to the north, the area has been given a relatively high connectivity score (WALGA, 2017).

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Table 7.6: Local conservation significance of vegetation types mapped by Maia

MVT code	% of Local Area	CSF in MVT Quadrats All CSF recorded in MVT	# of CSF in MVT	# of weed species in MVT	Average vegetation condition	Occurs outside Survey Area	Any other attributes increasing CS?	Local CS
*Et***MWL** (1)	8.32	Quadrats: None All records: None	0	20	3 (vegetation structure altered)	Yes	TEC, PEC (P3)	**Moderate**
*CcEm***F** (2)	49.42	Quadrats: Ada (P3), H?l (?P3), Hl (P3) All records: Ada (P3), H?l (?P3), Hl (P3)	3	18	3 (vegetation structure altered)	Yes	?PEC	**Moderate**
*EmCc***F** (3)	24.77	Quadrats: Ada (P3) All records: Ada (P3), G?d (P?4), Hl (P3),	3	14	3 (vegetation structure altered)	Yes		**Moderate**
Total	**82.51**							

Notes: MVT = Maia vegetation type; % = percentage; # = number; CSF = conservation significant flora; CS = conservation significance; Ada = *Acacia drummondii* subsp*. affinis*; Hl = *Haemodorum loratum*, H?l = *Haemodorum* ?*loratum*; G?d = *Grevillea* ?*drummondii*, P3 and P4 = Priority 3 and Priority 4 and P?3 and P?4 = potential P3 and P4.

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8 IMPACTS ASSESSMENT

8.1 CONSERVATION SIGNIFICANT FLORA

Potential impacts from the Project Area to the CSF recorded in the Survey Area are listed in **Table 8.1**. Impact to *Acacia drummondii* subsp. *affinis* is approximately 3%, to *Haemodorum loratum* 11% and to *Grevillea drummondii* less than 1%. It is likely that the impacts will be lower than this, as the habitats and vegetation types they are known to grow in occur outside of the Survey Area in areas that have not been surveyed. The CSF appear to be associated with the soil landscape mapping units of the Survey Area and mapping units 222Re12 and 222Re10 are mapped in the surrounding area. Also, the number of CSF plants recorded in the Project Area is high because approximately 96% of the Project Area was surveyed compared with approximately 30% of the Survey Area falling outside of the Project Area.

Table 8.1: Potential impacts to conservation significant flora species recorded in the Survey Area

Column 1	2	3	4	5	6	7	8	9
Species	Rank	PA	SA	Outside PA and SA	Other known records	FB records	Total known in WA	Impact to total known plants in WA
		#	#	#	#	#	#	%
Acacia drummondii subsp. *affinis*	P3	4	4	0		116	120	3.33
Haemodorum loratum†	P3	40	56	15	228	60	359	10.86
Grevillea drummondii††	P4	1	2	0		508	510	0.20

Note: Column 1: † = *Haemodorum loratum* and *Haemodorum* ?*loratum*, †† = *Grevillea drummondii* and *Grevillea* ?*drummondii*. Column 2: P3 and P4 = Priority 3 and Priority 4 species. Column 3: PA = Project Area. Column 4: Survey Area. Column 5: PA = Project Area, SA = Survey Area, additional numbers of plants recorded during the survey outside the Project Area and Survey Area. Column 6: other locations of plants recorded by Maia during other surveys in WA (locations are confidential). Column 7: FB = FloraBase (WAH, 1998-). Column 9: Column 3/Column 8 x 100.

8.2 VEGETATION

8.2.1 Impacts to Beard's Vegetation Associations

Potential impacts from the Project Area to the current extent of BVA 1020 in the SWA bioregion and SWA01 subregion are listed in **Table 8.2**. The current extent of BVA 1020 in both the SWA and SWA01 would be reduced by 0.57% if the 8.54 ha in the Project Area was cleared. The current extent in the SWA would decrease from 28.35% to 27.78% and the current extent in the SWA01 from 28.45% to 27.88%.

Table 8.2: Impact from the Project Area to the current extent of BVA 1020 on the Swan Coastal Plain and Dandaragan Plateau

Column 1	2	3	4	5	6	7
BVA	Area of Project Area (ha)	Proportion of the Project Area (%)	Pre-European extent / current extent in SWA (ha)	Proportion of SWA pre-European extent / current extent in the Project Area (%)	Pre-European extent / current extent in SWA01 (ha)	Proportion of SWA01 pre-European extent / current extent in the Project Area (%)
1020	8.54	69.02	5,295.68 / 1,501.37	0.16 / 0.57	5,262.92 / 1,497.21	0.16 / 0.57

Note: Column 1: BVA = Beard vegetation association. Columns 4 and 5: SWA = Swan Coastal Plain bioregion. Columns 4 and 6= GoWA (2015). Columns 6 and 7: SWA01 = Dandaragan Plateau subregion. Column 5: Column 2/Column 4*100. Column 7: Column 2/Column 6*100. Columns 2 and 3 are calculated using the undisturbed areas of the Project Area.

8.2.2 Impacts to Heddle Vegetation Complexes

Impact from the Project Area to the current extent of the Moondah HVC in the SWA bioregion and SWA01 subregion is listed in **Table 8.3**. Approximately 0.12% of the current extent of the Moondah HVC in the SWA bioregion would be impacted if the whole of the Project Area (8.54 ha) were to be cleared. The remaining area would decrease from 40.18% to 40.06%. Approximately 0.15% of the current extent of the Moondah HVC in the SWA01 subregion would be impacted if the whole of the Project Area (8.54 ha) were to be cleared. The remaining area would decrease from 46.00% to 45.85%.

Table 8.3: Impact from the Project Area to the current extent of Moondah HVC on the Swan Coastal Plain and Dandaragan Plateau

Column 1	2	3	4	5	6	7
HVC	Area of Project Area (ha)	Proportion of the Project Area (%)	Pre-European extent / current extent in SWA (ha)	Proportion of SWA pre-European extent / current extent in the Project Area (%)	Pre-European extent / current extent in SWA01 (ha)	Proportion of SWA01 pre-European extent / current extent in the Project Area (%)
Moondah	8.54	69.02	17,244.49 / 6,928.16	0.05 / 0.12	12,167.46 / 5,596.77	0.07 / 0.15

Note: Column 1: HVC = Heddle vegetation complex. Columns 4 and 5: SWA = Swan Coastal Plain bioregion. Columns 4 and 6= derived from shapefile data from DotEE (2012), DAFWA (2012b) and WALGA (2013). Columns 6 and 7: SWA01 = Dandaragan Plateau subregion. Column 5: Column 2/Column 4*100. Column 7: Column 2/Column 6*100. Columns 2 and 3 were calculated using the undisturbed areas of the Project Area.

8.2.3 Impacts to Maia Vegetation Types

Impact to each of the MVTs is calculated using the direct impact from the overall Project Area footprint. Impact to *Et***MWL** (1) will be highest at 83.39 % (2.26 ha) and to *CcEm***F** (2) the lowest at 18.71% (3.01 ha) of the mapped MVT. Impact to *Et***MWL** (1) is high even though the clearing footprint is low because the MVT is mapped mostly in the Project Area with only a small thin strip mapped along the southern edge of the Survey Area. However, this MVT extends into the lot adjacent to and south of the Survey Area but this area was not mapped by Maia and not included in the calculations.

Table 8.4: Impact from the Project Area on the MVTs of the Survey Area

Vegetation type	Mapped in Survey Area	Estimated clearing in Project Area	
	ha	ha	Proportion of mapped area (%)
*Et***MWL** (1)**:**	2.71	2.26	83.39
*CcEm***F** (2)	16.09	3.01	18.71
*EmCc***F** (3)	8.06	3.27	40.57
Disturbed	5.69	3.83	67.31
Total area	32.55	12.37	38

9 SUMMARY AND CONCLUSIONS AND RECOMMENDATIONS

Dot points follow on the main findings regarding the flora and vegetation of the Survey Area. Sets of dot points are followed by overall conclusions on the main areas covered by the preceding dot points.

9.1 FLORA

- Species diversity in the Study Area (199 taxa) is similar to that in areas surveyed in the surrounding area.
- Species accumulation analysis indicated that 96.15% of the flora estimated to be in the Survey Area was recorded, and this analysis used the 109 taxa recorded in the nine quadrats assessed in the Survey Area and did not include opportunistic collections made outside quadrats or weed species.
- No range extension species were located in the Survey Area.
- No species protected by the EPBC Act or the WC Act were located in the Survey Area.
- Two confirmed priority species were recorded in the Survey Area – *Acacia drummondii* subsp. *affinis* and *Haemodorum loratum* (both P3). One potential P3 species was recorded - *Haemodorum* ?*loratum* - and one potential P4 species - *Grevillea* ?*drummondii*.

Most CSF were recorded on the laterite hill in MVT *EmCc***F** (3) with fewer locations in the *CcEm***F** (2) and areas mapped as Disturbed. As the soil landscape, BVA and HVC in which these CSF were located are mapped in the wider area it is highly likely that these CSF would also occur in similarly mapped units in the remnant native vegetation in the surrounding area, and, based on the FloraBase distribution of each of the CSF, in other soil landscapes, BVAs and HVCs not mapped in the vicinity of the Survey Area.

- Twenty-four weed species were located in the Survey Area. No weed species on any of the national weeds lists or declared as a pest in WA was located in the Survey Area.
- None of the weed species located in the Survey Area is ranked as high in DPaW's Swan region weed rankings summary spreadsheet.

The number of weed species most probably reflects past clearing and grazing history on this lot and also its proximity to roads and tracks.

9.2 VEGETATION AND ECOLOGICAL COMMUNITIES

- Three vegetation types occur in the Survey Area: *Et***MWL** (1) - Mallee Woodland of *Eucalyptus todtiana* with a Low Shrubland of *Eremaea pauciflora* var. *pauciflora, Hibbertia hypericoides* subsp. *hypericoides* +/- Tall Scattered Shrubs of *Banksia menziesii* and *B. attenuata* (8% of the Survey Area); *CcEm***F** (2) - Open Forest of *Corymbia calophylla* +/- *Eucalyptus marginata* subsp. *thalassica* with an Open Shrubland of *Xanthorrhoea preissii* and a Low Open Shrubland of *Hibbertia hypericoides* subsp. *hypericoides* (49% of the Survey Area); *EmCc***F** (3) - Tall Woodland / Open Forest of *Eucalyptus marginata* subsp. *thalassica* and / or *Corymbia calophylla* with a Low mixed Shrubland (*Xanthorrhoea acanthostachya*, *Lechenaultia biloba, Hibbertia hypericoides* subsp. *hypericoides*) (25% of the Survey Area).
- Highest average species richness was in *EmCc***F** (3) (41.5 species), while lowest was in *Et***MWL** (1) (28.3 species) i.e. species richness was highest in the *Eucalyptus* and *Corymbia* Forest of the Survey Area.
- Vegetation condition in the Survey Area was rated mostly as a 3 (vegetation structure altered) and Disturbed (82.5% and 17.5% respectively).
- Multivariate analysis of the Survey Area quadrat data with the SCP data resulted in one of the nine quadrats assessed in spring 2016 (and mapped as *EmCc***F** (3)) grouping with quadrats from FCT3b defined as a state -listed TEC (SCP3b) *Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain.
- However this quadrat was sampled on a laterite hill with a surface layer of laterite gravel and stones over brown sandy-loam soil and not on sandy clay soils characteristic of this TEC and is therefore not likely to be the TEC.

- Five quadrats (Q04, Q06, Q07, Q08, Q09) grouped with FCT21c quadrats in the SCP data set, which is defined as a PEC - Low Lying *Banksia attenuata* woodlands or shrublands (PEC P3). Quadrats Q04 and Q09 are in *Et***MWL** (1), which is mapped on the lower sandy slopes of a low relief hill and are most likely this PEC. However, quadrats Q06, Q07 and Q08 are not in low lying habitats and are probably not this PEC.
- MVT, *Et***MWL** (1), is most likely a modified / degraded form of the federally protected TEC "Banksia Woodlands of the Swan Coastal Plain ecological community" listed under the EPBC Act.

One of the three vegetation types (*Et***MWL** (1)) mapped in the Survey Area is most likely a modified / degraded form of a federally protected TEC and a state listed priority 3 PEC. Although one quadrat from *EmCc***F** (3) grouped with SCP sites from a state listed TEC it is unlikely that this MVT is the TEC based on the habitat that it occurs in.

9.3 Regional and Local Significance Flora and Vegetation

- The regional significance rating for the two confirmed CSF species located in the Survey Area is moderate – *Acacia drummondii* subsp. *affinis* and *Haemodorum loratum* (both P3) and the third and potential *Grevillea drummondii* P4 is low. The local significance of these three species is moderate, low and moderate respectively.

- The single BVA occurring in the Survey Area is rated as having high regional and moderate local significance. Similarly, the single HVC occurring in the Survey Area is rated as having high regional and moderate local significance.

- The three MVTs of the Survey Area are considered to have moderate local conservation significance.

While one of the MVTs in the Survey Area is most likely a currently-listed federal TEC and state P3 PEC, the moderate (rather than high) rating mostly reflects the weediness of the MVTs and the altered or disturbed condition of the vegetation.

9.4 Ecological Linkages and Connectivity

The Survey Area does not lie within an area identified as an ecological linkage or a conceptual linkage. While the vegetation adjacent to two sides of Lot 195 is mostly cleared and the Great Northern Highway runs along the third side its connectivity has been given a relatively high connectivity score.

9.5 Impacts

- Highest potential impact to *Haemodorum loratum* (P3) located in the Survey Area is approximately 11%, while impact to the two other CSF species will be less than 4%. Between 20% and 25% of the FloraBase records for the three CSF species (excluding the Survey Area records) are on DPaW-managed land.

- MVTs *CcEm***F** (2) and *EmCc***F** (3) are relatively well represented outside the Project Area in the Survey Area and approximately 19% and 41% of these MVTs mapped in the Survey Area will be cleared. *Et***MWL** (1) occurs mostly (83%) in the Project Area and only 17% of it is mapped in the surrounding Survey Area, although a similar and better condition vegetation type extends into the lot adjacent to and south of the Survey Area, in an area not mapped by Maia.

Impacts from the Project Area are calculated assuming that all of the Project Area will be cleared; however, this will not be the case. While a defined infrastructure area will be cleared, small patches of native vegetation will be retained for landscaping along the north-western boundary of the Project Area.

9.6 RECOMMENDATIONS

- The Project Area boundaries should be clearly marked prior to construction and vegetation should only be cleared within these boundaries.
- Areas to be landscaped within the Project Area should retain existing native vegetation whenever possible.
- Every effort should be made to prevent a) the introduction of new weeds into the area on machinery used for the construction and ongoing works and b) the spread of existing weeds from the Project Area to the wider area of Lot 195.
- Standard Phytophthora Dieback hygiene practices should be employed to prevent the introduction or spread of the disease into susceptible native vegetation in areas around the Project Area.
- Access to remnant native vegetation outside of the Project Area but within Lot 195 should be restricted in order to prevent the spread of weeds, Phytophthora Dieback and to avoid unnecessary damage to the native vegetation and conservation significant flora.
- Existing fences around the boundaries of Lot 195 should be maintained to prevent grazing animals (sheep and horses) from adjacent properties accessing ungrazed areas of remnant vegetation. New fences should also be constructed around the boundary of the Project Area to restrict access to the adjacent remnant vegetation on Lot 195.

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11 MAPS

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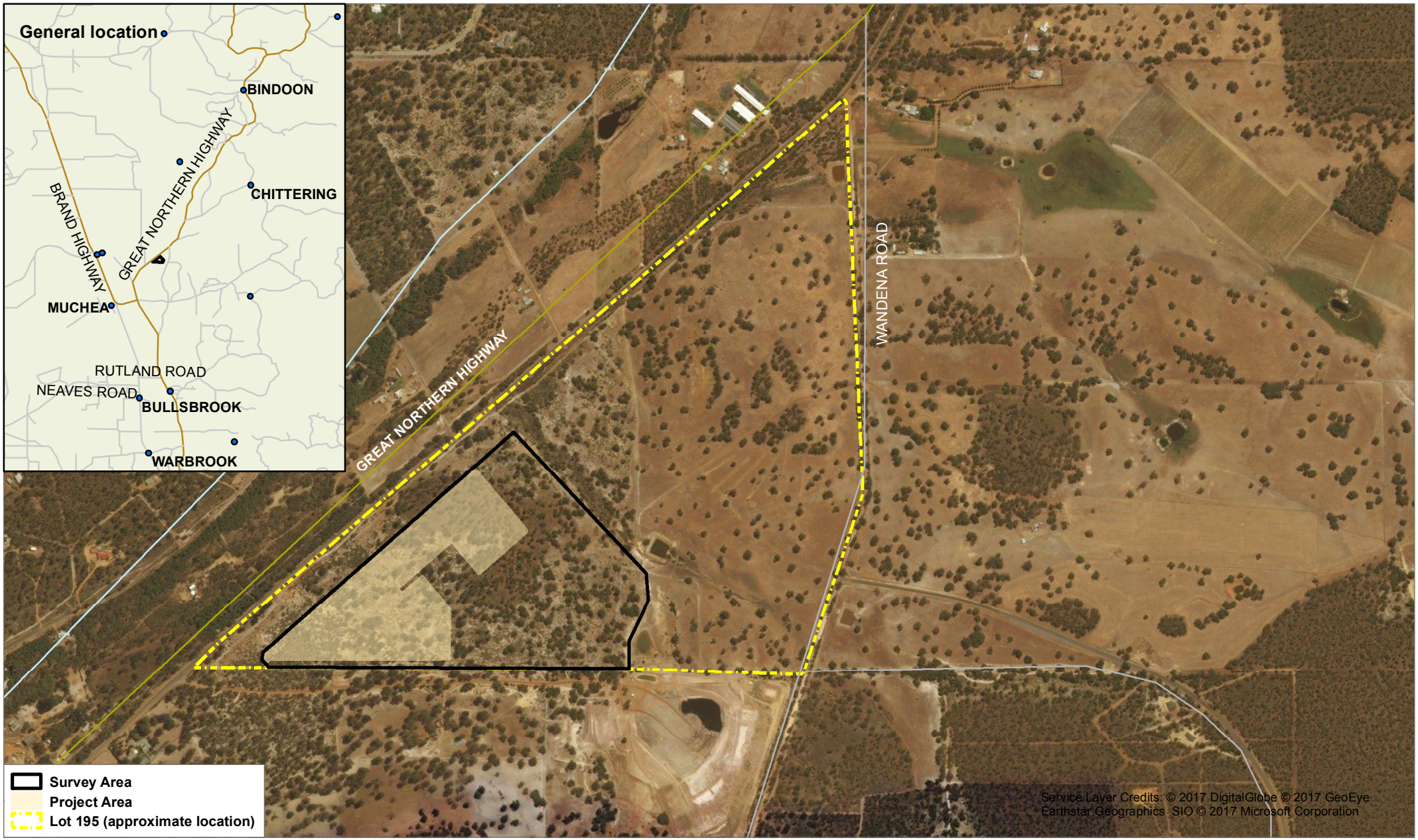

Principal Road
Minor Road
Watercourse lines

Survey Area and Project Area

maia

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Kilometres

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Prepared for: IPG
Drawn by: RH
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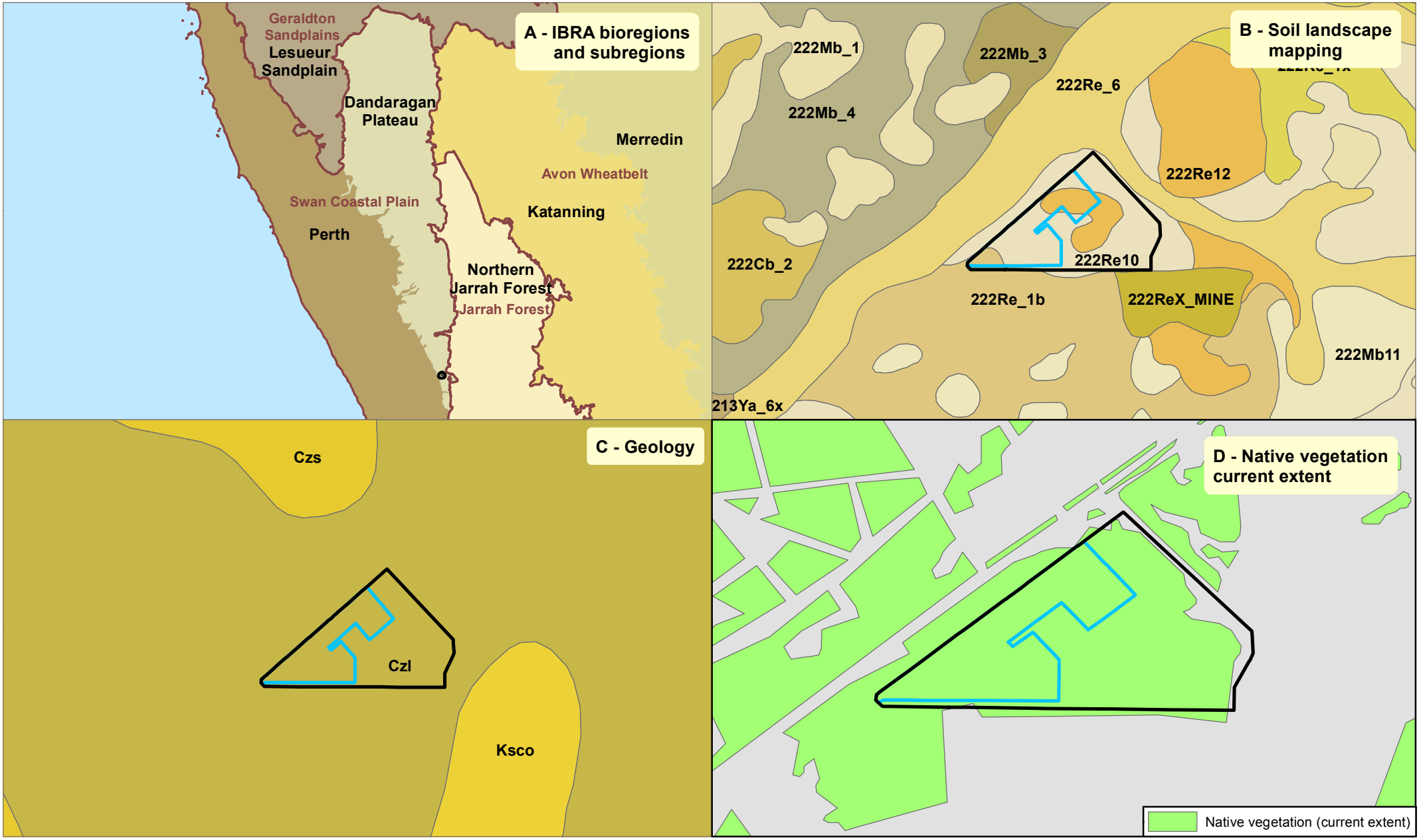

Location Map
- Port Hedland
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Survey Area
Project Area

IBRA bioregions and subregions, soil landscape mapping, geology and native vegetation (current extent)

maia

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Datum: GDA 1994, MGA 50

Map: 11.2
Prepared for: IPG
Drawn by: RH, SH
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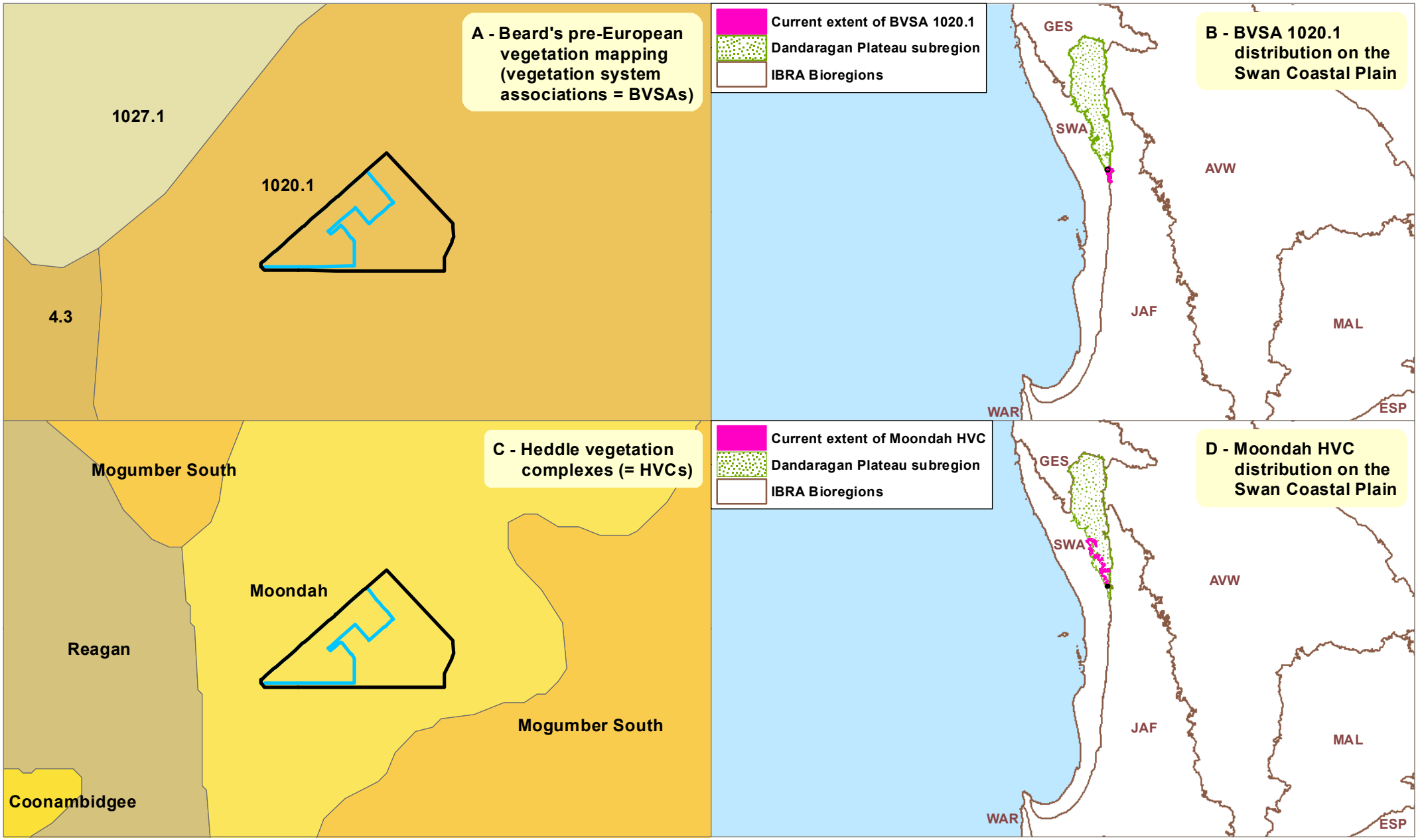

Location Map

- Port Hedland
- Newman
- Wiluna
- Geraldton
- Kalgoorlie
- Perth

Survey Area
Project Area

Beard's pre-European vegetation system associations (BVSAs), Heddle vegetation complexes (HVCs) and current extent on the Swan Coastal Plain bioregion

maia

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Datum: GDA 1994, MGA 50

Map: 11.3
Prepared for: IPG
Drawn by: RH
Date: 25/01/2017
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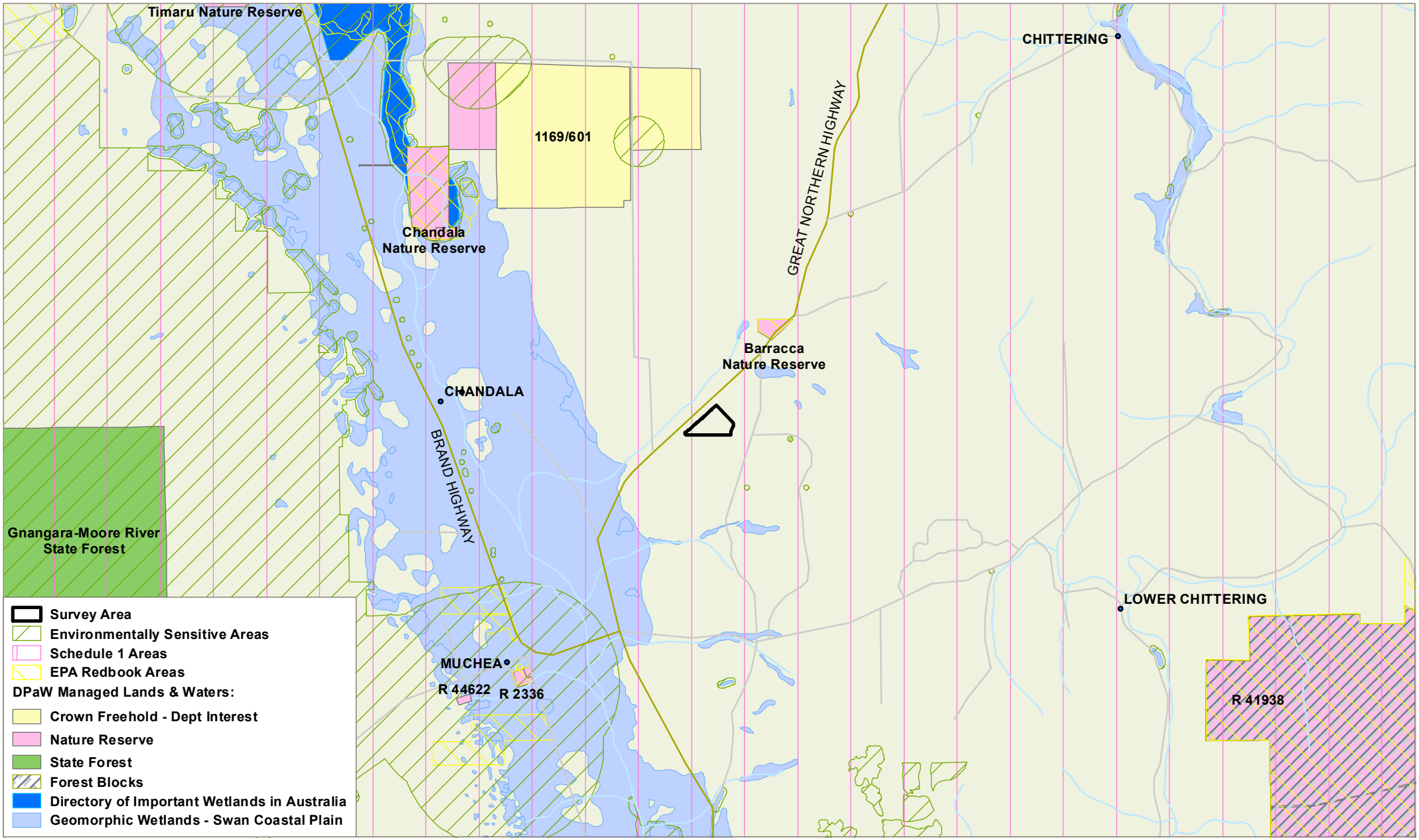

Location Map

Port Hedland
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Places
Principal Road
Minor Road
Watercourse lines

Protected and significant areas

maia

N

0 2

Kilometres

Datum: GDA 1994, MGA 50

Map: 11.4
Prepared for: IPG
Drawn by: RH
Date: 25/01/2017
Version: 1 **Size:** A4

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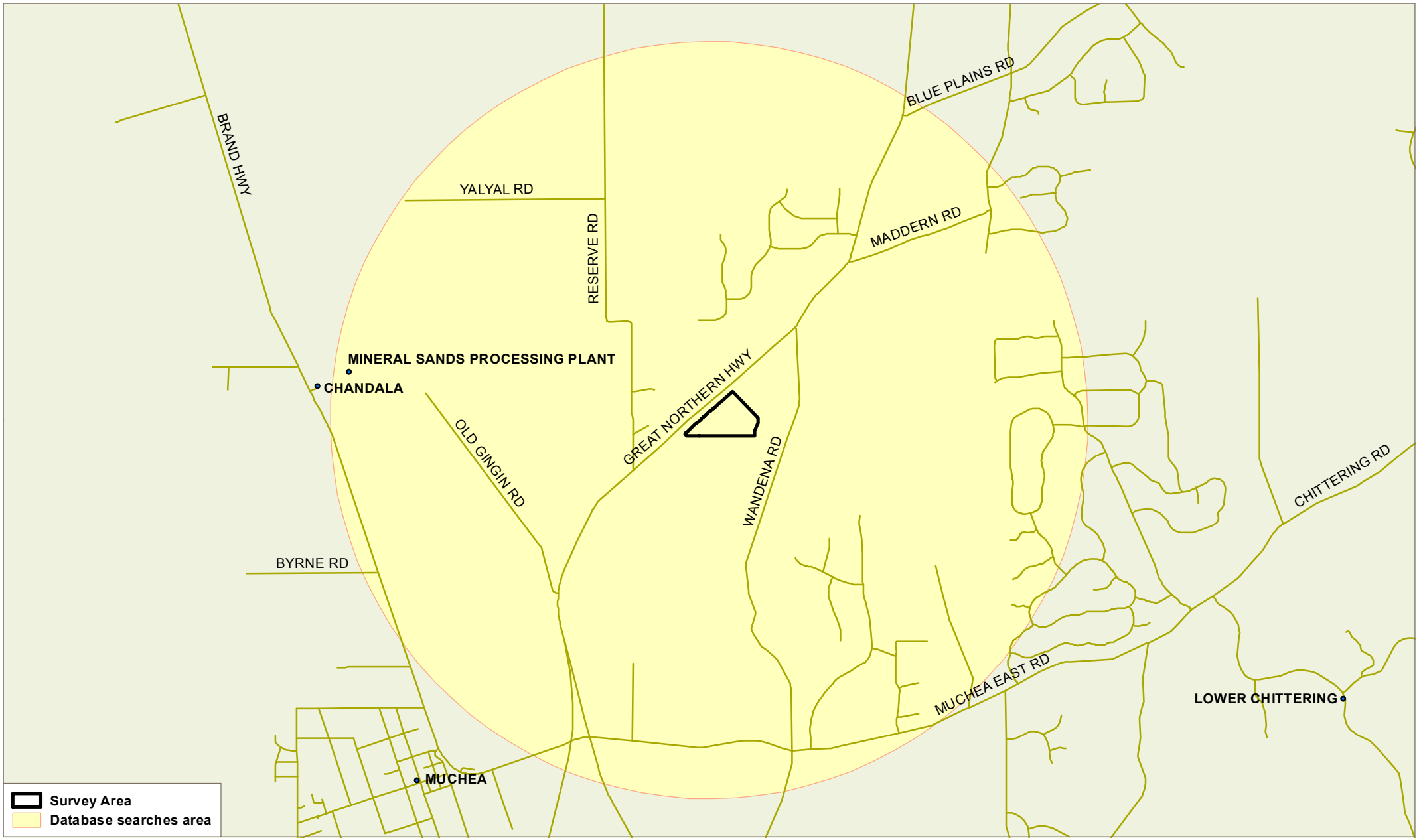

Location Map

Port Hedland
Newman
Wiluna
Geraldton
Kalgoorlie
Perth

Places
Roads

Database searches area

maia

N

0 1.5

Kilometres

Datum: GDA 1994, MGA 50

Map: 11.5
Prepared for: IPG
Drawn by: RH
Date: 25/01/2017
Version: 1 **Size:** A4

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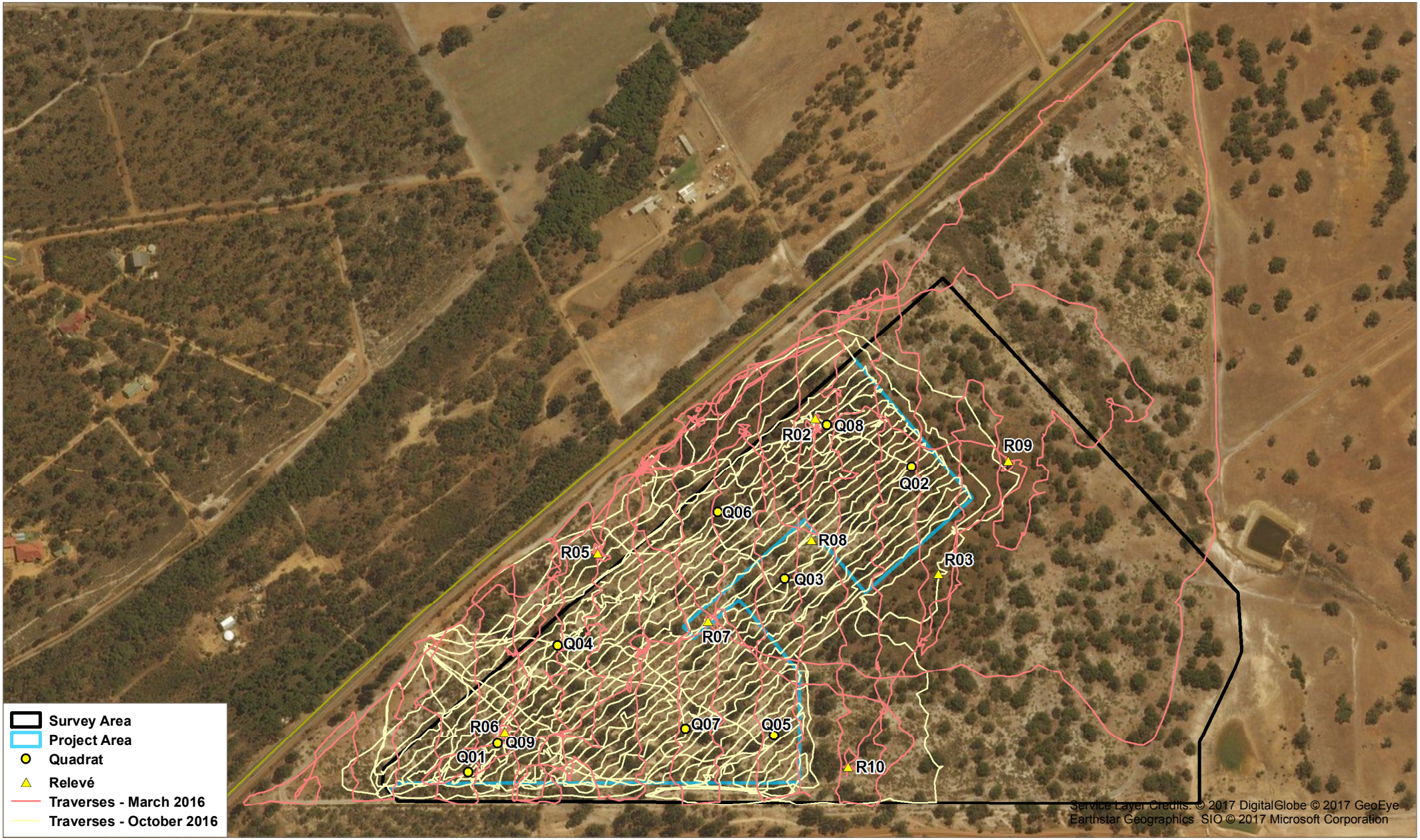

Location Map

• Port Hedland
• Newman
• Wiluna
• Geraldton
• Kalgoorlie
• Perth

Roads

Quadrats, relevés and traverses

maia

N

0 0.125

Kilometres

Datum: GDA 1994, MGA 50

Map: 11.6
Prepared for: IPG
Drawn by: RH, SH
Date: 08/02/2017
Version: 2 **Size:** A4

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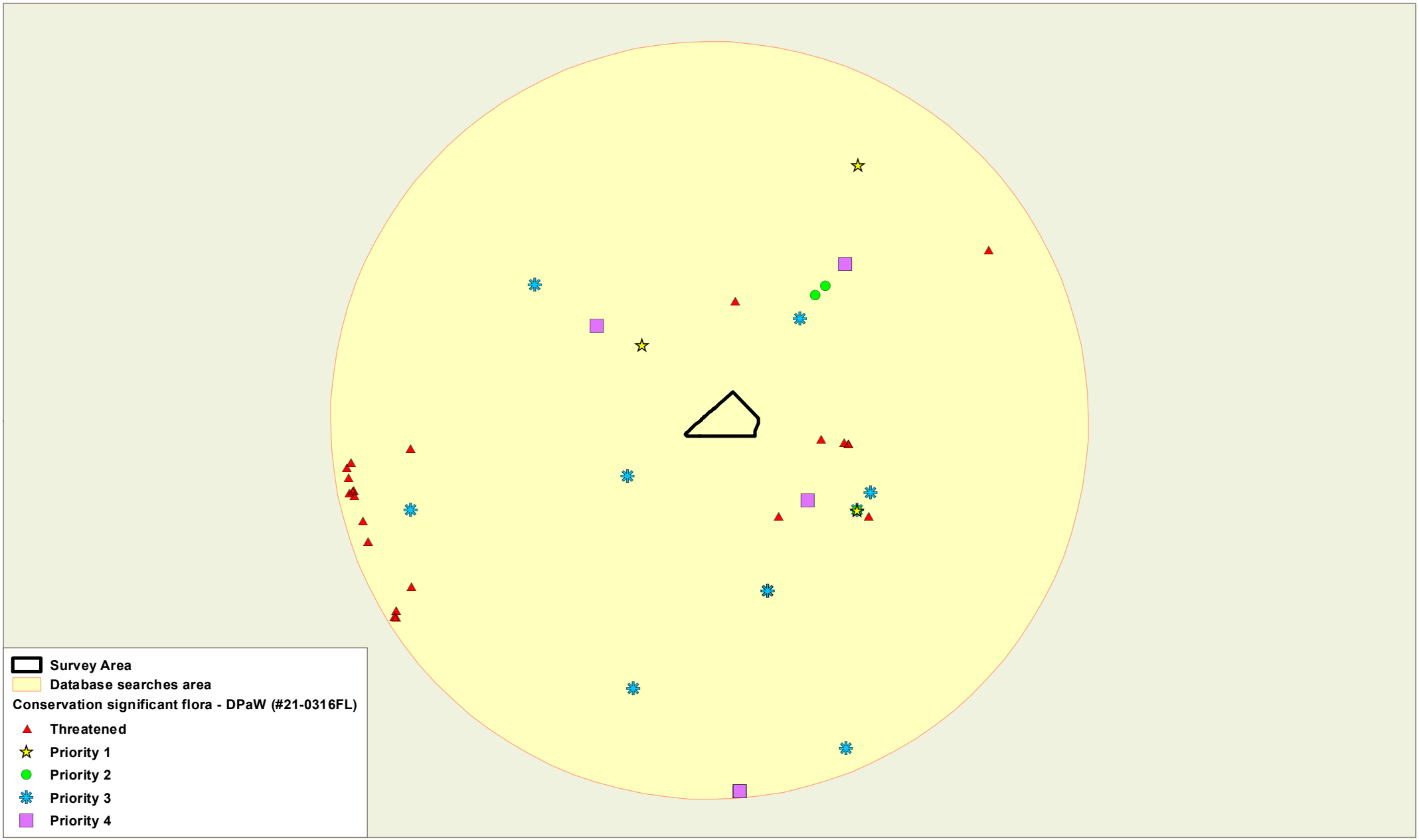

Conservation significant flora
(DPaW search reference #21-0316FL)

maia

N

0 1.5

Kilometres

Datum: GDA 1994, MGA 50

Map: 11.7
Prepared for: IPG
Drawn by: RH
Date: 25/01/2017
Version: 1 **Size:** A4

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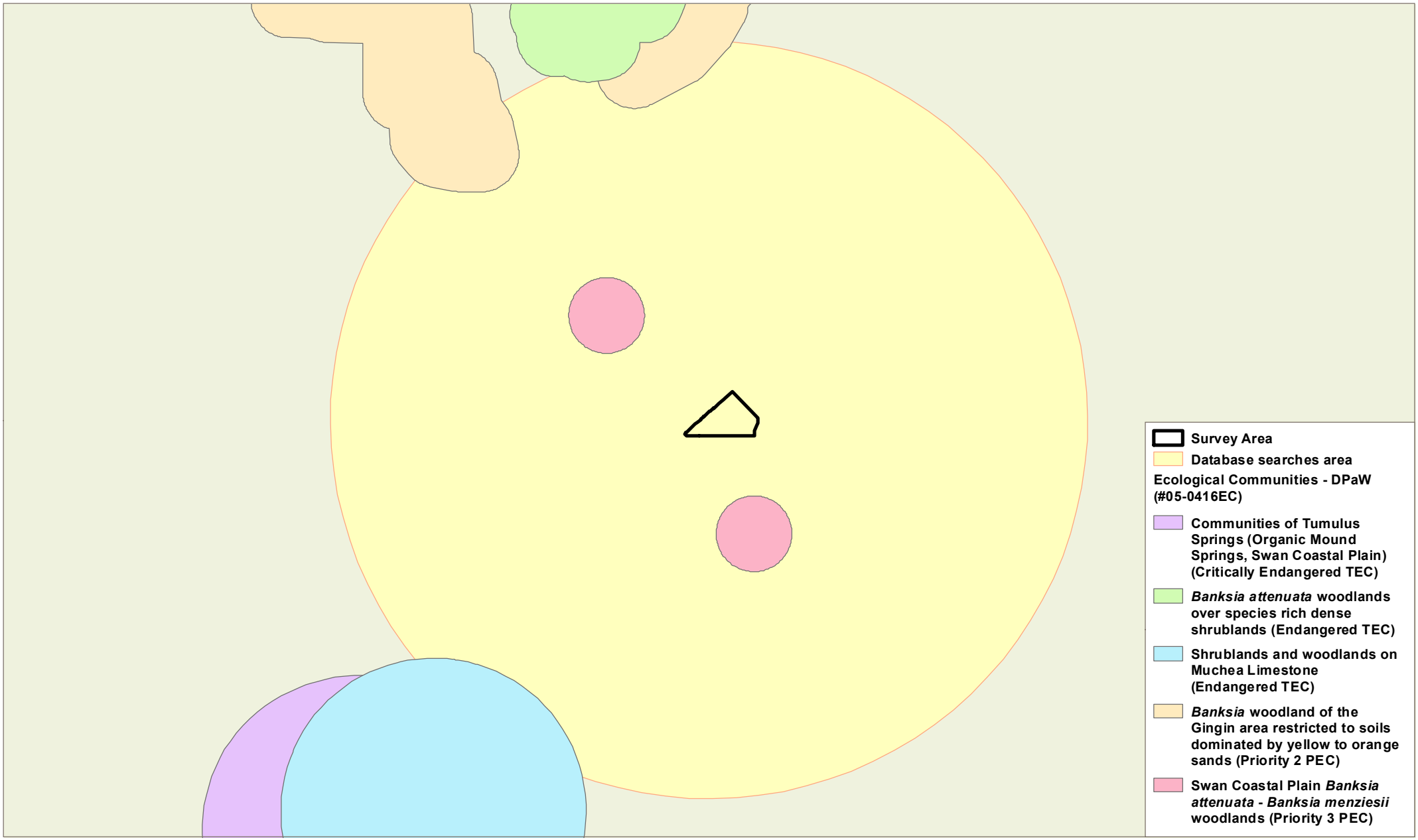

Threatened and Priority Ecological Communities (DPaW search reference #05-0416EC)

maia

N

0 1.5

Kilometres

Datum: GDA 1994, MGA 50

Map: 11.8
Prepared for: IPG
Drawn by: RH
Date: 25/01/2017
Version: 1 **Size:** A4

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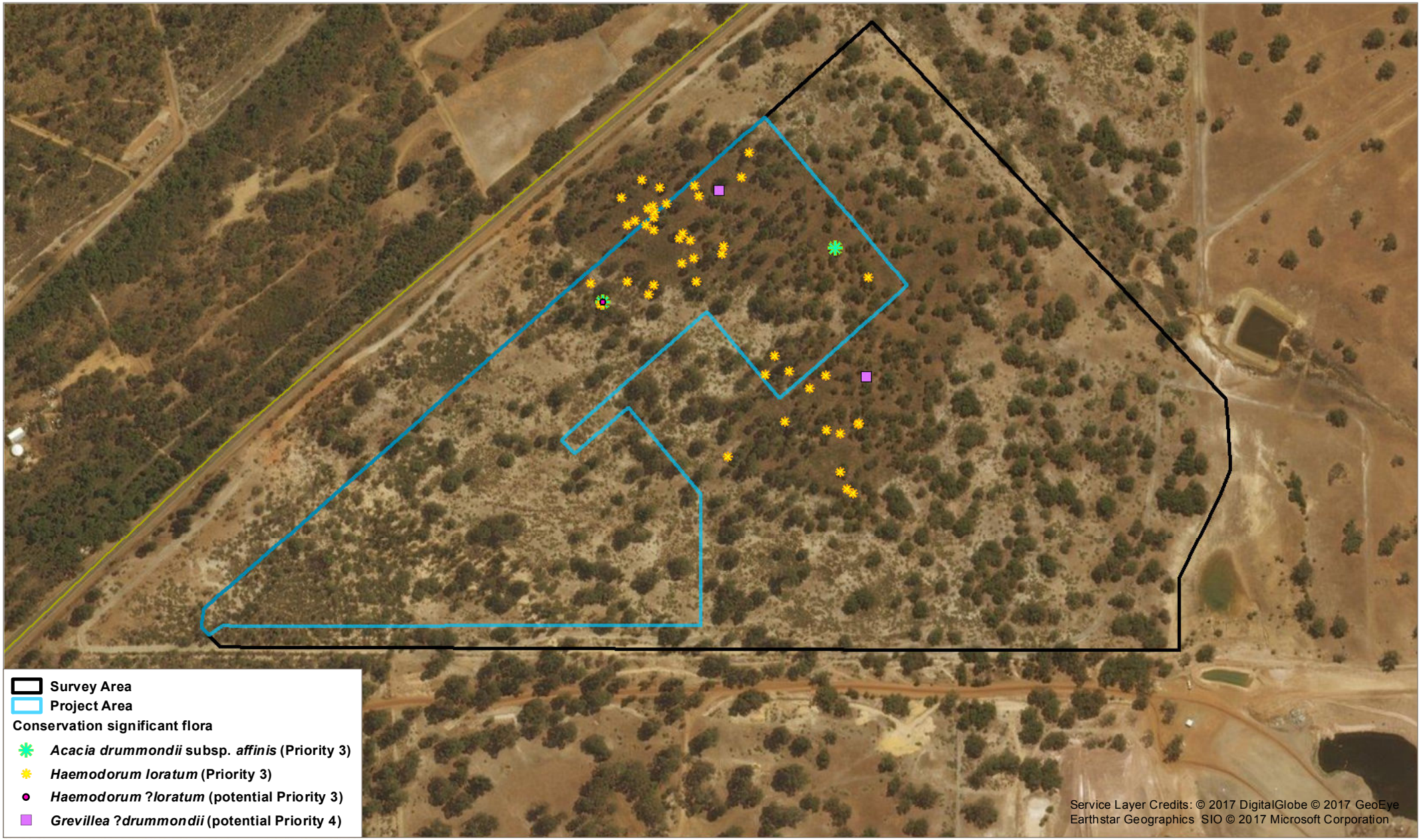

Location Map

Roads

Conservation significant flora

maia

N

0 0.1

Kilometres

Datum: GDA 1994, MGA 50

Map: 11.9
Prepared for: IPG
Drawn by: RH
Date: 25/01/2017
Version: 1 **Size:** A4

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Location Map

Roads

Environmental weed locations

N

0 0.1

Kilometres

Datum: GDA 1994, MGA 50

Map: 11.10
Prepared for: IPG
Drawn by: RH
Date: 25/01/2017
Version: 1 **Size:** A4

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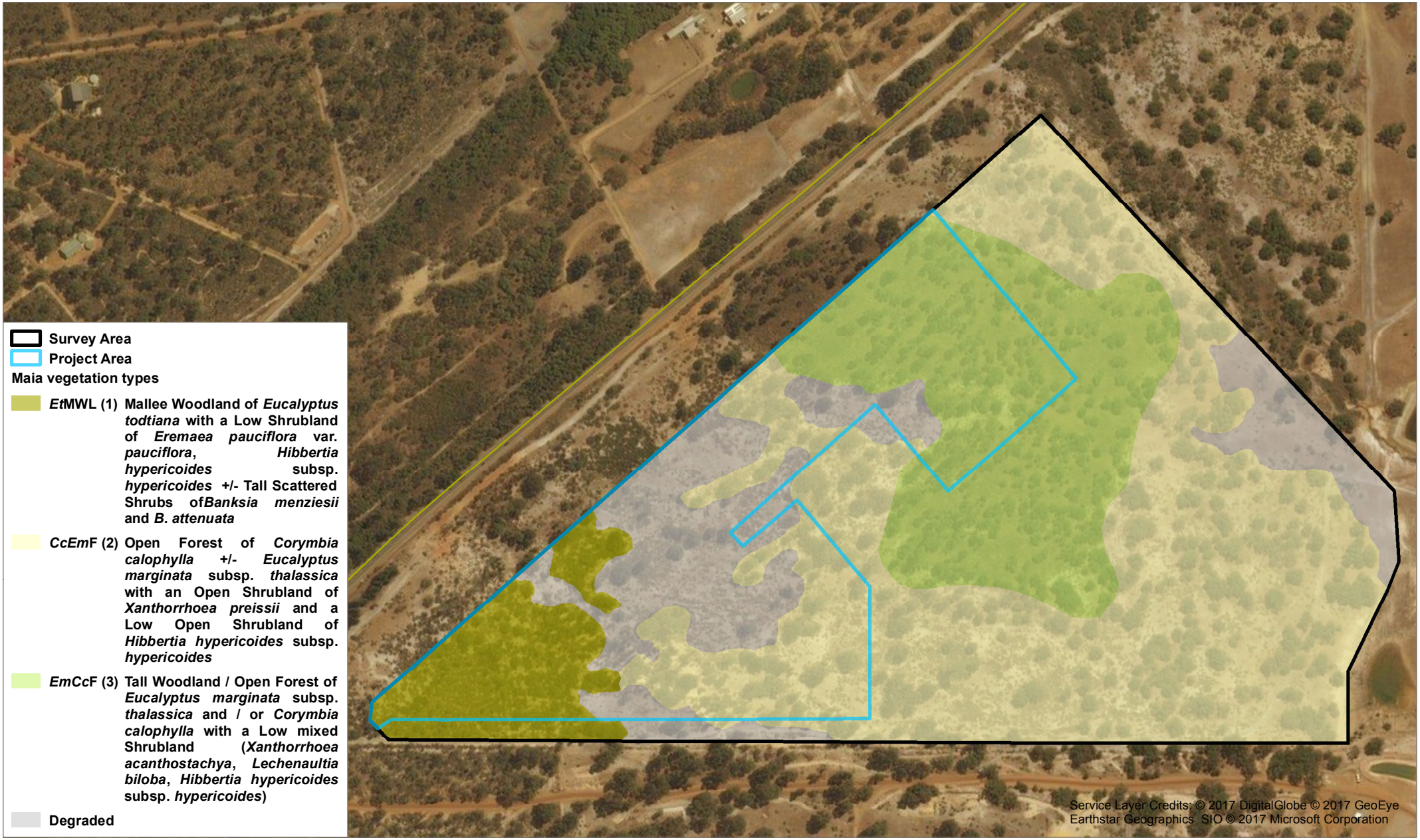

Roads

Maia vegetation types

maia

N

0 0.1

Kilometres

Datum: GDA 1994, MGA 50

Map:	11.11
Prepared for:	IPG
Drawn by:	RH SH
Date:	09/03/2017
Version: 2	**Size:** A4

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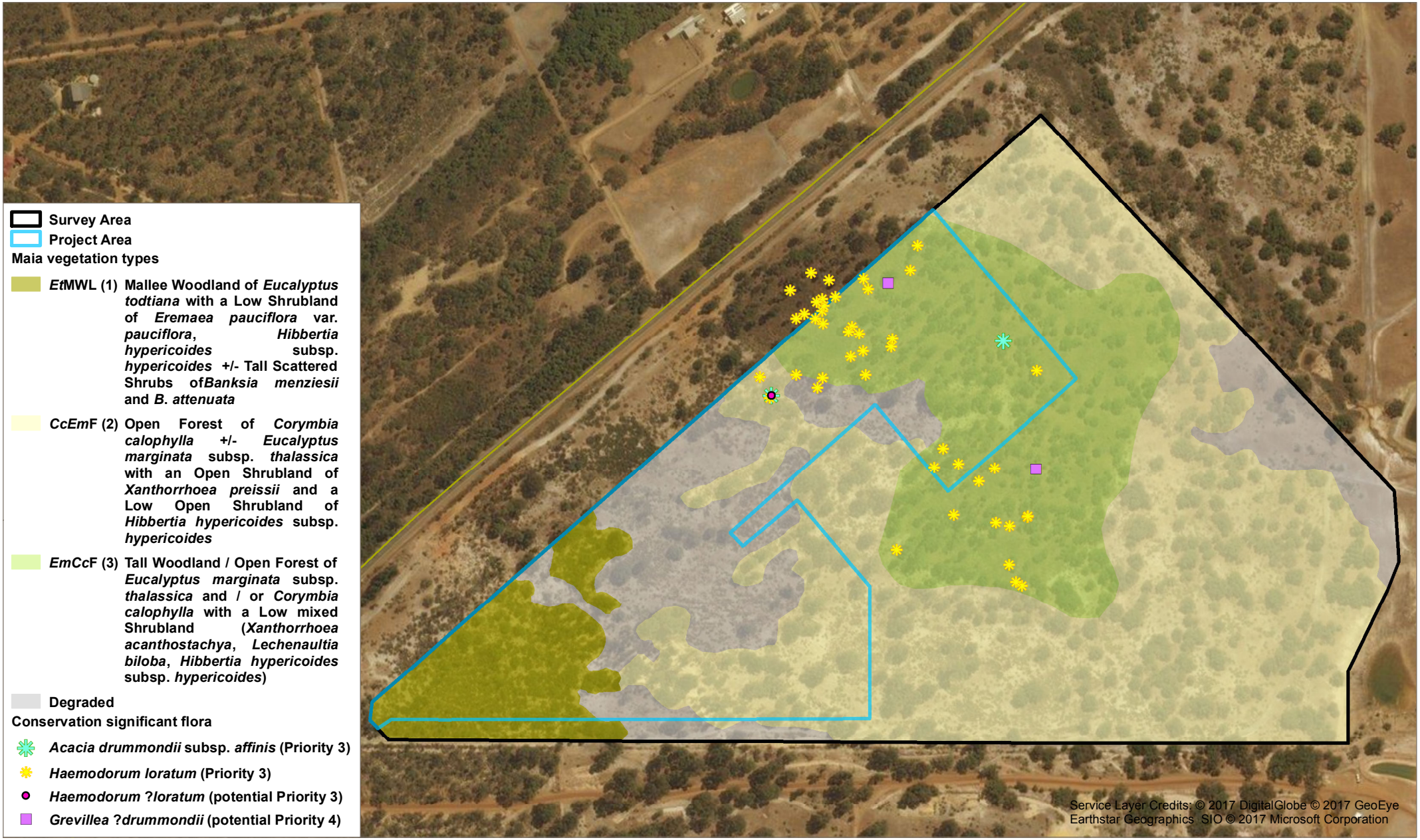

Location Map

Roads

Maia vegetation types and conservation significant flora

maia

N

0 0.1

Kilometres

Datum: GDA 1994, MGA 50

Map: 11.12
Prepared for: IPG
Drawn by: RH
Date: 25/01/2017
Version: 1 **Size:** A4

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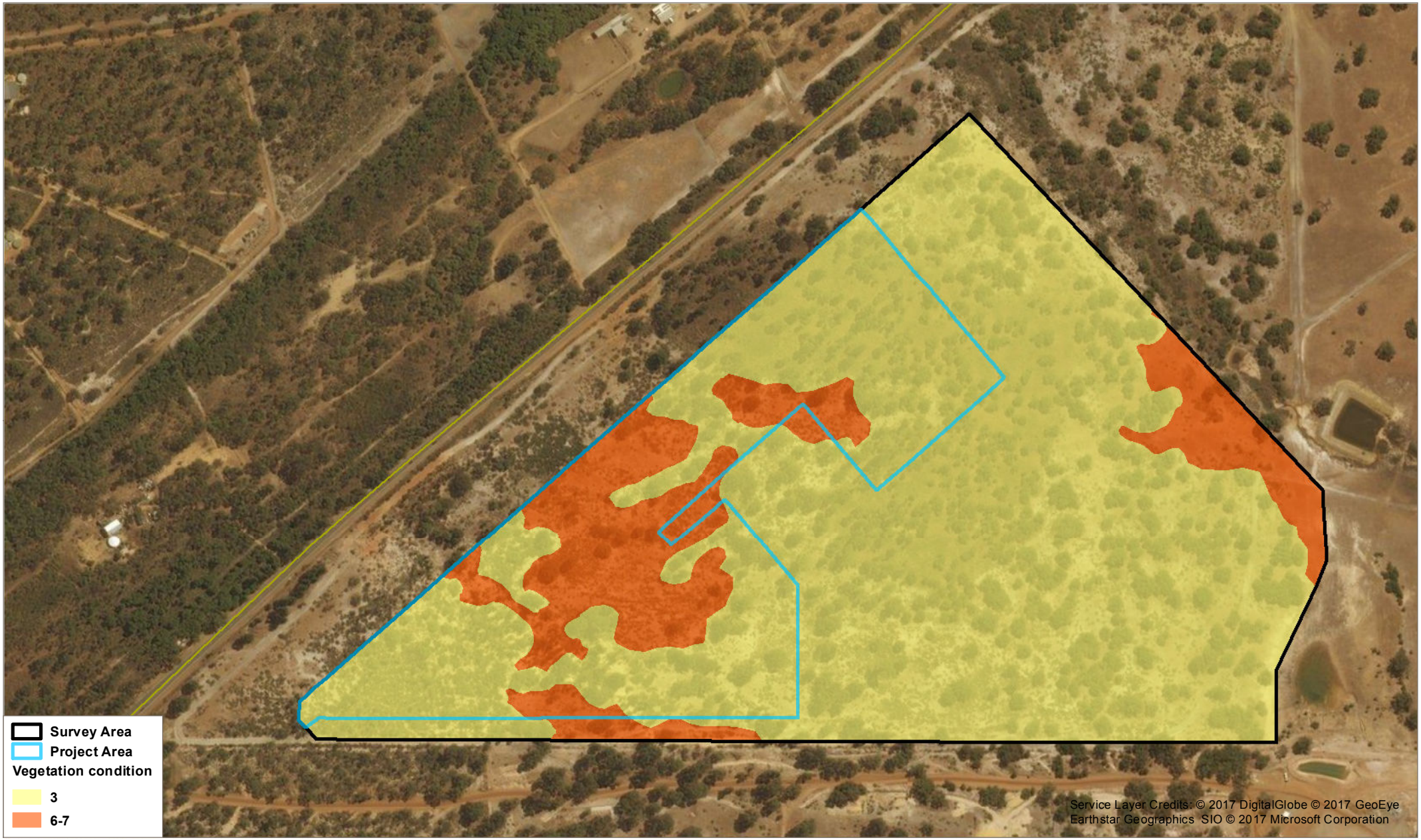

Location Map

Roads

Vegetation condition

maia

N

0 0.1

Kilometres

Datum: GDA 1994, MGA 50

Map: 11.13	
Prepared for: IPG	
Drawn by: RH	
Date: 29/01/2017	
Version: 1	**Size:** A4

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APPENDIX 1: DATABASE SEARCH RESULTS

Figure A1.1: EPBC Act Protected Matters Search Tool results (DotEE, 2017a)

Australian Government
Department of the Environment and Energy

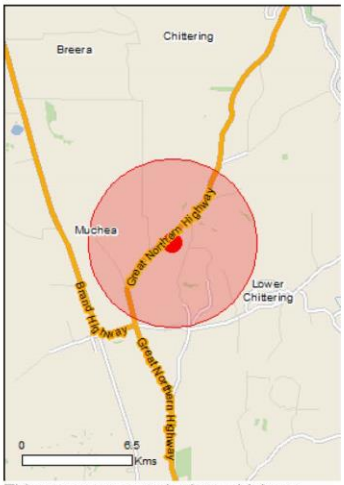
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/01/17 13:19:21



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 5.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	24
Listed Migratory Species:	5

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	10
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	1
Invasive Species:	38
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat known to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [88881]	Endangered	Species or species habitat likely to occur within area
Conospermum densiflorum subsp. unicephalatum One-headed Smokebush [64871]	Endangered	Species or species habitat may occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat may occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area
Grevillea corrugata a shrub [65445]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat known to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Barracca	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax		Species or species

Name	Status	Type of Presence
Broom [2800]		habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.53889 116.01528

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Figure A1.2: NatureMap search results (DPaW, 2007-)

NatureMap
Mapping Western Australia's biodiversity

16-03 NatureMap Species Report 5 km

Created By Guest user on 24/01/2017

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 116° 00' 55" E,31° 32' 20" S
Buffer 5km
Group By Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	111	148
Priority 1	1	1
Priority 2	3	5
Priority 3	3	10
Priority 4	3	5
Rare or likely to become extinct	4	14
TOTAL	**125**	**183**

	Name ID	Species Name	Naturalised	Conservation Code	†Endemic To Query Area
Rare or likely to become extinct					
1.	3219	*Acacia anomala (Grass Wattle)*		T	
2.	33559	*Grevillea althoferorum subsp. fragilis*		T	
3.	14409	*Grevillea curviloba subsp. incurva*		T	
4.	10862	*Thelymitra stellata (Star Orchid)*		T	
Priority 1					
5.	19775	*Hibbertia glomerata subsp. ginginensis*		P1	
Priority 2					
6.	8912	*Drosera sewelliae (Red Woolly Sundew)*		P2	
7.	1975	*Grevillea candolleana*		P2	
8.	7801	*Stylidium squamellosum (Maize Trigger Plant)*		P2	
Priority 3					
9.	11229	*Acacia drummondii subsp. affinis*		P3	
10.	11336	*Adenanthos cygnorum subsp. chamaephyton*		P3	
11.	12460	*Verticordia serrata var. linearis*		P3	
Priority 4					
12.	17622	*Hypolaena robusta*		P4	
13.	16867	*Synaphea grandis*		P4	
14.	14714	*Verticordia lindleyi subsp. lindleyi*		P4	
Non-conservation taxon					
15.	15466	*Acacia applanata*			
16.	3310	*Acacia drewiana*			
17.	11926	*Acacia drewiana subsp. drewiana*			
18.	11192	*Acacia drummondii subsp. elegans*			
19.	3410	*Acacia lateriticola*			
20.	15482	*Acacia pulchella var. goadbyi*			
21.	15483	*Acacia pulchella var. pulchella*			
22.	15480	*Acacia pulchella var. reflexa*			
23.	30033	*Acacia saligna subsp. lindleyi*			
24.	30032	*Acacia saligna subsp. saligna*			
25.	3554	*Acacia squamata*			
26.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
27.	1734	*Allocasuarina microstachya*			
28.	1409	*Anigozanthos humilis (Catspaw)*			
29.	11434	*Anigozanthos humilis subsp. humilis*			
30.	11566	*Anigozanthos viridis subsp. viridis*			
31.	6332	*Astroloma microdonta (Sandplain Cranberry)*			
32.	6339	*Astroloma xerophyllum*			
33.	1835	*Banksia micrantha*			

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	Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
34.	12111	*Banksia sphaerocarpa var. sphaerocarpa (Fox Banksia)*			
35.	5382	*Beaufortia elegans (Elegant Beaufortia)*			
36.	1417	*Blancoa canescens (Winter Bell)*			
37.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
38.	15348	*Caladenia flava subsp. flava*			
39.	2856	*Calandrinia liniflora (Parakeelya)*			
40.	5458	*Calytrix flavescens (Summer Starflower)*			
41.	5481	*Calytrix sylvana*			
42.	760	*Caustis dioica*			
43.	7925	*Chondrilla juncea (Skeleton Weed)*	Y		
44.	1864	*Conospermum crassinervium (Summer Smokebush)*			
45.	1885	*Conospermum triplinervium (Tree Smokebush)*			
46.	6347	*Conostephium minus (Pink-tipped Pearl flower)*			
47.	1423	*Conostylis aurea (Golden Conostylis)*			
48.	1427	*Conostylis candicans (Grey Cottonhead)*			
49.	11438	*Conostylis candicans subsp. candicans*			
50.	12035	*Conostylis caricina subsp. caricina*			
51.	1436	*Conostylis juncea*			
52.	11870	*Conostylis teretifolia subsp. teretifolia*			
53.	17104	*Corymbia calophylla (Marri)*			
54.	6747	*Cyanostegia angustifolia (Tinsel-flower)*			
55.	768	*Cyathochaeta avenacea*			
56.	3793	*Daviesia angulata*			
57.	11879	*Daviesia hakeoides subsp. hakeoides*			
58.	15505	*Daviesia incrassata subsp. incrassata*			
59.	15453	*Drosera gigantea subsp. gigantea*			
60.	19254	*Drosera zigzagia*			
61.	5541	*Eremaea pauciflora*			
62.	4648	*Euphorbia terracina (Geraldton Carnation Weed)*	Y		
63.	5209	*Frankenia pauciflora (Seaheath)*			
64.	3936	*Genista linifolia (Flaxleaf Broom)*	Y		
65.	6149	*Gonocarpus cordiger*			
66.	6161	*Gonocarpus pithyoides*			
67.	14106	*Grevillea althoferorum*			
68.	2066	*Grevillea pilulifera (Woolly-flowered Grevillea)*			
69.	14421	*Grevillea synapheae subsp. synapheae*			
70.	1472	*Haemodorum simplex*			
71.	6842	*Hemigenia barbata*			
72.	5114	*Hibbertia commutata*			
73.	5134	*Hibbertia huegelii*			
74.	5139	*Hibbertia lasiopus (Large Hibbertia)*			
75.	3968	*Hovea trisperma (Common Hovea)*			
76.	2221	*Isopogon asper*			
77.	4010	*Jacksonia floribunda (Holly Pea)*			
78.	19632	*Johnsonia pubescens subsp. pubescens*			
79.	14083	*Lambertia multiflora var. darlingensis*			
80.	5036	*Lasiopetalum lineare*			
81.		*Lepidosperma sp.*			
82.	947	*Lepidosperma tenue*			
83.	951	*Lepidosperma viscidum (Sticky Sword Sedge)*			
84.		*Lethocolea pansa*			
85.	6397	*Leucopogon glaucifolius*			
86.	6425	*Leucopogon oxycedrus*			
87.	28311	*Leucopogon sp. Great Southern (R.S. Cowan A 586)*			
88.	5893	*Melaleuca concreta*			
89.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
90.	5964	*Melaleuca seriata*			
91.	2308	*Petrophile seminuda*			
92.	18529	*Philotheca spicata (Pepper and Salt)*			
93.	11402	*Pimelea imbricata var. piligera*			
94.	12041	*Pimelea suaveolens subsp. suaveolens*			
95.	4524	*Platytheca galioides*			
96.	578	*Poa porphyroclados*			
97.	1669	*Prasophyllum cyphochilum (Pouched Leek Orchid)*			
98.	6033	*Scholtzia involucrata (Spiked Scholtzia)*			
99.	6037	*Scholtzia parviflora*			
100.	6	*Selaginella gracillima (Tiny Clubmoss)*			
101.	2316	*Stirlingia latifolia (Blueboy)*			
102.	7681	*Stylidium affine (Queen Triggerplant)*			
103.	12846	*Stylidium albolilacinum*			

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	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
104.	30278	*Stylidium androsaceum*			
105.	25831	*Stylidium araeophyllum (Stilt Walker)*			
106.	19249	*Stylidium cilium*			
107.	7710	*Stylidium cygnorum*			
108.	7716	*Stylidium diuroides (Donkey Triggerplant)*			
109.	11808	*Stylidium diuroides subsp. diuroides*			
110.	18420	*Stylidium flagellum*			
111.	7736	*Stylidium hispidum (White Butterfly Triggerplant)*			
112.	25829	*Stylidium neurophyllum (Coastal Plain Triggerplant)*			
113.	7768	*Stylidium obtusatum (Pinafore Triggerplant)*			
114.	7773	*Stylidium petiolare (Horn Triggerplant)*			
115.	45594	*Stylidium tenue subsp. majusculum (Showy Fountain Triggerplant)*			
116.	6476	*Styphelia tenuiflora (Common Pinheath)*			
117.	33020	*Tamarix parviflora*	Y		
118.	1319	*Thysanotus arenarius*			
119.	33677	*Triglochin centrocarpa*			
120.	12388	*Verticordia acerosa var. preissii*			
121.	15432	*Verticordia densiflora var. densiflora*			
122.	15434	*Verticordia insignis subsp. insignis*			
123.	6107	*Verticordia pennigera*			
124.	17042	*Vitis vinifera*	Y		
125.	6285	*Xanthosia ciliata*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

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Table A1.1: Conservation significant flora listed in the database search results

Column 1	2	3	4	5	6	7	8	9	10
Species	Rank and category	A or P	Source (s)	Flowering	Known habitats	Known Geological preferences	Known soil preferences	Common shared associated species	Nearest Known Location
Acacia anomala	T EPBC – V WC -V	P	EPBC; NM; TPFL; WAH	Aug-Sep	Slopes, ridges and flats	Laterite (gravel and boulders)	Lateritic soils	*Corymbia calophylla*, *Eucalyptus marginata*, *Hakea lissocarpha*, *Hibbertia hypericoides*, *Xanthorrhoea preissii*	Rosewood Ramble, Muchea, 1.2 km north of the Survey Area.
Andersonia gracilis	T EPBC – E WC -V	P	EPBC	Aug, Sep	Winter-wet depressions, undulating plains and claypans	Laterite	Grey sand, clay-loam, white sand, rusty brown sand-loam-clay, black sandy clay	*Allocasuarina humilis*, *Hypocalymma angustifolia*, *Nuytsia floribunda*, *Xanthorrhoea preissii*	Gully Road, Mindara, 49.88 km north of the Survey Area.
Anigozanthos viridis subsp. *terraspectans*	T EPBC – V WC -V	P	EPBC	Sep, Oct, Nov	Winter-wet areas, near swamps and flats	Laterite	White-grey sand, yellow sand-clay	*Verticordia densiflora*	Private property adjacent to Moore River National Park, 50.3 km north-west of the Survey Area.
Caladenia huegelii	T EPBC – E WC -CR	P	EPBC	Sep, Oct	Adjacent to swamps, flats, undulating plains and sandy rises in gently undulating terrain	Nil	Grey or brown sand, clay-loam	*Banksia attenuata*, *B. menziesii*, *Corymbia calophylla*, *Conostephium pendulum*, *Stirlingia latifolia*	Gnangarra Lake, approximately 31 km south-south-west of the Survey Area.

Column 1	2	3	4	5	6	7	8	9	10
Species	Rank and category	A or P	Source (s)	Flowering	Known habitats	Known Geological preferences	Known soil preferences	Common shared associated species	Nearest Known Location
Chamelaucium sp. Gingin (N.G. Marchant 6)	T EPBC – E WC -V	P	EPBC	Sep, Oct, Nov, Dec,	Slopes and undulating plains and the crests of scarps	Laterite	Yellow-orange sand, white-grey sand, white sand	*Adenanthos cygnorum*, *Allocasuarina humilis*, *Banksia attenuata*, *Corymbia calophylla*, *Eucalyptus todtiana*, *Hibbertia hypericoides*, *Xanthorrhoea preissii*	Reserve Road Chittering, 5.57 km north-northwest of the Survey Area.
Conospermum densiflorum subsp. *unicephalatum*	T EPBC – E WC -E	P	EPBC	Sep, Oct, Nov	Low-lying areas, plains and slopes	Laterite	Brown loam	*Hakea incrassata*	12 km south of New Norcia on the Great Northern Highway, 53.71 km north-northeast of the Survey Area.
Darwinia foetida	T EPBC – CR WC -E	P	EPBC	Oct	Moist flats, low lying plains and wetlands	Nil	Grey sand, grey-black peaty-sandy-clay	*Allocasuarina humilis*, *Banksia dallanneyi*, *Banksia menziesii*, *Bossiaea eriocarpa*, *Corymbia calophylla*, **Eragrostis curvula*, *Hibbertia hypericoides*, *Hypocalymma angustifolia*, *Melaleuca incana*, *Patersonia occidentalis*, *Xanthorrhoea preissii*	Muchea townsite, 6.24 km southwest of the Survey Area.

Column 1	2	3	4	5	6	7	8	9	10
Species	Rank and category	A or P	Source (s)	Flowering	Known habitats	Known Geological preferences	Known soil preferences	Common shared associated species	Nearest Known Location
Diuris micrantha	T EPBC – V WC -V	P	EPBC	Sep, Oct	Winter-wet swamps, in shallow water, lower slopes and flats	Limestone	Brown loam-clay, black clay-peat	Nil	Thomas Road, Medina, 78.83 km south-southwest of the Survey Area.
Diuris purdiei	T EPBC – E WC -E	P	EPBC	Sep, Oct	Winter-wet swamps and flats	Nil	Grey-black sand	*Corymbia calophylla, Hypocalymma angustifolium, Xanthorrhoea preissii*	Railway Parade, Cannington, 53.35 km south of the Survey Area.
Eleocharis keigheryi	T EPBC – V WC -V		EPBC	Aug to Nov	Emergent in freshwater: creeks, claypans	Nil	Clay, sandy loam	*Amphibromus nervosus, Calothamnus quadrifidus, Casuarina obesa, Chorizandra enodis, Eucalyptus wandoo, Eucalyptus rudis, Hakea marginatus, Isolepis cernua* var. *setiformis, Isotoma pusilla, Juncus acutus* subsp. *Acutus, Meeboldina coangustata, Melaleuca lateritia, Melaleuca rhaphiophylla, Melaleuca teretifolia, Microtis orbicularis, Triglochin linearis, Liparophyllum capitatum*	Bambun Reserve 22831, 16 km north-west of Survey Area.
Eucalyptus leprophloia	T EPBC – E WC -E	P	EPBC	Aug, Sep, Oct	Valley slopes and floors and laterite breakaways	Laterite	White-grey sand, brown loam	*Macrozamia riedlei*	Boothendarra Hill Reserve, Badgingarra, 147.74 km northwest of

Column 1	2	3	4	5	6	7	8	9	10
Species	Rank and category	A or P	Source (s)	Flowering	Known habitats	Known Geological preferences	Known soil preferences	Common shared associated species	Nearest Known Location
									the Survey Area.
Eucalyptus x *balanites*	T EPBC – E WC -CR	P	EPBC	Oct, Nov, Dec, Jan, Feb	Slopes and plains	Lateritic (gravel)	Brown sandy-loam, grey sand	*Allocasuarina humilis*, *Corymbia calophylla*, *Xanthorrhoea preissii*,	Mitchell Street, Armadale, 71.05 km south-southwest of the Survey Area.
Grevillea althoferorum subsp. *fragilis*	T EPBC – E WC -CR	P	NM; TPFL; WAH	Oct	Slopes and undulating outwash plains	Laterite	Fine white sand, grey over yellow, white-brown loam	*Acacia pulchella*, *Banksia attenuata*, *Conostephium pendulum*, *Corymbia calophylla*, *Eucalyptus marginata*, *Hibbertia huegelii*, *Hibbertia hypericoides*, *Petrophile macrostachya*, *Xanthorrhoea preissii*	Powderbark Road, Muchea, 1.5 km east-southeast of the Survey Area.
Grevillea corrugata	T EPBC – E WC -V	P	EPBC	Aug, Sep	Roadsides, slopes above drainage lines, hill slopes and crests	Granite, laterite	red-brown clay loam, brown loam	*Corymbia calophylla*, *Hypocalymma angustifolium*, *Xanthorrhoea preissii*,	Julimar Road, 11.99 km northeast of the Survey Area.
Grevillea curviloba subsp. *curviloba*	T EPBC – E WC -CR	P	EPBC	Oct	Winter-wet heaths, drainage lines and riparian zones	Limestone	Grey sand, brown sand, grey peaty-sand over clay	*Banksia menziesii*, *Corymbia calophylla*, *Hibbertia hypericoides*, *Xanthorrhoea preissii*	Muchea Nature Reserve, 6.21 km southwest of the Survey Area.
Grevillea curviloba subsp. *incurva*	T EPBC – E WC -E	P	EPBC; NM; TPFL; WAH;	Aug, Sep	Winter-wet heaths, road verges and low lying inundated areas of sandplains	Laterite, ironstone	White sand, sand-loam, red sand, black sand-clay, grey peaty-sand over clay	*Eucalyptus marginata*, *Jacksonia floribunda*, *Xanthorrhoea preissii*	Brand Highway Muchea, 5 km west-southwest of the Survey Area.

Column 1	2	3	4	5	6	7	8	9	10
Species	Rank and category	A or P	Source (s)	Flowering	Known habitats	Known Geological preferences	Known soil preferences	Common shared associated species	Nearest Known Location
Thelymitra dedmaniarum	T EPBC – E WC - CR	A	EPBC	Nov, Dec, Jan	Slopes	Granite (laterite gravel)	Grey loam, brown sand-clay	*Corymbia calophylla*, *Eucalyptus marginata*,	Walyunga National Park, 23.98 km southeast of the Survey Area.
Thelymitra stellata	T EPBC – E WC - E	A/P	EPBC; NM; TPFL	Oct, Nov	Uplands, hill crests, laterite ridges, stony hills and slopes, watercourses, gullys and sandy depressions in laterite hills	Laterite (gravel)	Grey sand, lateritic loam, brown clay-loam	*Acacia pulchella*, *Banksia attenuata*, *B. menziesii*, *Corymbia calophylla*, *Grevillea bipinnatifida*, *Hakea lissocarpha*, *Hypocalymma angustifolium*, *Leschenaultia biloba*, *Xanthorrhoea preissii*	Blue Plains Road, Chittering, 5.6 km north-northeast of the Survey Area.
Hibbertia glomerata subsp. *ginginensis*	P1	P	NM; WAH	Jul, Aug, Sep	Roadsides, plains, hill slopes and crests	Laterite (gravel and boulders)	Sand, brown clay, brown loam-sand	*Conostephium pendula*, *Corymbia calophylla*, *Eucalyptus marginata*, *Xanthorrhoea preissii*	Just off Blue Gum Road, Chittering, 3.7 km north of the Survey Area.
Drosera sewelliae	P2	P	NM; WAH	Oct	Upland laterite flats, hill slopes and crests	Laterite (gravel and conglomerate)	White silica sand, brown loamy sand, shallow grey gravel-sand pockets	*Allocasuarina humilis*, *Calothamnus sanguineus*, *Corymbia calophylla*, *Eucalyptus marginata*, *Hibbertia hypericoides*, *Melaleuca trichophylla*	Powderbark Road, Muchea, 2 km east-southeast of the Survey Area.

Column 1	2	3	4	5	6	7	8	9	10
Species	Rank and category	A or P	Source (s)	Flowering	Known habitats	Known Geological preferences	Known soil preferences	Common shared associated species	Nearest Known Location
Grevillea candolleana	P2	P	NM; WAH	Aug, Sep	Hillsides, crests and ridges	Laterite (conglomerate, gravel, boulders, duricrust)	Lateritic loam, brown sandy clay-loam	*Acacia pulchella*, *Allocasuarina humilis*, *Calothamnus sanguineus*, *Corymbia calophylla*, *Eucalyptus marginata*, *Hibbertia hypericoides*, *Hypocalymma angustifolium*, *Xanthorrhoea preissii*	Powderbark Road, Muchea, 2.10 km southeast of the Survey Area.
Stylidium squamellosum	P2	P	NM; WAH	Oct, Nov	Winter-wet habitats and depressions and upslope from depressions	Ironstone	Grey-brown loam-clay, red-brown clay-loam, brown-yellow sandy-clay	*Corymbia calophylla*, *Eucalyptus marginata*, *Grevillea bipinnatifida*	Barracca Nature Reserve, Muchea, 2.6 km northeast of the Survey Area.
Acacia drummondii subsp. *affinis*	P3	P	NM; TPFL; WAH	Jul-Aug	Slopes, hilltops, plateaus, lateritic breakaways and flats	Laterite (gravel)	Lateritic sandy-clay, loam, white sand	*Acacia latericola*, *Corymbia calophylla*, *Eucalyptus marginata*	Wandena Road, Muchea, 2.18 km south-southeast of the Survey Area.
Adenanthos cygnorum subsp. *chamaephyton*	P3	P	[#]NM; TPFL	Jul, Sep, Oct, Nov, Dec, Jan	Road verges, swales and slopes	Laterite (gravel and boulders)	Grey sand-loam, white-grey sand, brown sand, red-brown clay	*Allocasuarina humilis*, *Banksia attenuata*, *B. menziesii*, *Calothamnus sanguineus*, *Eucalyptus marginata*, *Hakea lissocarpha*, *Hibbertia hypericoides*, *Jacksonia floribunda*, *Xanthorrhoea*	Jenkins Road, Bullsbrook, 9.48 km southeast of the Survey Area.

Column 1	2	3	4	5	6	7	8	9	10
Species	Rank and category	A or P	Source (s)	Flowering	Known habitats	Known Geological preferences	Known soil preferences	Common shared associated species	Nearest Known Location
								preissii	
Verticordia serrata var. *linearis*	P3	P	NM; TPFL; WAH	Sep, Oct	Slopes	Laterite (gravel), granite/dolerite	White-yellow sand, grey sand, deep white and orange sands	*Adenanthos cygnorum*, *Alexgeorgea nitens*, *Caustis dioica*, *Corymbia calophylla*, *Desmocladus fasciculatus*, *Eucalyptus marginata*, *Hakea ruscifolia*, *Hibbertia hypericoides*, *Mesomelaena pseudostygia*, *Xanthorrhoea preissii*	Powderbark Road, Muchea, 2 km east of the Survey Area
Hypolaena robusta	P4	P	NM; WAH	Sep, Oct	Sandplains, poorly drained areas, hill tops and slopes	Laterite, limestone	White sand, grey sand, brown-yellow sand	*Adenanthos cygnorum*, *Allocasuarina humilis*, *Banksia attenuata*, *B. menziesii*, *Calothamnus sanguineus*, *Eucalyptus todtiana*, *Hibbertia hypericoides*, *Melaleuca trichophylla*, *Stirlingia latifolia*, *Xanthorrhoea preissii*	Just off Reserve Road, Muchea, 2.14 km northwest of the Survey Area

Column 1	2	3	4	5	6	7	8	9	10
Species	Rank and category	A or P	Source (s)	Flowering	Known habitats	Known Geological preferences	Known soil preferences	Common shared associated species	Nearest Known Location
Synaphea grandis	P4	P	NM; WAH	Oct, Nov	Plains, low rises and hill tops	Laterite gravel, boulders	Brown loam, grey sand, brown-yellow sand	*Allocasuarina humilis*, *Banksia grandis*, *Calothamnus sanguineus*, *Corymbia calophylla*, *Eucalyptus marginata*, *Hibbertia hypericoides*, *Xanthorrhoea preissii*	East of Muchea, 5.07 km south of the Survey Area
*Verticordia lindley*i subsp. *lindleyi*	P4	P	NM; TPFL; WAH	May, Nov, Dec, Jan	Winter-wet depressions, plains, drainage lines and poorly drained areas	Nil	Grey-white sand, yellow sand, yellow sandy-clay, grey loam	*Acacia pulchella*, *Adenanthos cygnorum*, *Banksia menziesii*, *Corymbia calophylla*, *Corynotheca micrantha*, *Eucalyptus marginata*, *Nuytsia floribunda*, *Patersonia occidentalis*, *Stirlingia latifolia*	Between Wandena Road and Powderbark Road, Muchea, 1.59 km southeast of the Survey Area

Note: Column 2: T = Threatened species, P1 – P4 = Priority 1 to Priority 4 species, EPBC = EPBC Act, WC = WC Act, CR = Critically Endangered, E = Endangered, V = Vulnerable. Column 3: A = annual, P = perennial. Column 4: EPBC = DotEE's EPBC Act Protected Matters Search Tool (DotEE, 2017a), NM = NatureMap (DPaW, 2007-), TPFL = DPaW's Threatened (Declared Rare) and Priority Flora database, WAH = Western Australian Herbarium. Column 6 to column 10: all habitats, soil, associated species information and nearest locations are sourced from FloraBase (WAH, 1998 -).

Table A1.2: Weed species listed in the database search results and previous Swan weed ranking (DPaW, 2012)

Column 1	2	3	4
Species (Common name)	Rank	Swan Region Rank	Search
Chrysanthemoides monilifera subsp. *monilifera* (Boneseed)	WoNS, STBC, DP (C2 – whole of state)	Very High	EPBC
Cenchrus ciliaris (Buffel Grass)	EW	High	EPBC
Olea europaea (Olive)	EW	High	EPBC
Tamarix aphylla (Tamarisk)	WoNS, DP (C3 – whole of state)	High	EPBC
Tamarix parviflora	EW	High	NM
Urochloa mutica (previously *Brachiaria mutica*)	EW	High	EPBC
Euphorbia terracina (Geraldton Carnation Weed)	EW	Medium	NM
Genista linifolia (Flaxleaf Broom)	WoNS, STBC	Medium	NM, EPBC
Salvinia molesta (Salvinia)	WoNS, DP (C2 – whole of state)	Medium	EPBC
Asparagus asparagoides (Bridal Creeper)	WoNS, STBC, DP (C3 – whole of state)	Low	EPBC
Lantana camara (Lantana)	WoNS, DP (C3 – whole of state)	Low	EPBC
Lycium ferocissimum (African Boxthorn)	WoNS	Low	EPBC
Pinus radiata (Radiata Pine)	EW	Low	EPBC
Rubus fruticosus aggregate (Blackberry)	WoNS, STBC, Possible DP	Low	EPBC
Salix spp. (Willows)	WoNS, DP (C1 or C3)	Low	EPBC
Genista sp. X Genista monspessulana (Broom)	Possible WoNS and STBC	Low (possible)	EPBC
Vitis vinifera	EW	Further assessment required	NM
Chondrilla juncea (Skeleton Weed)	DP (C2 – Shire of Chittering)	Alert species	NM

Note: Column 2: EW = environmental weed, DP = Declared plant, STBC = species targeted for biological control; WoNS = Weed of National Significance; C1 = exclusion, C2 = eradication, C3 = management; Column 4: NM = NatureMap (DPaW, 2007-), EPBC = DoTEE's EPBC Act Protected Matters Search Tool (DotEE, 2017a).

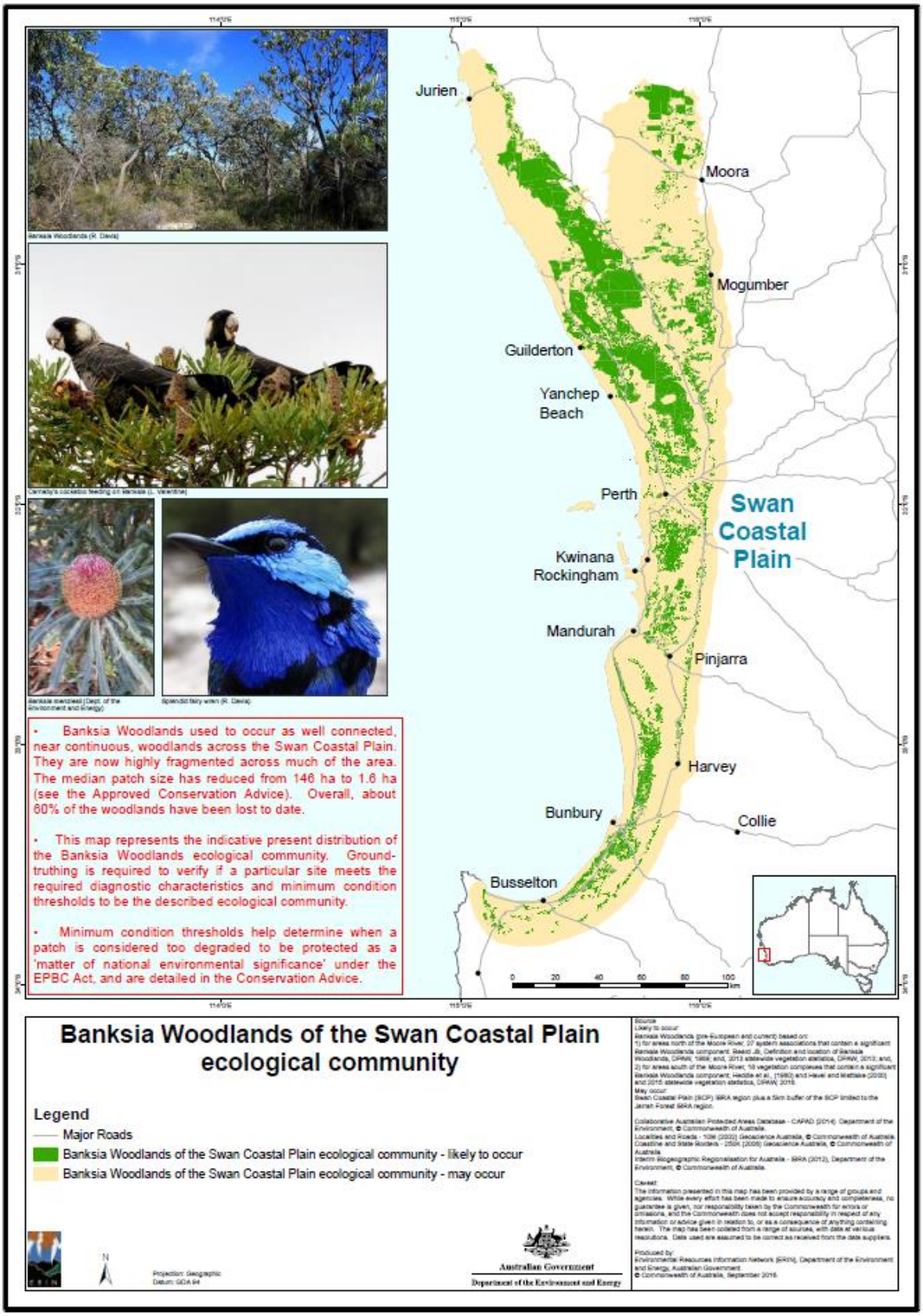


Figure A1.3: Indicative distribution map – Banksia Woodlands of the Swan Coastal Plain Ecological Community (DotEE, 2017b)

APPENDIX 2: SITE DATA – QUADRATS AND RELEVÉS

Table A2.1: Information collected at quadrats and relevés

Quadrat:	Q01	Described by:	Scott Hitchcock and Rochelle Haycock		Date:	25/10/2016	Photograph
Location (GDA94):		MGA50	406085	m E	6510048	m N	
Habitat:		Hill (very gentle slope foot slope)					
Soil:		White-grey sandy-loam loose soil (100%)					
Rocks:		No rocks					
Mapped as:		*Et***MWL** (1)					
Vegetation Type:		Low Shrubland of *Eremaea pauciflora* var. *pauciflora* and *Hibbertia hypericoides* subsp. *hypericoides* with Isolated Mallee Trees of *Eucalyptus todtiana* and Isolated Tall Shrubs of *Banksia attenuata*					
Vegetation Condition:		3					
Disturbances:		Weeds and partial clearing with re-growth					
Fire Age:		Old >5 years					
Species:		*Acacia pulchella* var. *reflexa*, *Anigozanthos humilis* subsp. *humilis*, *Austrostipa compressa*, *Banksia attenuata*, *Bossiaea eriocarpa*, *Burchardia congesta*, *Cassytha racemosa*, *Chordifex sinuosus*, *Drosera erythrorhiza*, ***Ehrharta calycina*,*** *Eremaea pauciflora* var. *pauciflora*, *Eucalyptus todtiana*, ***Gladiolus caryophyllaceus*,*** *Gompholobium preissii*, *Hibbertia hypericoides* subsp. *hypericoides*, *Hibbertia subvaginata*, *Hyalosperma cotula*, ***Hypochaeris radicata*,*** *Levenhookia stipitata*, ***Lolium rigidum*,*** *Lomandra caespitosa*, *Lomandra sericea*, ***Lysimachia arvensis*,*** *Melaleuca trichophylla*, *Mesomelaena pseudostygia*, *Neurachne alopecuroidea*, ***Ornithopus compressus*, Pentameris airoides* subsp. *airoides*, Pentameris airoides*,*** *Philotheca spicata*, *Podotheca gnaphalioides*, *Poranthera microphylla*, *Trachymene pilosa*, ***Ursinia anthemoides* subsp. *anthemoides*, Wahlenbergia capensis***					
Quadrat:	**Q02**	**Described by:**	**Scott Hitchcock and Rochelle Haycock**		**Date:**	**25/10/2016**	**Photograph**
Location (GDA94):		MGA50	406581	m E	6510390	m N	
Habitat:		Hill (gentle midslope)					
Soil:		Brown sandy-loam loose soil (5%)					
Rocks:		Laterite gravel (85%), stones (10%)					
Mapped as:		*EmCc***F** (3)					
Vegetation Type:		Open Low Shrubland of *Hibbertia hypericoides* subsp. *hypericoides*, *Lechenaultia biloba* and *Xanthorrhoea acanthostachya* with Open Low Woodland of *Corymbia calophylla* and *Eucalyptus marginata* subsp. *thalassica*					
Vegetation Condition:		3					
Disturbances:		Weeds and partial clearing of understorey					
Fire Age:		Old >5 years					
Species:		***Acacia drummondii* subsp. *affinis* (P3),** *Acacia pulchella* var. *reflexa*, *Astroloma pallidum*, *Banksia bipinnatifida* subsp. *multifida*, *Banksia dallanneyi* subsp. *sylvestris*, *Bossiaea eriocarpa*, ***Briza maxima*,*** *Cassytha racemosa*, *Cassytha* sp., *Chamaescilla corymbosa*, *Conostylis setigera* subsp. *setigera*, *Corymbia calophylla*, *Daviesia decurrens* subsp. *decurrens*, *Desmocladus fasciculatus*, ***Ehrharta calycina*,*** *Eucalyptus marginata* subsp. *thalassica*, *Gompholobium knightianum*, *Haemodorum venosum*, *Hakea stenocarpa*, *Hibbertia commutata*, *Hibbertia huegelii*, *Hibbertia hypericoides* subsp. *hypericoides*, *Hovea trisperma* var. *trisperma*, ***Hypochaeris radicata*,*** *Lechenaultia biloba*, *Lepidosperma pubisquameum*, *Lomandra sericea*, *Neurachne alopecuroidea*, ***Orobanche minor*,*** *Orthrosanthus laxus* var. *laxus*, ***Pentameris airoides*,*** *Pithocarpa* sp., *Podotheca gnaphalioides*, *Poranthera microphylla*, *Ptilotus stirlingii*, *Stackhousia pubescens*, *Stylidium ciliatum*, *Synaphea aephynsa*, *Trachymene pilosa*, *Tricoryne elatior*, ***Ursinia anthemoides*,*** *Wahlenbergia gracilenta*, *Waitzia suaveolens* var. *suaveolens*, *Xanthorrhoea acanthostachya*, *Xanthorrhoea preissii*					

Quadrat:	Q03	Described by:	Scott Hitchcock and Rochelle Haycock		Date:	25/10/2016		Photograph
Location (GDA94):		MGA50	406439	m E	6510265		m N	
Habitat:		Hill (very gentle midslope)						
Soil:		White-grey sandy-loam loose soil (100%)						
Rocks:		No rocks						
Mapped as:		*CcEm***F** (2)						
Vegetation Type:		Tall Woodland of *Corymbia calophylla* and *Eucalyptus marginata* subsp. *thalassica* with Open Low Shrubland of *Hibbertia hypericoides* subsp. *hypericoides* and Sparse Mid Shrubland of *Xanthorrhoea preissii*						
Vegetation Condition:		3						
Disturbances:		Clearing adjacent and weeds						
Fire Age:		Old >5 years						
Species:		*Banksia bipinnatifida* subsp. *multifida*, *Bossiaea eriocarpa, Caesia micrantha, Caladenia flava, Centrolepis drummondii, Conostephium pendulum, Corymbia calophylla, Crassula colorata* var. *acuminata*, *Drosera erythrorhiza, **Ehrharta calycina*,** Eucalyptus marginata* subsp. *thalassica*, ***Gladiolus caryophyllaceus*,** Gompholobium preissii, Hibbertia hypericoides* subsp. *hypericoides*, ***Hordeum leporinum*, Hypochaeris glabra*, Hypochaeris radicata*,** Lepidosperma pubisquameum, Lomandra sericea, **Parentucellia latifolia*, Pentameris airoides* subsp. *airoides*, Pentameris airoides*,** Pericalymma ellipticum* var. *ellipticum*, *Podotheca gnaphalioides, Pterostylis* sp. cauline leaves (N. Gibson & M.N. Lyons 1490), *Stylidium calcaratum, Tricoryne elatior, **Ursinia anthemoides* subsp. *anthemoides*, Ursinia anthemoides*,** Xanthorrhoea preissii*						

Quadrat:	Q04	Described by:	Scott Hitchcock and Rochelle Haycock		Date:	25/10/2016		Photograph
Location (GDA94):		MGA50	406185	m E	6510190		m N	
Habitat:		Hill (very gentle midslope)						
Soil:		White-grey sandy-loam loose soil (100%)						
Rocks:		No rocks						
Mapped as:		*Et***MWL** (1)						
Vegetation Type:		Open Low Shrubland of *Hibbertia hypericoides* subsp. *hypericoides* with Open Mallee Woodland of *Eucalyptus todtiana* with Sparse Mid Shrubland of *Eremaea pauciflora* var. *pauciflora* and Isolated Sedges of *Mesomelaena pseudostygia*						
Vegetation Condition:		2						
Disturbances:		Clearing adjacent and weeds						
Fire Age:		Old >5 years						
Species:		*Acacia ?applanata, Alexgeorgea nitens, Anigozanthos humilis* subsp. *humilis*, *Austrostipa compressa, **Briza maxima*,** Burchardia congesta, Caladenia flava, Cassytha racemosa, Desmocladus fasciculatus, Drosera erythrorhiza, **Ehrharta calycina*,** Eremaea pauciflora* var. *pauciflora*, *Eucalyptus todtiana, **Gladiolus caryophyllaceus*,** Gompholobium preissii, Haemodorum spicatum, Hibbertia hypericoides* subsp. *hypericoides*, *Hibbertia subvaginata, **Hypochaeris radicata*,** Jacksonia floribunda, Lepidosperma leptostachyum, Lomandra caespitosa, Lomandra micrantha* subsp. *micrantha*, *Lomandra sericea, Lysinema pentapetalum, Marianthus erubescens, Melaleuca trichophylla, Mesomelaena pseudostygia, **Pentameris airoides*,** Petrophile linearis, Podotheca gnaphalioides, Scaevola phlebopetala, **Sonchus oleraceus*,** Stirlingia latifolia, **Ursinia anthemoides* subsp. *anthemoides*, Ursinia anthemoides*, Wahlenbergia capensis****						

Quadrat:	Q05	Described by:	Scott Hitchcock and Rochelle Haycock		Date:	25/10/2016	Photograph
Location (GDA94):		MGA50	406427	m E	6510089	m N	
Habitat:		Hill (very gentle midslope)					
Soil:		White-grey sandy-loam loose soil (100%)					
Rocks:		No rocks					
Mapped as:		*CcEm***F** (2)					
Vegetation Type:		Open Tall Woodland of *Corymbia calophylla* with Sparse Mid Shrubland of *Xanthorrhoea preissii* and Sparse Low Shrubland of *Hibbertia hypericoides* subsp. *hypericoides*					
Vegetation Condition:		4					
Disturbances:		Weeds and partial clearing with re-growth					
Fire Age:							
Species:		*Alexgeorgea nitens, Austrostipa compressa, Burchardia congesta, Caladenia flava, Chamaescilla corymbosa, Conostylis aculeata* subsp. *cygnorum*, *Corymbia calophylla, Desmocladus fasciculatus, Drosera erythrorhiza,* ***Ehrharta calycina*,*** *Gompholobium knightianum, Hibbertia huegelii, Hibbertia hypericoides* subsp. *hypericoides*, *Hypocalymma angustifolium* subsp. Dandaragan plateau (S. Patrick 702A), ***Hypochaeris radicata*,*** *Labichea lanceolata* subsp. *lanceolata*, *Lechenaultia biloba, Lepidosperma pubisquameum, Lomandra hermaphrodita, Lomandra micrantha* subsp. *micrantha*, *Lomandra sericea, Melaleuca trichophylla, Mesomelaena pseudostygia, Microtis media* subsp. *media*, *Neurachne alopecuroidea,* ***Parentucellia latifolia*,*** *Philotheca spicata, Podotheca gnaphalioides,* ***Romulea rosea*,*** *Tricoryne elatior,* ***Ursinia anthemoides*** **subsp. *anthemoides*, Ursinia anthemoides*,*** *Xanthorrhoea preissii*					

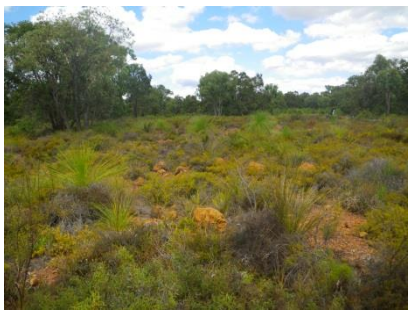
Quadrat:	Q06	Described by:	Scott Hitchcock and Rochelle Haycock		Date:	25/10/2016	Photograph
Location (GDA94):		MGA50	406364	m E	6510339	m N	
Habitat:		Hill (very gentle midslope)					
Soil:		White-grey sandy-loam loose soil (100%)					
Rocks:		No rocks					
Mapped as:		*CcEm***F** (2)					
Vegetation Type:		Tall Woodland of *Corymbia calophylla* with Open Mid Shrubland of *Xanthorrhoea preissii* and *Allocasuarina humilis* and Open Low Shrubland of *Hibbertia hypericoides* subsp. *hypericoides*					
Vegetation Condition:		3					
Disturbances:		Weeds and partial clearing with re-growth					
Fire Age:							
Species:		***Acacia drummondii*** **subsp. *affinis* (P3),** *Alexgeorgea nitens, Allocasuarina humilis, Anigozanthos humilis* subsp. *humilis*, *Austrostipa compressa, Banksia bipinnatifida* subsp. *multifida, Bossiaea eriocarpa,* ***Briza maxima*,*** *Burchardia congesta, Caesia micrantha, Caladenia flava, Centrolepis drummondii, Conostephium pendulum, Conostylis setigera* subsp. *setigera*, *Corymbia calophylla, Crassula colorata* var. *acuminata*, *Cyathochaeta avenacea, Daviesia decurrens* subsp. *decurrens*, *Desmocladus fasciculatus, Drosera erythrorhiza,* ***Gladiolus caryophyllaceus*, Haemodorum ?loratum*** **(potential P3),** *Hibbertia hypericoides* subsp. *hypericoides*, ***Hypochaeris radicata*,*** *Isotropis cuneifolia* subsp. *cuneifolia*, ***Lolium rigidum*,*** *Lomandra caespitosa, Lomandra sericea, Mesomelaena pseudostygia, Microtis media* subsp. *media*, *Neurachne alopecuroidea,* ***Ornithopus compressus*, Orobanche minor*,*** *Podotheca gnaphalioides, Poranthera microphylla, Stylidium calcaratum, Stylidium diuroides, Tricoryne elatior,* ***Ursinia anthemoides*** **subsp. *anthemoides*, Ursinia anthemoides*,*** *Xanthorrhoea preissii*					

Quadrat:	Q07	Described by:	Scott Hitchcock and Rochelle Haycock		Date:	25/10/2016		Photograph
Location (GDA94):		MGA50	406328	m E	6510097		m N	
Habitat:		Hill (very gentle midslope)						
Soil:		White-grey sandy-loam loose soil (100%)						
Rocks:		No rocks						
Mapped as:		*CcEm***F** (2)						
Vegetation Type:		Open Low Woodland of *Corymbia calophylla* and *Eucalyptus marginata* subsp. *thalassica* with Sparse Mid Shrubland of *Xanthorrhoea preissii* and Sparse Low Shrubland of *Hibbertia hypericoides* subsp. *hypericoides*						
Vegetation Condition:		3						
Disturbances:		Clearing adjacent and weeds						
Fire Age:		Old >5 years						
Species:		*Acacia ?applanata, Alexgeorgea nitens, Anigozanthos humilis* subsp. *humilis*, *Astroloma xerophyllum, Banksia dallanneyi* subsp. *sylvestris*, ***Briza maxima*,*** *Burchardia congesta, Centrolepis drummondii, Chamaescilla corymbosa, Corymbia calophylla, Crassula colorata* var. *acuminata*, *Desmocladus fasciculatus, Drosera glanduligera, Drosera menziesii* subsp. *penicillaris*, ***Ehrharta calycina*,*** *Eucalyptus marginata* subsp. *thalassica*, ***Gladiolus caryophyllaceus*,*** *Gompholobium knightianum, Gompholobium preissii, Haemodorum* sp., *Haemodorum spicatum, Hibbertia huegelii, Hibbertia hypericoides* subsp. *hypericoides*, ***Hypochaeris radicata*,*** *Johnsonia acaulis, Levenhookia stipitata, Lomandra caespitosa, Lomandra sericea, Lyginia barbata, Melaleuca trichophylla, Mesomelaena pseudostygia, Microtis media* subsp. *media*, ***Parentucellia latifolia*, Pentameris airoides*,*** *Petrophile linearis, Phyllangium divergens, Poranthera microphylla, Pterostylis* sp. cauline leaves (N. Gibson & M.N. Lyons 1490), ***Romulea rosea*,*** *Siloxerus filifolius, Stirlingia latifolia, Thelymitra campanulata, Tricoryne elatior,* ***Ursinia anthemoides*** **subsp.** ***anthemoides*, Wahlenbergia capensis*,*** *Xanthorrhoea preissii*						

Quadrat:	Q08	Described by:	Scott Hitchcock and Rochelle Haycock		Date:	25/10/2016		Photograph
Location (GDA94):		MGA50	406486	m E	6510437		m N	
Habitat:		Hill (very gentle midslope)						
Soil:		Brown-white sandy-loam loose soil (1%)						
Rocks:		Laterite gravel (99%)						
Mapped as:		*EmCc***F** (3)						
Vegetation Type:		Open Low Shrubland of *Hibbertia hypericoides* subsp. *hypericoides* and *Xanthorrhoea acanthostachya* with Open Low Woodland of *Eucalyptus marginata* subsp. *thalassica*						
Vegetation Condition:		3						
Disturbances:		Clearing adjacent and weeds						
Fire Age:		Old >5 years						
Species:		*Acacia pulchella* var. *reflexa*, *Astroloma xerophyllum, Austrostipa compressa, Banksia bipinnatifida* subsp. *multifida*, *Banksia dallanneyi* subsp. *sylvestris*, *Boronia ramosa* subsp. *anethifolia*, *Cassytha racemosa, Chamaescilla corymbosa, Crassula colorata* var. *acuminata*, *Dampiera linearis, Daviesia decurrens* subsp. *decurrens*, *Daviesia triflora, Desmocladus fasciculatus, Drosera barbigera, Eucalyptus marginata* subsp. *thalassica*, ***Gladiolus caryophyllaceus*,*** *Gompholobium knightianum, Gompholobium marginatum, Haemodorum ?venosum, Haemodorum laxum, Haemodorum venosum, Hibbertia commutata, Hibbertia hypericoides* subsp. *hypericoides*, ***Hypochaeris radicata*,*** *Laxmannia ramosa* subsp. *ramosa*, *Lechenaultia biloba, Lepidosperma pubisquameum, Levenhookia stipitata, Mesomelaena tetragona, Monotaxis grandiflora, Neurachne alopecuroidea,* ***Orobanche minor*, Parentucellia latifolia*, Pentameris airoides*** **subsp.** ***airoides*, Pentameris airoides*,*** *Petrophile striata,* ***Petrorhagia dubia*,*** *Podotheca angustifolia, Poranthera microphylla, Ptilotus manglesii, Ptilotus stirlingii, Stirlingia simplex, Stylidium ciliatum, Synaphea aephynsa, Tetratheca nuda, Thysanotus patersonii, Trachymene pilosa, Tricoryne elatior,* ***Ursinia anthemoides*** **subsp.** ***anthemoides*, Ursinia anthemoides*, Wahlenbergia capensis*,*** *Waitzia suaveolens* var. *suaveolens*, *Xanthorrhoea acanthostachya, Xanthorrhoea preissii*						

Quadrat:	Q09	Described by:	Scott Hitchcock and Rochelle Haycock		Date:	25/10/2016	Photograph
Location (GDA94):		MGA50	406118	m E	6510080	m N	
Habitat:		Hill (midslope)					
Soil:		White-grey sandy-loam loose soil (100%)					
Rocks:		No rocks					
Mapped as:		*Et***MWL** (1)					
Vegetation Type:		Sparse Mid Shrubland of *Xanthorrhoea preissii* with Isolated Mallee Trees of *Eucalyptus todtiana* with Isolated Tall Shrubs of *Banksia attenuata* and Isolated Low Shrubs of *Hibbertia hypericoides* subsp. *hypericoides*					
Vegetation Condition:		4					
Disturbances:		Weeds and partial clearing with re-growth					
Fire Age:		Old >5 years					
Species:		*Acacia ?applanata, Acacia pulchella* var. *reflexa*, *Alexgeorgea nitens, Anigozanthos humilis* subsp. *humilis*, *Austrostipa compressa, Banksia attenuata, Blennospora drummondii,* ***Briza maxima*, Briza minor*,*** *Burchardia congesta, Caladenia flava, Cassytha racemosa, Conostylis setigera* subsp. *setigera*, *Crassula colorata* var. *acuminata*, *Daviesia triflora, Drosera erythrorhiza, Drosera menziesii* subsp. *penicillaris*, ***Ehrharta calycina*,*** *Eremaea pauciflora* var. *pauciflora*, ***Erodium botrys*,*** *Eucalyptus todtiana,* ***Galium divaricatum*, Gladiolus caryophyllaceus*,*** *Haemodorum spicatum, Hibbertia huegelii, Hibbertia hypericoides* subsp. *hypericoides*, ***Hordeum leporinum*, Hypochaeris radicata*,*** *Jacksonia floribunda, Lepidosperma leptostachyum, Levenhookia stipitata, Lomandra caespitosa,* ***Lysimachia arvensis*,*** *Melaleuca trichophylla, Mesomelaena pseudostygia,* ***Parentucellia latifolia*, Pentameris airoides*,*** *Petrophile linearis, Podotheca gnaphalioides, Siloxerus filifolius, Stirlingia latifolia, Trachymene pilosa, Tricoryne elatior,* ***Ursinia anthemoides*** **subsp.** ***anthemoides*, Wahlenbergia capensis*,*** *Xanthorrhoea preissii*					

Relevé:	R02	Described by:	Scott Hitchcock		Date:	22/03/2016	Photograph
Location (GDA94):		MGA50	406473	m E	6510444	m N	
Habitat:		Hill (very gentle west facing lowerslope)					
Soil:		Red-brown sandy-loam loose soil (<2%)					
Rocks:		Laterite gravel (95%), stones (5%)					
Mapped as:		*EmCc***F** (3)					
Vegetation Type:		Low Shrubland of *Xanthorrhoea preissii*, *Banksia dallanneyi* subsp. *sylvestris* and *Hibbertia hypericoides* subsp. *hypericoides* with Tall Woodland of *Eucalyptus marginata* subsp. *thalassica*					
Vegetation Condition:		3					
Disturbances:		Previous clearing - woodpiles adjacent with cleared area					
Fire Age:		Old >5 years					
Species:		*Acacia pulchella* var. *reflexa*, *Banksia dallanneyi* subsp. *sylvestris*, *Cassytha racemosa, Daviesia hakeoides* subsp. *subnuda*, *Daviesia incrassata* subsp. *incrassata*, *Desmocladus fasciculatus, Eucalyptus marginata* subsp. *thalassica*, *Gompholobium knightianum, Gonocarpus cordiger,* ***Grevillea ?drummondii*** **(Potential P4),** *Hakea lissocarpha, Hakea stenocarpa, Hibbertia commutata, Hibbertia hypericoides* subsp. *hypericoides*, *Isopogon asper, Labichea lanceolata* subsp. *lanceolata*, *Lechenaultia biloba, Patersonia occidentalis* var. *occidentalis, Petrophile striata, Pimelea suaveolens* subsp. *suaveolens*, *Trymalium angustifolium, Xanthorrhoea preissii*					

Relevé:	R03	Described by:	Scott Hitchcock		Date:	22/03/2016	Photograph
Location (GDA94):		MGA50	406391	m E	6510428	m N	
Habitat:		Hill (very gentle north-west facing slope lower slope)					
Soil:		Red-brown sandy-loam loose soil (<2%)					
Rocks:		Laterite gravel (80%), boulders (20%)					
Mapped as:		*EmCc***F** (3)					
Vegetation Type:		Low Shrubland of *Xanthorrhoea acanthostachya*, *Banksia dallanneyi* subsp. *sylvestris* and *Hibbertia hypericoides* subsp. *hypericoides* with Open Tall Woodland of *Corymbia calophylla* and Sparse Mid Shrubland of *Acacia pulchella* var. *reflexa*					
Vegetation Condition:		3					
Disturbances:		Previous clearing - some trees removed					
Fire Age:		Old >5 years					
Species:		*Acacia pulchella* var. *reflexa*, *Banksia bipinnatifida* subsp. *multifida*, *Banksia dallanneyi* subsp. *sylvestris*, *Burchardia congesta*, *Calothamnus sanguineus, Corymbia calophylla, Daviesia hakeoides* subsp. *subnuda*, *Daviesia incrassata* subsp. *incrassata*, *Daviesia nudiflora* subsp. *nudiflora*, *Gompholobium knightianum, Gonocarpus cordiger,* ***Grevillea ?drummondii*** **(Potential P4),** *Hakea lissocarpha, Hakea stenocarpa, Hibbertia commutata, Hibbertia huegelii, Hibbertia hypericoides* subsp. *hypericoides*, *Isopogon asper, Labichea lanceolata* subsp. *lanceolata*, *Lechenaultia biloba, Mesomelaena pseudostygia, Petrophile macrostachya, Petrophile striata, Xanthorrhoea acanthostachya*					

Relevé:	R05	Described by:	Scott Hitchcock		Date:	22/03/2016	Photograph
Location (GDA94):		MGA50	406230	m E	6510293	m N	
Habitat:		Hill (gentle north-west facing slope footslope)					
Soil:		White coarse sand loose soil (100%)					
Rocks:		No rocks					
Mapped as:		Not mapped – outside Survey Area					
Vegetation Type:		Low Shrubland of *Eremaea pauciflora* var. *pauciflora* with Sparse Mid Shrubland of *Eremaea pauciflora* var. *pauciflora*					
Vegetation Condition:		2					
Disturbances:		Adjacent to a cleared area and weeds					
Fire Age:		None evident					
Species:		*Alexgeorgea nitens, Bossiaea eriocarpa, Caustis dioica, Conostephium pendulum, Dasypogon bromeliifolius, Daviesia triflora,* ***Eragrostis curvula*,*** *Eremaea pauciflora* var. *pauciflora*, *Gompholobium tomentosum, Hibbertia huegelii, Hibbertia subvaginata, Jacksonia floribunda, Leucopogon conostephioides, Lyginia barbata, Lysinema pentapetalum, Melaleuca lateritia, Melaleuca trichophylla, Mesomelaena pseudostygia, Patersonia occidentalis* var. *occidentalis*, ***Pentameris airoides*** **subsp.** ***airoides*,*** *Petrophile linearis, Podotheca chrysantha, Scholtzia involucrata, Stirlingia latifolia, Synaphea spinulosa* subsp. *spinulosa*					

Relevé:	R06	Described by:	Scott Hitchcock		Date:	22/03/2016	Photograph
Location (GDA94):		MGA50	406126	m E	6510093	m N	
Habitat:		Hill (very gentle north-west facing footslope)					
Soil:		White coarse sand loose soil (100%)					
Rocks:		No rocks					
Mapped as:		*Et***MWL** (1)					
Vegetation Type:		Low Shrubland of *Melaleuca trichophylla*, *Eremaea pauciflora* var. *pauciflora* and *Stirlingia latifolia* with Mallee Woodland of *Eucalyptus todtiana*					
Vegetation Condition:		3					
Disturbances:		Previous clearing and weeds					
Fire Age:		None evident					
Species:		*Adenanthos cygnorum* subsp. *cygnorum*, *Alexgeorgea nitens, Banksia attenuata, Burchardia congesta, Cassytha racemosa, Caustis dioica, Conostephium pendulum, Conostylis aculeata, Daviesia decurrens* subsp. *decurrens*, *Daviesia triflora, Eremaea pauciflora* var. *pauciflora*, *Eucalyptus todtiana, Gompholobium tomentosum, Hibbertia huegelii, Hibbertia hypericoides* subsp. *hypericoides*, *Lepidosperma ?costale*, *Lyginia barbata, Melaleuca lateritia, Melaleuca trichophylla, Mesomelaena pseudostygia, Nuytsia floribunda, Patersonia occidentalis* var. *occidentalis*, ***Pentameris airoides* subsp. *airoides**,** *Petrophile linearis, Scholtzia involucrata, Stirlingia latifolia, Synaphea spinulosa* subsp. *spinulosa*, *Xanthorrhoea preissii*					

Relevé:	R07	Described by:	Scott Hitchcock		Date:	22/03/2016	Photograph
Location (GDA94):		MGA50	406353	m E	6510217	m N	
Habitat:		Hill (very gentle north facing lower slope)					
Soil:		White coarse sand loose soil (95%)					
Rocks:		Laterite gravel (5%)					
Mapped as:		Degraded					
Vegetation Type:		Open Tall Shrubland of *Xanthorrhoea preissii* with Sparse Low Shrubland of *Daviesia triflora*, *Petrophile linearis* and *Stirlingia latifolia*					
Vegetation Condition:		6					
Disturbances:		Weeds and previous clearing – wood piles adjacent, tree layer removed					
Fire Age:		Old >5 years					
Species:		*Banksia dallanneyi* subsp. *sylvestris*, *Calytrix flavescens, Daviesia incrassata* subsp. *incrassata*, *Daviesia nudiflora* subsp. *nudiflora*, *Daviesia triflora, Desmocladus fasciculatus, Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* subsp. *hypericoides*, *Lomandra caespitosa, Lyginia barbata, Mesomelaena pseudostygia,* ***Pentameris airoides* subsp. *airoides**,** *Petrophile linearis, Podotheca chrysantha, Scholtzia involucrata, Stirlingia latifolia, Synaphea spinulosa* subsp. *spinulosa*, *Xanthorrhoea preissii*					

Relevé:	R08	Described by:	Scott Hitchcock		Date:	22/03/2016	Photograph
Location (GDA94):		MGA50	406469	m E	6510308	m N	
Habitat:		Hill (gentle north-west facing upper slope)					
Soil:		Orange-white fine sand loose soil (100%)					
Rocks:		No rocks					
Mapped as:		Degraded					
Vegetation Type:		Open Tall Shrubland of *Xanthorrhoea preissii* with Sparse Low Shrubland of *Daviesia triflora*, *Petrophile linearis* and *Stirlingia latifolia*					
Vegetation Condition:		4					
Disturbances:		Weeds and previous clearing – tree layer removed					
Fire Age:		Moderate 1-5 years					
Species:		*Banksia dallanneyi* subsp. *sylvestris*, *Daviesia incrassata* subsp. *incrassata*, *Daviesia nudiflora* subsp. *nudiflora*, *Daviesia triflora, Eremaea pauciflora* var. *pauciflora*, *Hibbertia hypericoides* subsp. *hypericoides*, *Lomandra caespitosa, Lyginia barbata, Mesomelaena pseudostygia,* ***Pentameris airoides* subsp. *airoides**,** *Petrophile linearis, Scholtzia involucrata, Stirlingia latifolia, Synaphea spinulosa* subsp. *spinulosa*, *Xanthorrhoea preissii*					

Relevé:	R09	Described by:	Scott Hitchcock		Date:	22/03/2016	Photograph
Location (GDA94):		MGA50	406689	m E	6510397	m N	
Habitat:		Hill (gentle west facing upper slope)					
Soil:		Brown sandy-clay loose soil (4%)					
Rocks:		Laterite gravel (70%), boulders (26%)					
Mapped as:		*EmCc***F** (3)					
Vegetation Type:		Low Woodland of *Eucalyptus marginata* subsp. *thalassica* with Open Tall Shrubland of *Xanthorrhoea preissii* and Open Low Shrubland of *Synaphea spinulosa* subsp. *spinulosa*, *Banksia bipinnatifida* subsp. *multifida* and *Hibbertia commutata*					
Vegetation Condition:		2					
Disturbances:		Previous clearing adjacent to site					
Fire Age:		Old >5 years					
Species:		*Acacia lateriticola, Banksia bipinnatifida* subsp. *multifida*, *Banksia dallanneyi* subsp. *sylvestris*, *Cassytha racemosa, Daviesia triflora, Desmocladus fasciculatus, Eremaea pauciflora* var. *pauciflora*, *Eucalyptus marginata* subsp. *thalassica*, *Gompholobium knightianum, Gonocarpus cordiger, Hakea stenocarpa, Hibbertia commutata, Opercularia vaginata, Pimelea suaveolens* subsp. *suaveolens*, *Ptilotus manglesii, Synaphea spinulosa* subsp. *spinulosa*, *Trymalium angustifolium, Xanthorrhoea acanthostachya, Xanthorrhoea preissii, Xanthosia huegelii*					

Relevé:	R10	Described by:	Scott Hitchcock		Date:	22/03/2016	Photograph
Location (GDA94):		MGA50	406510	m E	6510054	m N	
Habitat:		Hill (gentle west facing midslope)					
Soil:		Orange-white sandy-clay loose soil (90%)					
Rocks:		Laterite gravel (10%)					
Mapped as:		*CCEm***F** (2)					
Vegetation Type:		Open Tall Forest of *Corymbia calophylla* with Open Mid Shrubland of *Xanthorrhoea preissii* and Isolated Sedges of *Mesomelaena pseudostygia* and *Lepidosperma* ?*costale*					
Vegetation Condition:		2					
Disturbances:		Weeds and previous clearing adjacent to site					
Fire Age:		Old >5 years					
Species:		*Banksia dallanneyi* subsp. *sylvestris*, *Burchardia congesta, Corymbia calophylla, Desmocladus fasciculatus, Eremaea pauciflora* var. *pauciflora*, *Lepidosperma* ?*costale*, *Lomandra caespitosa, Lyginia barbata, Mesomelaena pseudostygia, Patersonia occidentalis* var. *occidentalis*, ***Pentameris airoides* subsp. *airoides*,*** *Podotheca chrysantha, Xanthorrhoea preissii*					

Note: MGA50 = Map Grid of Australia zone 50, GDA94 = Geocentric Datum of Australia 1994, m E = metres east, m N = metres north, P3 and P4 = Priority 3 and Priority 4, * = environmental weed, subsp. = subspecies, var. = variety, sp. = species, ? = query.

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APPENDIX 3: STATISTICAL ANALYSIS INPUTS AND OUTPUTS

Table A3.1: Taxa reconciliations for regional analysis

Gibson *et. al.* (1994)	Maia 2016 (this survey)	Comments on Maia 2016 taxon
Acacia willdenowiana	*Acacia* ?*applanata*	Was included with former in 1994.
Acacia pulchella	*Acacia pulchella* var. ALL	
Adenanthos cygnorum	*Adenanthos cygnorum* subsp. *cygnorum*	
Agrostocrinum scabrum	*Agrostocrinum hirsutum*	Only split off in 2004.
Anigozanthos humilis	*Anigozanthos humilis* subsp. *humilis*	
Stipa compressa	*Austrostipa compressa*	
Baeckea camphorosmae	*Babingtonia camphorosmae*	
Dryandra nivea	*Banksia dallanneyi* subsp. *sylvestris*	
Boronia ramosa	*Boronia ramosa* subsp. *anethifolia*	
Burchardia umbellata	*Burchardia congesta*	
	Cassytha sp.	Deleted
Restio sinuosus scps ms	*Chordifex sinuosus*	
Conostylis aculeata	*Conostylis aculeata* subsp. *cygnorum*	
Conostylis setigera	*Conostylis setigera* subsp. *setigera*	
Eucalyptus calophylla	*Corymbia calophylla*	
Crassula colorata	*Crassula colorata* var. *acuminata*	
Daviesia decurrens	*Daviesia decurrens* subsp. *decurrens*	
Loxocarya fasciculata	*Desmocladus fasciculatus*	
Eremaea pauciflora	*Eremaea pauciflora* var. *pauciflora*	
Eucalyptus marginata	*Eucalyptus marginata* subsp. *thalassica*	
	Haemodorum ?*venosum*	Deleted. *H. venosum* in plot also.
	Haemodorum sp.	Deleted. *H. spicatum* in plot also.
Haemodorum loratum	*Haemodorum* ?*loratum*	Safest option to treat this as *H. loratum*, other than to delete.
Hibbertia hypericoides	*Hibbertia hypericoides* subsp. *hypericoides*	
Hovea trisperma	*Hovea trisperma* var. *trisperma*	
Hypocalymma angustifolium	*Hypocalymma angustifolium* subsp. Dandaragan plateau (S. Patrick 702A)	
Hypochaeris glabra	*Hypochaeris radicata*	Was called *H. glabra* at the time.
Isotropis cuneifolia	*Isotropis cuneifolia* subsp. *cuneifolia*	
Jacksonia densiflora / floribunda complex scps	*Jacksonia floribunda*	
Laxmannia ramosa	*Laxmannia ramosa* subsp. *ramosa*	
Lepidosperma angustatum	*Lepidosperma pubisquameum*	*Lepidosperma* is problematic in SCP 1994 dataset. *L. pubisquameum* is probably either *L. angustatum* or *L. squamatum*. The former was present in about half the SCP plots, the latter only in seven of them. Other than

Gibson *et. al.* (1994)	Maia 2016 (this survey)	Comments on Maia 2016 taxon
		deleting *Lepidosperma*, this would be the safest decision. Often *pubisquameum-angustatum/squamatum* lumped, however, this is just as problematic as it removes an entity from the SCP original dataset.
	Lepidosperma leptostachyum	Left in as it is impossible to tell if it equates to another species in SCP, it is more of a Darling Range species. Its presence independent of the SCP may be valid considering the location of the project area.
Lomandra micrantha	*Lomandra micrantha* subsp. *micrantha*	
Anagallis arvensis	*Lysimachia arvensis*	
Dryandra bipinnatifida	*Banksia bipinnatifida* subsp. *multifida*	
Laxmannia ramosa	*Laxmannia ramosa* subsp. *ramosa*	
Lysinema ciliatum	*Lysinema pentapetalum*	K.R. Thiele in Nuytsia 19:271(2009)
Microtis media	*Microtis media* subsp. *media*	
Orthrosanthus laxus	*Orthrosanthus laxus* var. *laxus*	
Pentaschistis airoides	*Pentameris airoides* subsp. *airoides*	
Pericalymma ellipticum	*Pericalymma ellipticum* var. *ellipticum*	
Petrorhagia velutina	*Petrorhagia dubia*	
Eriostemon spicatus	*Philotheca spicata*	
Pterostylis aff. *nana* SCP GJK/NG 1867cbs	*Pterostylis* sp. cauline leaves (N. Gibson & M.N. Lyons 1490)	*P.* '*nana*' were lumped under this in the SCP data (80 sites).
Danthonia occidentalis	*Rytidosperma occidentale*	
	Pithocarpa sp.	Q2. Deleted. Unless likely to be *P. pulchella* (no other species in SCP dataset)
Stackhousia monogyna	*Stackhousia pubescens*	
Stylidium diuroides	*Stylidium diuroides* subsp. *diuroides*	
Thysanotus sp. *manglesianus/patersonii* scps	*Thysanotus patersonii*	
Ursinia anthemoides	*Ursinia anthemoides* subsp. *anthemoides*	
Waitzia suaveolens	*Waitzia suaveolens* var. *suaveolens*	
Wahlenbergia preissii	*Wahlenbergia gracilenta*	Retained but may have been the same.
Mitrasacme paradoxa	*Phyllangium divergens*	Highly likely to be *Mitrasacme paradoxa*.

Table A3.2: Local analysis site by species matrix

Taxa	Q01	Q02	Q03	Q04	Q05	Q06	Q07	Q08	Q09
	*Et***MWL** (1)	*EmCc***F** (2)	*CcEm***F** (3)	*Et***MWL** (1)	*CcEm***F** (3)	*CcEm***F** (3)	*CcEm***F** (3)	*EmCc***F** (2)	*Et***MWL** (1)
Acacia ?applanata	0	0	0	1	0	0	1	0	1
Acacia drummondii subsp. *affinis*	0	1	0	0	0	1	0	0	0
Acacia pulchella var. *reflexa*	1	1	0	0	0	0	0	1	1
Alexgeorgea nitens	0	0	0	1	1	1	1	0	1
Anigozanthos humilis subsp. *humilis*	1	0	0	1	0	1	1	0	1
Astroloma xerophyllum	0	0	0	0	0	0	1	1	0
Austrostipa compressa	1	0	0	1	1	1	0	1	1
Banksia attenuata	1	0	0	0	0	0	0	0	1
Banksia bipinnatifida subsp. *multifida*	0	1	1	0	0	1	0	1	0
Banksia dallanneyi subsp. *sylvestris*	0	1	0	0	0	0	1	1	0
Bossiaea eriocarpa	1	1	1	0	0	1	0	0	0
Burchardia congesta	1	0	0	1	1	1	1	0	1
Caesia micrantha	0	0	1	0	0	1	0	0	0
Caladenia flava	0	0	1	1	1	1	0	0	1
Cassytha racemosa	1	1	0	1	0	0	0	1	1
Centrolepis drummondiana	0	0	1	0	0	1	1	0	0
Chamaescilla corymbosa	0	1	0	0	1	0	1	1	0
Conostephium pendulum	0	0	1	0	0	1	0	0	0
Conostylis setigera subsp. *setigera*	0	1	0	0	0	1	0	0	1
Corymbia calophylla	0	1	1	0	1	1	1	0	0
Crassula colorata var. *acuminata*	0	0	1	0	0	1	1	1	1
Daviesia decurrens subsp. *decurrens*	0	1	0	0	0	1	0	1	0
Daviesia triflora	0	0	0	0	0	0	0	1	1
Desmocladus fasciculatus	0	1	0	1	1	1	1	1	0
Drosera erythrorhiza	1	0	1	1	1	1	0	0	1
Drosera menziesii subsp. *penicillaris*	0	0	0	0	0	0	1	0	1
Eremaea pauciflora var. *pauciflora*	1	0	0	1	0	0	0	0	1
Eucalyptus marginata subsp. *thalassica*	0	1	1	0	0	0	1	1	0
Eucalyptus todtiana	1	0	0	1	0	0	0	0	1
Gompholobium knightianum	0	1	0	0	1	0	1	1	0
Gompholobium preissii	1	0	1	1	0	0	1	0	0
Haemodorum spicatum	0	0	0	1	0	0	1	0	1
Haemodorum venosum	0	1	0	0	0	0	0	1	0
Hibbertia commutata	0	1	0	0	0	0	0	1	0
Hibbertia huegelii	0	1	0	0	1	0	1	0	1
Hibbertia hypericoides subsp. *hypericoides*	1	1	1	1	1	1	1	1	1
Hibbertia subvaginata	1	0	0	1	0	0	0	0	0
Jacksonia floribunda	0	0	0	1	0	0	0	0	1
Lechenaultia biloba	0	1	0	0	1	0	0	1	0
Lepidosperma leptostachyum	0	0	0	1	0	0	0	0	1
Lepidosperma pubisquameum	0	1	1	0	1	0	0	1	0
Levenhookia stipitata	1	0	0	0	0	0	1	1	1
Lomandra caespitosa	1	0	0	1	0	1	1	0	1
Lomandra micrantha subsp. *micrantha*	0	0	0	1	1	0	0	0	0
Lomandra sericea	1	1	1	1	1	1	1	0	0
Melaleuca trichophylla	1	0	0	1	1	0	1	0	1
Mesomelaena pseudostygia	1	0	0	0	1	1	1	0	1
Microtis media subsp. media	0	0	0	0	1	1	1	0	0
Neurachne alopecuroidea	1	1	0	0	1	1	0	1	0
Petrophile linearis	0	0	0	1	0	0	1	0	1

Taxa	Q01	Q02	Q03	Q04	Q05	Q06	Q07	Q08	Q09
	*Et***MWL** (1)	*EmCc***F** (2)	*CcEm***F** (3)	*Et***MWL** (1)	*CcEm***F** (3)	*CcEm***F** (3)	*CcEm***F** (3)	*EmCc***F** (2)	*Et***MWL** (1)
Philotheca spicata	1	0	0	0	1	0	0	0	0
Podotheca gnaphalioides	1	1	1	1	1	1	0	0	1
Poranthera microphylla	1	1	0	0	0	1	1	1	0
Pterostylis sp. cauline leaves (N. Gibson & M.N. Lyons 1490)	0	0	1	0	0	0	1	0	0
Ptilotus stirlingii	0	1	0	0	0	0	0	1	0
Rytidosperma occidentale	0	1	0	0	0	0	1	0	0
Siloxerus filifolius	0	0	0	0	0	0	1	0	1
Stirlingia latifolia	0	0	0	1	0	0	1	0	1
Stylidium calcaratum	0	0	1	0	0	1	0	0	0
Stylidium ciliatum	0	1	0	0	0	0	0	1	0
Synaphea aephynsa	0	1	0	0	0	0	0	1	0
Trachymene pilosa	1	1	0	0	0	0	0	1	1
Tricoryne elatior	0	1	1	0	1	1	1	1	1
Waitzia suaveolens var. *suaveolens*	0	1	0	0	0	0	0	1	0
Xanthorrhoea acanthostachya	0	1	0	0	0	0	0	1	0
Xanthorrhoea preissii	0	1	1	0	1	1	1	1	1

Note: 1 = present, 0 = absent.

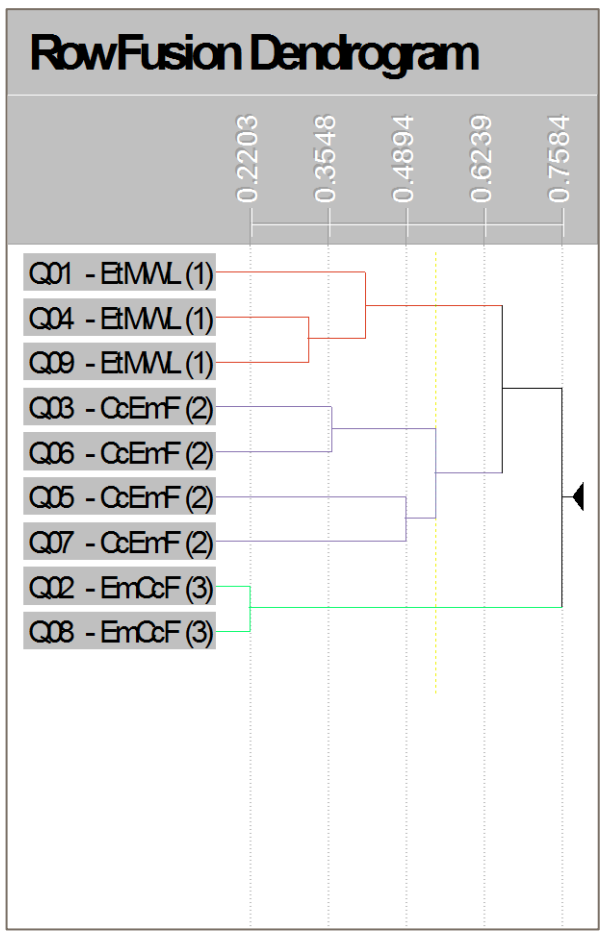

Figure A3.1: Dendrogram produced by PATN analysis of local area data

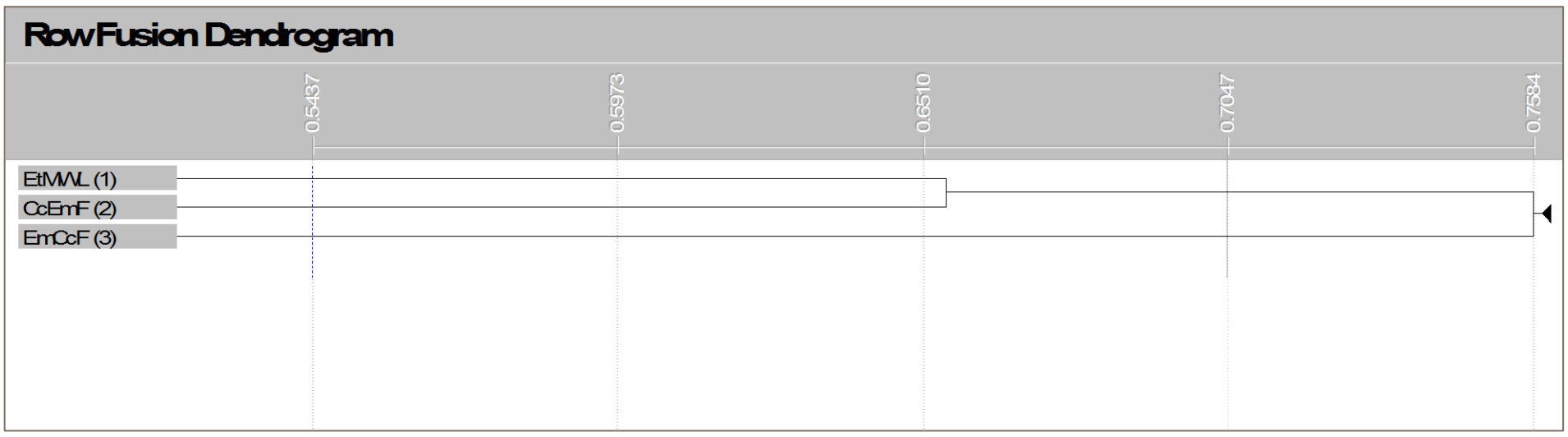

Figure A3.2: Group dendrogram produced by PATN analysis of local area data

```
Recipe of analysis to be performed on    at  08:51:58, January 24, 2017


Analysis based on rows -
    Association Measure: Bray Curtis
    Classification Strategy: Agglomerative Hierarchical Fusion
        Technique: Flexible UPGMA
        Beta: -0.1000
        Number of groups to produce: 3
    Ordination Method: SSH
        CutOff = 0.900
        3 Dimensions
        Number of random starts: 10
        Max iterations: 50
        Random Seed Value: 1235

Analysis based on columns -
    Association Measure: Bray Curtis
    Classification Strategy: Agglomerative Hierarchical Fusion
        Technique: Flexible UPGMA
        Beta: -0.1000
        Number of groups to produce: 9
```

Figure A3.3: PATN recipe used in local area pattern analyses

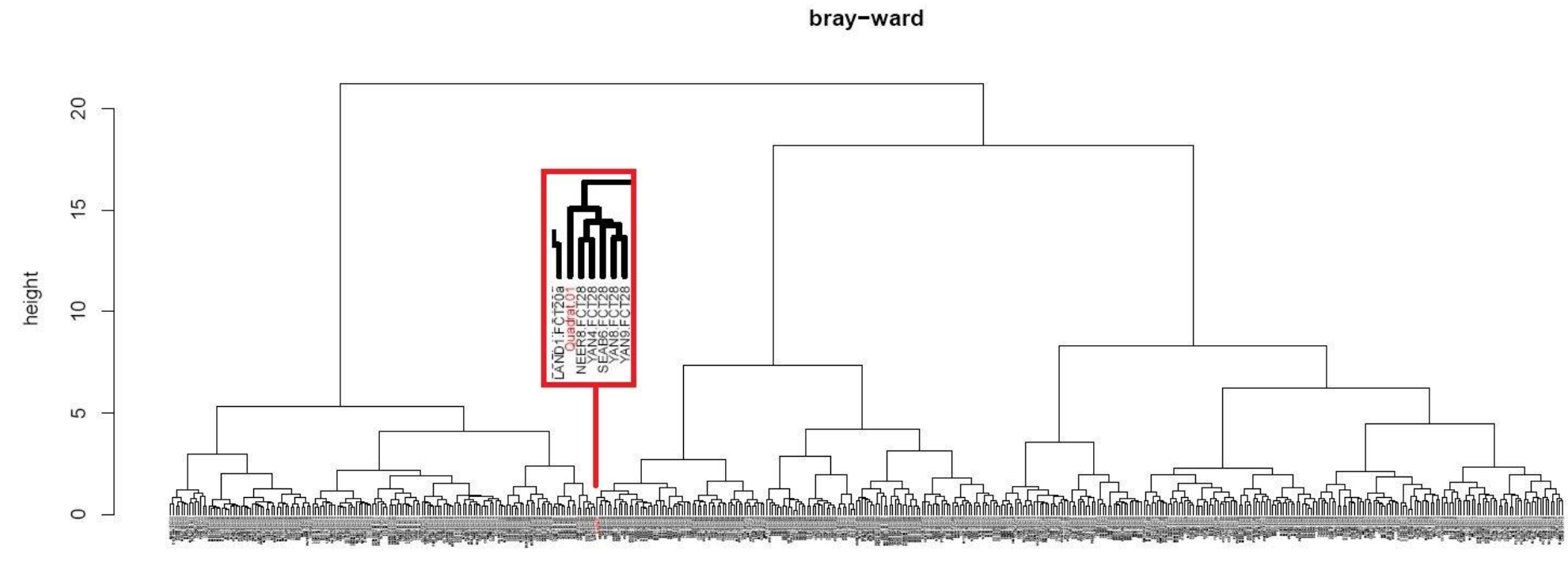

Figure A3.4: Regional analysis dendrogram Q01

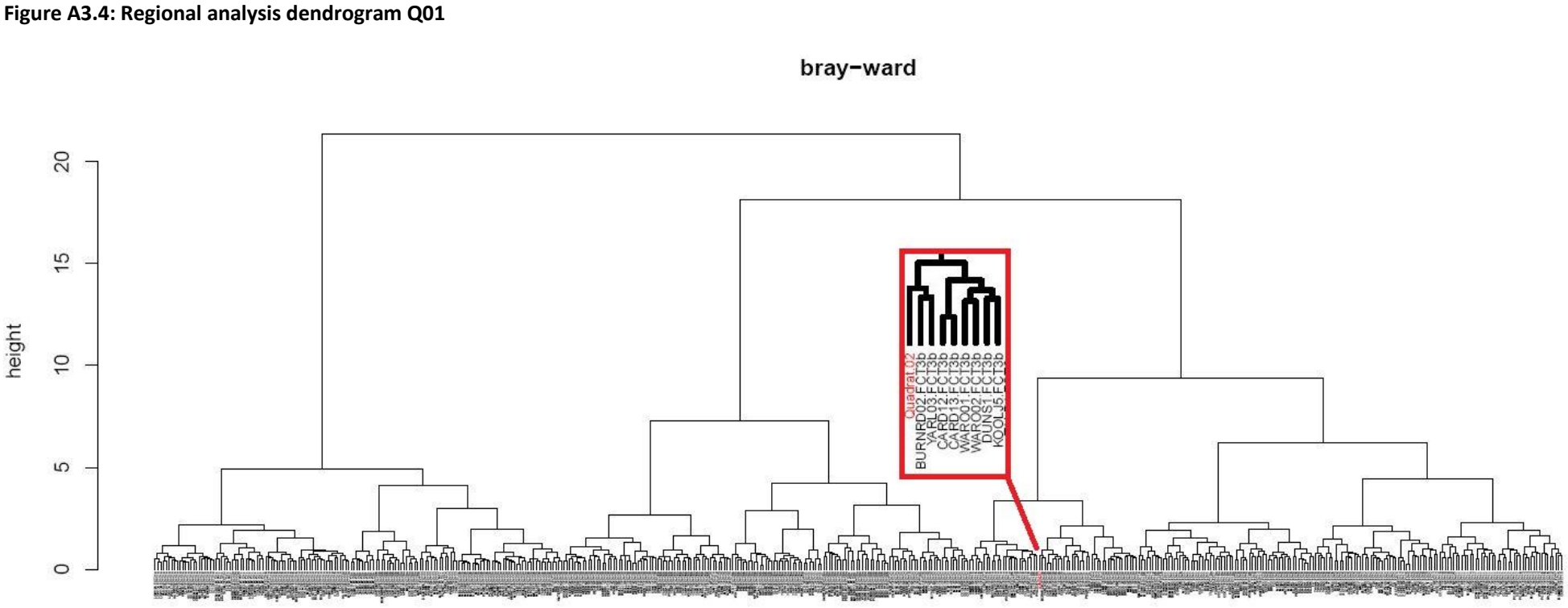

Figure A3.5: Regional analysis dendrogram Q02

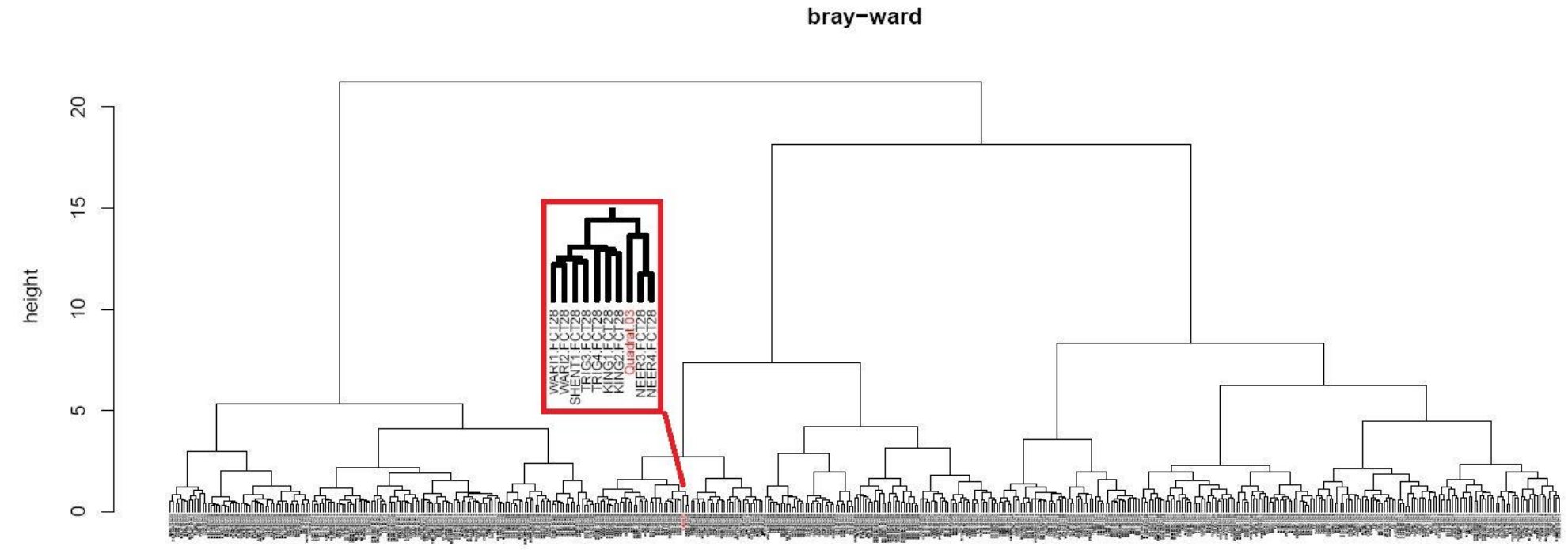

Figure A3.6: Regional analysis dendrogram Q03

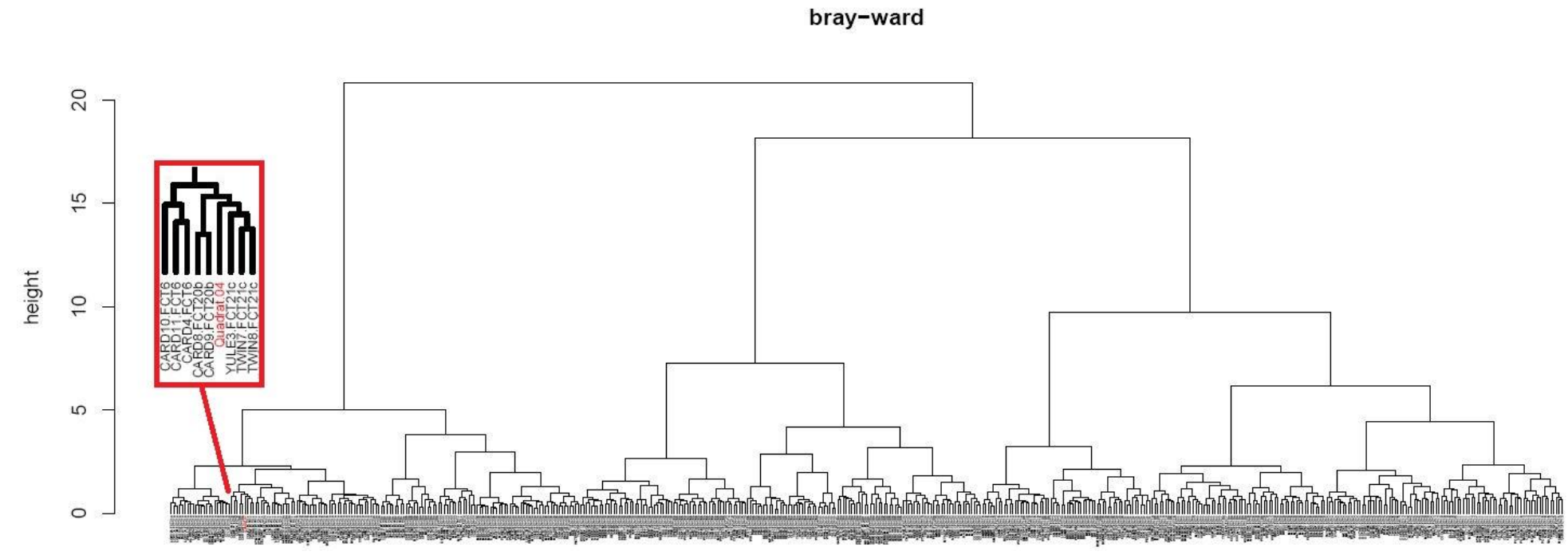

Figure A3.7: Regional analysis dendrogram Q04

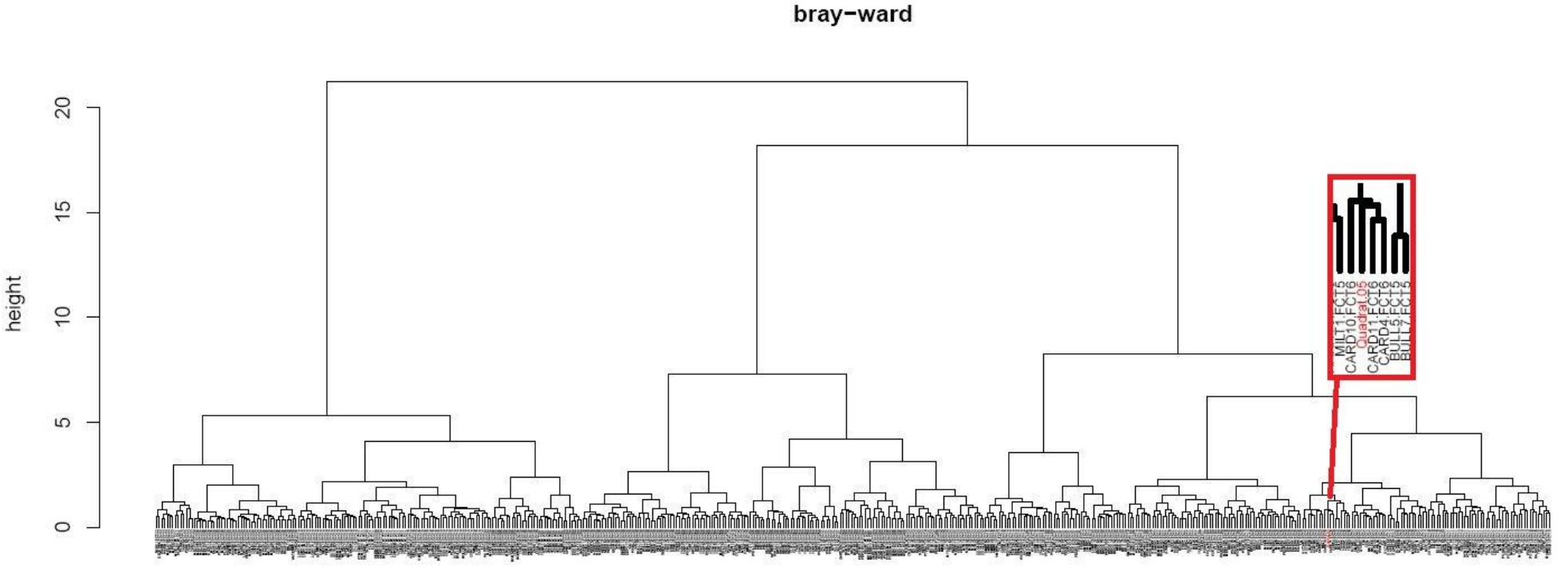

Figure A3.8: Regional analysis dendrogram Q05

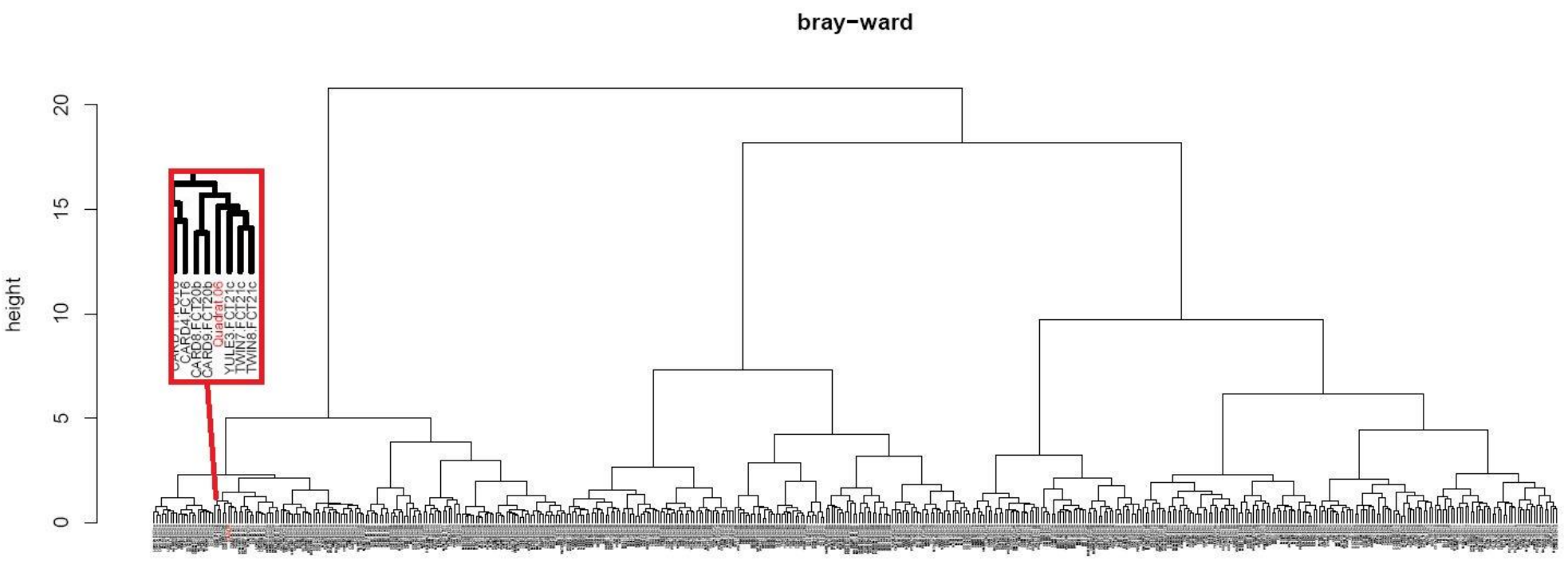

Figure A3.9: Regional analysis dendrogram Q06

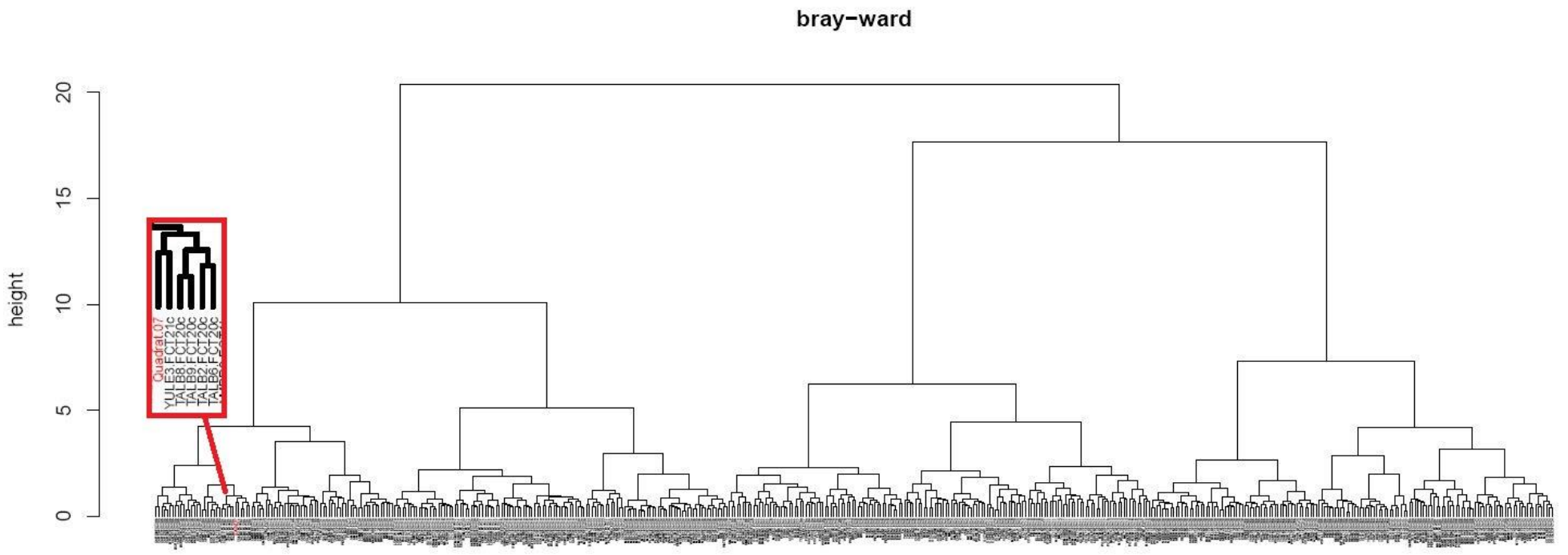

Figure A3.10: Regional analysis dendrogram Q07

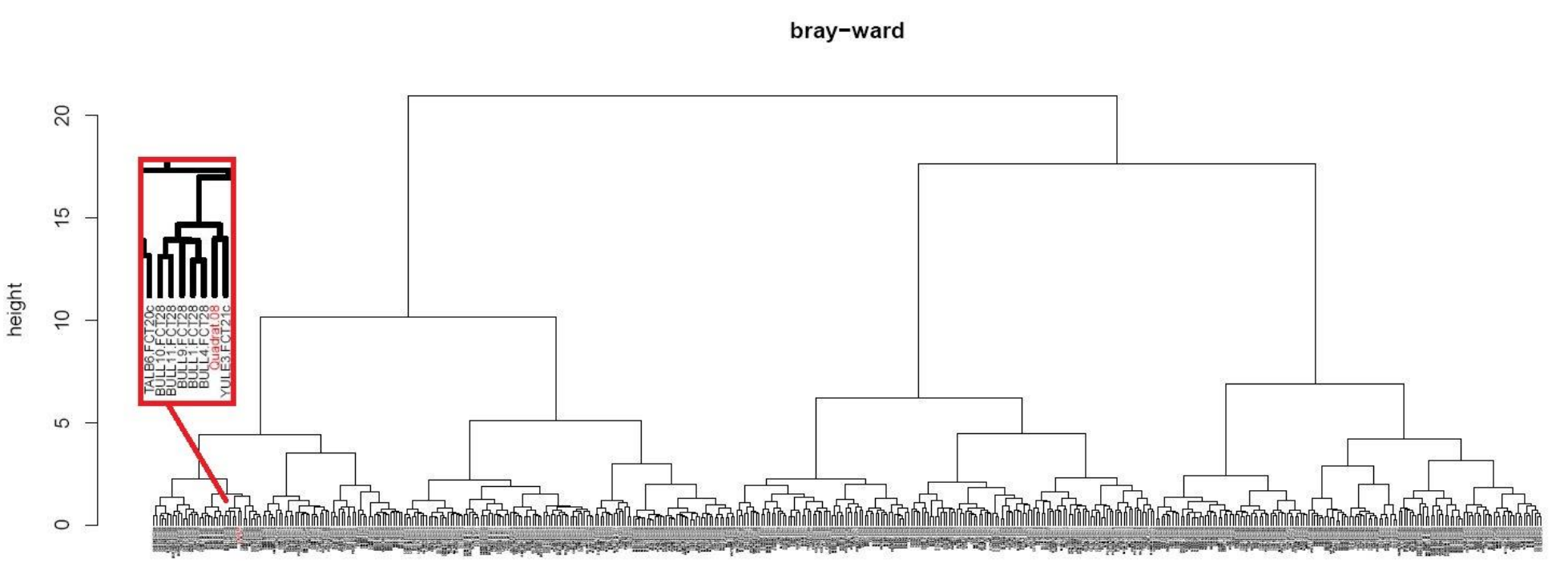

Figure A3.11: Regional analysis dendrogram Q08

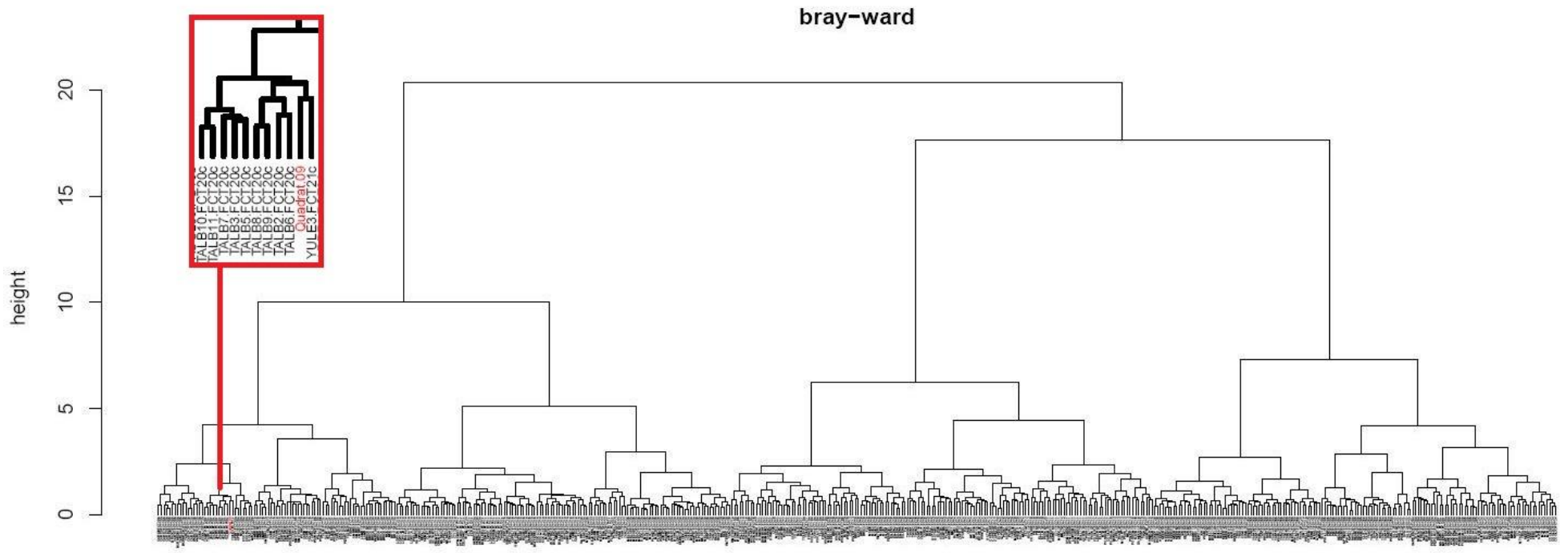

Figure A3.12: Regional analysis dendrogram Q09

APPENDIX 4: NATIONAL VEGETATION INFORMATION SYSTEM VEGETATION CLASSIFICATION

Table A4.1: NVIS growth forms and descriptions

Growth Form	Description
Tree	Woody plants, more than 2m tall with a single stem or branches well above the base.
Tree Mallee	Woody perennial plant usually of the genus *Eucalyptus*. Multi-stemmed with fewer than 5 trunks of which at least 3 exceed 100 mm at breast height (1.3 m). Usually 8 m or more in height.
Shrub	Woody plants multi-stemmed at the base (or within 200 mm from ground level) or if single stemmed, less than 2 m in height.
Mallee Shrub	Commonly less than 8 m tall, usually with 5 or more trunks, of which at least 3 of the largest do not exceed 100 mm at breast height (1.3 m).
Heath Shrub	Shrub usually less than 2 m, with sclerophyllous leaves having high fibre: protein ratios and with an area of nanophyll or smaller (less than 225 sq. m.). Often a member of the following families: Epacridaceae, Myrtaceae, Fabaceae and Proteaceae. Commonly occur in nutrient-poor substrates.
Chenopod Shrub	Single or multi-stemmed, semi-succulent shrub of the family Chenopodiaceae exhibiting drought and salt tolerance.
Samphire Shrub	Genera (of Tribe Salicornioideae, viz: *Halosarcia*, *Pachycornia, Sarcocornia*, *Sclerostegia*, *Tecticornia* and *Tegicornia*) with articulate branches, fleshy stems and reduced flowers within the Chenopodiaceae family, succulent chenopods. Also genus *Suaeda*.
Tussock Grass	Forms discrete but open tussocks usually with distinct individual shoots, or if not, then forming a hummock. These are common agricultural grasses.
Hummock Grass	Coarse xeromorphic grass with a mound-like form often dead in the middle; genera are *Triodia* and *Plectrachne*.
Sedge	Herbaceous, usually perennial erect plant generally with a tufted habit and of the families Cyperaceae (true sedges) or Restionaceae (node sedges).
Rush	Herbaceous, usually perennial erect monocot that is neither a grass nor sedge. For the purposes of NVIS, rushes include the monocotyledon families Juncaceae, Typhaceae, Liliaceae, Iridaceae, Xyridaceae and the genus *Lomandra* (i.e. "graminoid" or grass-like genera).
Forb	Herbaceous or slightly woody, annual or sometimes perennial plant (usually a dicotyledon).
Grass-tree	Australian grass trees. Members of the family Xanthorrhoeaceae.
Cycad	Members of the families Cycadaceae and Zamiaceae.

Table A4.2: Height classes defined for the NVIS

Height Classes	Height Range (m)	Tree	Shrub, Heath Shrub, Chenopod Shrub, Samphire Shrub, Cycad, Grass-tree	Tree Mallee, Mallee Shrub	Tussock Grasses, Sedges, Rushes and Forbs
8	**>30**	tall			
7	**10-30**	mid		tall	
6	**<10**	low		mid	
5	**<3**			low	
4	**>2**		tall		tall

Height Classes	Height Range (m)	Tree	Shrub, Heath Shrub, Chenopod Shrub, Samphire Shrub, Cycad, Grass-tree	Tree Mallee, Mallee Shrub	Tussock Grasses, Sedges, Rushes and Forbs
3	**1-2**		mid		tall
2	**0.5-1**		low		mid
1	**<0.5**		low		low

Table A4.3: NVIS structural formation terminology

Growth Form	Height (m)	Foliage Cover (%)					
		>70	**30-70**	**10-30**	**2-10**	**<2 (isolated)**	**<2 (isolated clump)**
Tree	**<10,10-30, >30**	Closed Forest	Open Forest	Woodland	Open Woodland	Isolated Trees	Isolated Clumps Of Trees
Tree Mallee	**<3, <10, 10-30**	Closed Mallee Forest	Open Mallee Forest	Mallee Woodland	Open Mallee Woodland	Isolated Mallee Trees	Isolated Clumps Of Mallee Trees
Shrub	**<1,1-2,>2**	Closed Shrubland	Shrubland	Open Shrubland	Sparse Shrubland	Isolated Shrubs	Isolated Clumps Of Shrubs
Mallee Shrub	**<3, <10, 10-30**	Closed Mallee Shrubland	Mallee Shrubland	Open Mallee Shrubland	Sparse Mallee Shrubland	Isolated Mallee Shrubs	Isolated Clumps Of Mallee Shrubs
Heath Shrub	**<1,1-2,>2**	Closed Heathland	Heathland	Open Heathland	Sparse Heathland	Isolated Heath Shrubs	Isolated Clumps Of Heath Shrubs
Chenopod Shrub	**<1,1-2,>2**	Closed Chenopod Shrubland	Chenopod Shrubland	Open Chenopod Shrubland	Sparse Chenopod Shrubland	Isolated Chenopod Shrubs	Isolated Clumps Of Chenopod Shrubs
Samphire Shrub	**<0.5,>0.5**	Closed Samphire Shrubland	Samphire Shrubland	Open Samphire Shrubland	Sparse Samphire Shrubland	Isolated Samphire Shrubs	Isolated Clumps Of Samphire Shrubs
Hummock Grass	**<2,>2**	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Sparse Hummock Grassland	Isolated Hummock Grasses	Isolated Clumps Of Hummock Grasses
Tussock Grass	**<0.5,>0.5**	Closed Tussock Grassland	Tussock Grassland	Open Tussock Grassland	Sparse Tussock Grassland	Isolated Tussock Grasses	Isolated Clumps Of Tussock Grasses
Sedge	**<0.5,>0.5**	Closed Sedgeland	Sedgeland	Open Sedgeland	Sparse Sedgeland	Isolated Sedges	Isolated Clumps Of Sedges
Rush	**<0.5,>0.5**	Closed Rushland	Rushland	Open Rushland	Sparse Rushland	Isolated Rushes	Isolated Clumps Of Rushes
Forb	**<0.5,>0.5**	Closed Forbland	Forbland	Open Forbland	Sparse Forbland	Isolated Forbs	Isolated Clumps Of Forbs

Source: **Tables A4.1 to A4.3** from ESCAVI (2003).

APPENDIX 5: CONSERVATION SIGNIFICANCE (FLORA AND ECOLOGICAL COMMUNITIES)

Table A5.1: Criteria for listing threatened species (DotEE, 2016c) – EPBC Act

Criteria for listing species in the critically endangered, endangered or vulnerable categories			
Criterion	**Critically Endangered**	**Endangered**	**Vulnerable**
1. It has undergone, is suspected to have undergone or is likely to undergo in the immediate future:	a very severe reduction in numbers	a severe reduction in numbers	a substantial reduction in numbers
2. Its geographic distribution is precarious for the survival of the species and is:	very restricted	restricted	limited
3. The estimated total number of individuals is:	very low	low	limited
And either of (a) or (b) is true:			
a) Evidence suggests that the number will continue to decline at: **b) The number is likely to continue to decline and its geographic distribution is:**	A very high rate Precarious for its survival	A high rate Precarious for its survival	A substantial rate Precarious for its survival
4. The estimated total number of mature individuals is:	extremely low	very low	low
5. The probability of its extinction in the wild is at least:	50% in the immediate future	20% in the near future	10% in the medium-term future

Eligibility for listing species in the extinct, extinct in the wild, or conservation dependent categories	
Category	**Definition**
Extinct*	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: a) it is only known to survive in cultivation, in captivity or as a naturalized population well outside its past range; or b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Conservation dependent*	A native species is eligible to be included in the conservation dependent category if, at that time: a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; **or** b) the following subparagraphs are satisfied; I. the species is a species of fish; II. the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; III. the plan of management is in force under a law of the Commonwealth or of a State or Territory; IV. cessation of the plan of management would adversely affect the conservation status of the species.
*Note: Species listed as 'conservation dependent' and 'extinct' are not matters of national environmental significance and therefore do not trigger the EPBC Act.	

Table A5.2: Categories and definitions for threatened (declared rare) flora and fauna (DPaW, 2015) – WC Act

Code	Definition
T	**Threatened species** Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora). **Threatened fauna** is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act. **Threatened flora** is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	**Critically endangered species** Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EN	**Endangered species** Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
VU	**Vulnerable species** Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.
EX	**Presumed extinct species** Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
IA	**Migratory birds protected under an international agreement** Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.
CD	**Conservation dependent fauna** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.
OS	**Other specially protected fauna** Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Table A5.3: Categories and definitions for priority species (DPaW, 2015)

Code	Definition
P	**Priority species** Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**Priority One: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
2	**Priority Two: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
3	**Priority Three: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
4	**Priority Four: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any intraspecific category i.e. subspecies or variety, or a distinct population).	

Table A5.4: Criteria for listing threatened ecological communities (TECs) under the EPBC Act (Austlii, 2016)

Criteria for listing species in the critically endangered, endangered or vulnerable categories				
Item	**Criterion**	**Category**		
		Critically Endangered	**Endangered**	**Vulnerable**
1	Its decline in geographic distribution is:	Very severe	severe	substantial
2	Its geographic distribution is: and the nature of its distribution makes it likely that the action of a threatening process could cause it to be lost in:	Very restricted The immediate future	Restricted The near future	Limited The medium-term future
3	For a population of a native species that is likely to play a major role in the community, there is a: to the extent that restoration of the community is not likely to be possible in:	Very severe decline The immediate future	Severe decline The near future	Substantial decline The medium-term future
4	The reduction in its integrity across most of its geographic distribution is: As indicated by degradation of the community or its habitat, or disruption of important community processes that is:	Very severe Very severe	Severe severe	Substantial substantial
5	Its rate of continuing detrimental change is: As indicated by: a) A rate of continuing decline in its geographic distribution, or a population of a native species that is believed to play a major role in the community, that is: Or b) Intensification, across most of its geographic distribution, in degradation, or disruption of important community processes, that is:	Very severe Very severe Very severe	Severe Severe Severe	Substantial Substantial Serious
6	A quantitative analysis shows that its probability of extinction, or extreme degradation over all of its geographic distribution is:	At least 50% in the immediate future	At least 20% in the near future	At least 10% in the medium-term future

Table A5.5: Categories, definitions and criteria for threatened ecological communities (TECs) (DEC, 2013)

Category	Definition and Criteria
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats; or B) All occurrences recorded within the last 50 years have since been destroyed.
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii): (i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); (ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
Critically Endangered (CR)	B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii): (i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); (ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; (iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B, or C): A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): (i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); (ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

Category	Definition and Criteria
Endangered (EN)	B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii): (i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); (ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; (iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as **Vulnerable** when it 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. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. 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.

Table A5.6: Categories, definitions and criteria for priority ecological communities (PECs) (DEC, 2013)

Category	Definition and Criteria
Priority One: Poorly-known ecological communities	Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Category	Definition and Criteria
Priority Two: Poorly-known ecological communities	Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat 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.
Priority Three: Poorly-known ecological communities	(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring.	(a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five: Conservation Dependent ecological communities	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX 6: DECLARED PESTS CATEGORIES AND CONTROLS

Table A6.1: Control categories for declared pests (DAFWA, 2017b)

Category (C)	Definition
C1 (Exclusion)	Organisms which should be excluded from part or all of Western Australia.
C2 (Eradication)	Organisms which should be eradicated from part or all of Western Australia.
C3 (Management)	Organisms that should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
Unassigned	Unassigned: Declared pests that are recognised as having a harmful impact under certain circumstances, where their subsequent control requirements are determined by a Plan or other legislative arrangements under the Act.

APPENDIX 7: SPECIES LIST AND SPECIES ACCUMULATION ANALYSIS

Table A7.1: Vascular flora of the Survey Area

Family	Taxa	March			October		
		R	OC	FlFr	Q	OC	FlFr
Amaranthaceae	*Ptilotus manglesii*	•			•		Fl
Amaranthaceae	*Ptilotus stirlingii*				•		Fl
Anarthriaceae	*Lyginia barbata*	•	•	Fr	•		Fr
Anarthriaceae	*Lyginia imberbis*					•	Fr
Apiaceae	*Xanthosia huegelii*	•					
Araliaceae	*Trachymene pilosa*				•		Fl
Asparagaceae	*Chamaescilla corymbosa*				•		Fl
Asparagaceae	*Laxmannia ramosa* subsp. *ramosa*				•		Fr
Asparagaceae	*Laxmannia squarrosa*					•	Fl
Asparagaceae	*Lomandra caespitosa*	•			•		
Asparagaceae	*Lomandra hermaphrodita*				•		
Asparagaceae	*Lomandra micrantha* subsp. *micrantha*				•		
Asparagaceae	*Lomandra sericea*		•		•		
Asparagaceae	*Thysanotus patersonii*				•		Fl
Asteraceae	***Arctotheca calendula****		•	Fl		•	Fl
Asteraceae	*Blennospora drummondii*				•		Fl
Asteraceae	*Hyalosperma cotula*				•		Fl
Asteraceae	***Hypochaeris glabra****				•		Fl
Asteraceae	***Hypochaeris radicata****				•		
Asteraceae	*Pithocarpa pulchella* var. *pulchella*					•	Fl
Asteraceae	*Pithocarpa* sp.				•		
Asteraceae	*Podotheca angustifolia*				•		Fl
Asteraceae	*Podotheca chrysantha*	•					
Asteraceae	*Podotheca gnaphalioides*				•		Fl
Asteraceae	*Siloxerus filifolius*				•	•	Fl
Asteraceae	***Sonchus oleraceus****				•		Fl
Asteraceae	*Trichocline spathulata*					•	
Asteraceae	***Ursinia anthemoides* subsp. *anthemoides****				•		Fl
Asteraceae	***Ursinia anthemoides****				•		Fl
Asteraceae	*Waitzia suaveolens* var. *suaveolens*				•		Fl
Campanulaceae	*Isotoma hypocrateriformis*					•	Fl
Campanulaceae	*Isotoma scapigera*					•	Fl
Campanulaceae	***Wahlenbergia capensis****				•		Fl
Campanulaceae	*Wahlenbergia gracilenta*				•		Fl
Caryophyllaceae	***Petrorhagia dubia****				•		Fl
Casuarinaceae	*Allocasuarina humilis*		•	Fr	•		
Celastraceae	*Stackhousia pubescens*				•	•	Fl
Celastraceae	*Tripterococcus brunonis*					•	
Centrolepidaceae	*Centrolepis drummondiana*				•		
Colchicaceae	*Burchardia congesta*	•		Fl	•		Fl
Crassulaceae	*Crassula colorata* var. *acuminata*				•		FlFr
Cyperaceae	*Caustis dioica*	•		Fr			
Cyperaceae	*Cyathochaeta avenacea*				•		

Family	Taxa	March			October		
		R	OC	FlFr	Q	OC	FlFr
Cyperaceae	*Cyathochaeta equitans*		•			•	
Cyperaceae	*Lepidosperma ?costale*	•					
Cyperaceae	*Lepidosperma leptostachyum*				•		
Cyperaceae	*Lepidosperma pubisquameum*				•		FlFr
Cyperaceae	*Mesomelaena pseudostygia*	•		Fr	•		Fr
Cyperaceae	*Mesomelaena tetragona*				•		Fr
Dasypogonaceae	*Calectasia* sp.					•	
Dasypogonaceae	*Dasypogon bromeliifolius*	•	•	FlFr			
Dilleniaceae	*Hibbertia commutata*	•	•	FlFr	•		FlFr
Dilleniaceae	*Hibbertia huegelii*	•	•	Fr	•		
Dilleniaceae	*Hibbertia hypericoides* subsp. *hypericoides*	•	•	Fl	•		
Dilleniaceae	*Hibbertia subvaginata*	•			•		
Droseraceae	*Drosera barbigera*				•		Fl
Droseraceae	*Drosera erythrorhiza*				•		
Droseraceae	*Drosera glanduligera*				•	•	FlFr
Droseraceae	*Drosera menziesii* subsp. *penicillaris*				•		Fl
Droseraceae	*Drosera pallida*					•	
Elaeocarpaceae	*Tetratheca nuda*				•		Fl
Ericaceae	*Astroloma pallidum*				•		Fl
Ericaceae	*Astroloma xerophyllum*		•	Fl	•		Fr
Ericaceae	*Conostephium pendulum*	•		Fl	•		
Ericaceae	*Leucopogon conostephioides*	•		Fl			
Ericaceae	*Leucopogon propinquus*		•	Fl			
Ericaceae	*Lysinema pentapetalum*	•			•		
Euphorbiaceae	*Monotaxis grandiflora*				•		Fr
Fabaceae	*Acacia ?applanata*				•		
Fabaceae	***Acacia drummondii* subsp. *affinis* (P3)**				•		
Fabaceae	*Acacia huegelii*		•				
Fabaceae	*Acacia lateriticola*	•	•				
Fabaceae	*Acacia pulchella* var. *reflexa*	•		Fl	•		
Fabaceae	*Bossiaea eriocarpa*	•			•		Fl
Fabaceae	*Daviesia angulata*		•	Fl			
Fabaceae	*Daviesia decurrens* subsp. *decurrens*	•			•		Fl
Fabaceae	*Daviesia hakeoides* subsp. *subnuda*	•	•			•	
Fabaceae	*Daviesia incrassata* subsp. *incrassata*	•					
Fabaceae	*Daviesia nudiflora* subsp. *nudiflora*	•					
Fabaceae	*Daviesia triflora*	•			•		Fr
Fabaceae	*Gompholobium confertum*		•				
Fabaceae	*Gompholobium knightianum*	•			•		Fr
Fabaceae	*Gompholobium marginatum*				•		
Fabaceae	*Gompholobium preissii*				•		Fr
Fabaceae	*Gompholobium tomentosum*	•	•	Fl			
Fabaceae	*Hovea trisperma* var. *trisperma*				•		Fr
Fabaceae	*Isotropis cuneifolia* subsp. *cuneifolia*				•		Fr
Fabaceae	*Jacksonia floribunda*	•		Fl	•		
Fabaceae	*Labichea lanceolata* subsp. *lanceolata*	•			•		Fl
Fabaceae	***Ornithopus compressus****				•	•	FlFr
Geraniaceae	***Erodium botrys****				•		Fr
Geraniaceae	***Pelargonium capitatum****					•	Fl

Family	Taxa	March			October		
		R	OC	FlFr	Q	OC	FlFr
Goodeniaceae	*Dampiera linearis*				•		Fl
Goodeniaceae	*Lechenaultia biloba*	•	•		•	•	Fl
Goodeniaceae	*Scaevola phlebopetala*				•	•	Fl
Haemodoraceae	*Anigozanthos humilis* subsp. *humilis*				•		Fl
Haemodoraceae	*Conostylis aculeata*	•		Fl			
Haemodoraceae	*Conostylis aculeata* subsp. *cygnorum*				•		Fl
Haemodoraceae	*Conostylis setigera* subsp. *setigera*				•		FlFr
Haemodoraceae	*Haemodorum laxum*				•		Fl
Haemodoraceae	***Haemodorum loratum* (P3)**					•	Fl
Haemodoraceae	***Haemodorum ?loratum* (potential P3)**				•		
Haemodoraceae	*Haemodorum* sp.				•		
Haemodoraceae	*Haemodorum spicatum*				•		Fl
Haemodoraceae	*Haemodorum venosum*				•		Fl
Haemodoraceae	*Haemodorum ?venosum*				•		
Haloragaceae	*Gonocarpus cordiger*	•					
Hemerocallidaceae	*Agrostocrinum hirsutum*					•	Fl
Hemerocallidaceae	*Caesia micrantha*				•		Fr
Hemerocallidaceae	*Corynotheca micrantha* var. *micrantha*		•	Fl			
Hemerocallidaceae	*Johnsonia acaulis*				•		Fr
Hemerocallidaceae	*Tricoryne elatior*				•	•	Fl
Hemerocallidaceae	*Tricoryne tenella*		•	Fl			
Iridaceae	***Gladiolus caryophyllaceus****				•		Fl
Iridaceae	*Orthrosanthus laxus* var. *laxus*				•		
Iridaceae	*Patersonia occidentalis* var. *occidentalis*	•					
Iridaceae	***Romulea rosea****				•		Fr
Juncaceae	*Juncus pallidus*		•	Fr			
Lamiaceae	*Hemiandra linearis*					•	Fl
Lauraceae	*Cassytha racemosa*	•		Fl	•		
Lauraceae	*Cassytha* sp.				•		
Loganiaceae	*Phyllangium divergens*				•		Fl
Loranthaceae	*Nuytsia floribunda*	•	•				
Molluginaceae	*Macarthuria australis*					•	Fl
Myrtaceae	*Babingtonia camphorosmae*		•	Fl			
Myrtaceae	*Calothamnus sanguineus*	•	•	FlFr			
Myrtaceae	*Calytrix flavescens*	•		Fl			
Myrtaceae	*Corymbia calophylla*	•	•	Fr	•		
Myrtaceae	*Eremaea pauciflora* var. *pauciflora*	•		Fr	•		Fr
Myrtaceae	*Eucalyptus marginata* subsp. *thalassica*	•	•	Fr	•		
Myrtaceae	*Eucalyptus todtiana*	•	•	FlFr	•		
Myrtaceae	*Hypocalymma angustifolium* subsp. Dandaragan plateau (S. Patrick 702A)		•		•		Fl
Myrtaceae	*Kunzea glabrescens*		•	Fr		•	Fl
Myrtaceae	*Melaleuca lateritia*	•					
Myrtaceae	*Melaleuca trichophylla*	•	•	FlFr	•		Fr
Myrtaceae	*Melaleuca viminea* subsp. *viminea*		•	Fr			
Myrtaceae	*Pericalymma ellipticum*		•	Fr			
Myrtaceae	*Pericalymma ellipticum* var. *ellipticum*				•		Fl
Myrtaceae	*Scholtzia involucrata*	•	•	Fl			
Myrtaceae	*Verticordia densiflora* var. *cespitosa*					•	Fl

Family	Taxa	March			October		
		R	OC	FlFr	Q	OC	FlFr
Myrtaceae	*Verticordia densiflora* var. *densiflora*		•	Fl		•	
Orchidaceae	*Caladenia flava*				•	•	Fl
Orchidaceae	*Caladenia marginata*					•	Fl
Orchidaceae	*Microtis media* subsp. *media*				•		Fl
Orchidaceae	*Pterostylis* sp. cauline leaves (N. Gibson & M.N. Lyons 1490)				•		Fl
Orchidaceae	*Thelymitra campanulata*				•		Fl
Orobanchaceae	***Orobanche minor****				•		Fl
Orobanchaceae	***Parentucellia latifolia****				•	•	Fl
Phyllanthaceae	*Poranthera microphylla*				•		Fr
Pittosporaceae	*Billardiera fraseri*		•	Fr			
Pittosporaceae	*Marianthus erubescens*				•		
Poaceae	*Austrostipa compressa*				•		
Poaceae	***Briza maxima****				•		Fr
Poaceae	***Briza minor****				•		Fr
Poaceae	***Ehrharta calycina****				•		Fr
Poaceae	***Eragrostis curvula****	•	•	Fr		•	
Poaceae	***Hordeum leporinum****				•		Fr
Poaceae	***Lolium rigidum****				•		
Poaceae	*Neurachne alopecuroidea*				•		Fr
Poaceae	***Pentameris airoides* subsp. *airoides****	•		Fr	•		Fr
Poaceae	***Pentameris airoides****				•		Fr
Polygalaceae	*Comesperma calymega*					•	Fl
Primulaceae	***Lysimachia arvensis****				•		FlFr
Proteaceae	*Adenanthos cygnorum* subsp. *cygnorum*	•		Fl			
Proteaceae	*Banksia armata* var. *armata*		•	Fl			
Proteaceae	*Banksia attenuata*	•			•		Fr
Proteaceae	*Banksia bipinnatifida* subsp. *multifida*	•	•	Fl	•		FlFr
Proteaceae	*Banksia dallanneyi* subsp. *sylvestris*	•		Fl	•		
Proteaceae	*Banksia menziesii*		•	Fl			
Proteaceae	*Conospermum stoechadis* subsp. *stoechadis*					•	Fl
Proteaceae	***Grevillea ?drummondii* (potential P4)**	•					
Proteaceae	*Grevillea bipinnatifida* subsp. *bipinnatifida*		•				
Proteaceae	*Grevillea synapheae* subsp. *synapheae*		•			•	Fr
Proteaceae	*Hakea lissocarpha*	•	•				
Proteaceae	*Hakea ruscifolia*		•	Fl			
Proteaceae	*Hakea stenocarpa*	•			•		
Proteaceae	*Isopogon asper*	•		Fr		•	Fr
Proteaceae	*Petrophile linearis*	•		Fl	•		
Proteaceae	*Petrophile macrostachya*	•	•	FlFr			
Proteaceae	*Petrophile striata*	•	•	FlFr	•		FlFr
Proteaceae	*Stirlingia latifolia*	•		FlFr	•		
Proteaceae	*Stirlingia simplex*				•		
Proteaceae	*Synaphea aephynsa*				•	•	Fl
Proteaceae	*Synaphea spinulosa* subsp. *spinulosa*	•	•	FlFr		•	
Restionaceae	*Alexgeorgea nitens*	•		Fr	•		
Restionaceae	*Chordifex sinuosus*				•		Fr
Restionaceae	*Desmocladus fasciculatus*	•		Fr	•		

Family	Taxa	March			October		
		R	OC	FlFr	Q	OC	FlFr
Rhamnaceae	*Trymalium angustifolium*	•					
Rubiaceae	***Galium divaricatum****				•		Fl
Rubiaceae	*Opercularia vaginata*	•		Fr			
Rutaceae	*Boronia ovata*		•			•	Fl
Rutaceae	*Boronia ramosa* subsp. *anethifolia*		•		•		Fr
Rutaceae	*Philotheca spicata*				•		Fl
Scrophulariaceae	***Dischisma arenarium****					•	Fr
Stylidiaceae	*Levenhookia stipitata*				•		Fl
Stylidiaceae	*Stylidium calcaratum*				•		Fl
Stylidiaceae	*Stylidium ciliatum*		•		•	•	Fl
Stylidiaceae	*Stylidium diuroides*				•		Fl
Stylidiaceae	*Stylidium diuroides* subsp. *diuroides*					•	Fl
Stylidiaceae	*Stylidium neurophyllum*					•	Fl
Thymelaeaceae	*Pimelea suaveolens*					•	Fl
Thymelaeaceae	*Pimelea suaveolens* subsp. *suaveolens*	•	•	Fl			
Violaceae	*Hybanthus calycinus*					•	Fl
Xanthorrhoeaceae	*Xanthorrhoea acanthostachya*	•			•		FR
Xanthorrhoeaceae	*Xanthorrhoea preissii*	•		Fr	•		
Zamiaceae	*Macrozamia riedlei*		•	Fr		•	

Note: P3 and P4 = Priority 3 and Priority 4, * = environmental weed, subsp. = subspecies, var. = variety, sp. = species, ? = query; Fl = flowering, Fr = fruiting, blank cell in FlFr columns indicates vegetative/sterile specimens; Q = taxa recorded in quadrats, R = taxa recorded in relevés, OC = taxa recorded as opportunistic collections. Green highlighting = native species susceptible to Phytophthora Dieback (CPSM, 2014). Nomenclature based on current WA Herbarium terminology and confirmed on FloraBase (WAH, 1998-).

Table A7.2: Results from EstimateS species accumulation analysis

Samples	Individuals (computed)	Sobs (Mao Tau)	Sobs 95% CI Lower Bound	Sobs 95% CI Upper Bound	Sobs SD (Mao Tau)	Sobs Mean (runs)	Singletons Mean	Singletons SD (runs)	Doubletons Mean	Doubletons SD (runs)	Uniques Mean	Uniques SD (runs)
1	31.56	31.56	26.37	36.74	2.65	31.76	31.76	6.88	0	0	31.76	6.88
2	63.11	51.61	44.38	58.84	3.69	51.84	40.36	10.84	11.48	3.94	40.36	10.84
3	94.67	65.76	57.55	73.98	4.19	65.71	42.36	9.4	17.76	3.79	42.36	9.4
4	126.22	76.49	67.74	85.25	4.47	76.37	42.86	7.97	20.3	4.39	42.86	7.97
5	157.78	85.12	76	94.24	4.65	84.85	43.02	6.94	20.81	3.99	43.02	6.94
6	189.33	92.36	82.92	101.79	4.81	92.05	43.32	6	20.58	3.5	43.32	6
7	220.89	98.61	88.86	108.36	4.98	98.54	43.81	4.5	20.49	2.69	43.81	4.5
8	252.44	104.11	94.01	114.22	5.16	104.13	43.91	2.75	21.17	2.75	43.91	2.75
9	284	**109**	98.48	119.52	5.36	109	44	0	22	0	44	0

Samples	Duplicates Mean	Duplicates SD (runs)	ACE Mean	ACE SD (runs)	ICE Mean	ICE SD (runs)	Chao 1 Mean	Chao 1 95% CI Lower Bound	Chao 1 95% CI Upper Bound	Chao 1 SD (analytical)	Chao 2 Mean
1	0	0	543.98	224.03	487.07	199.89	543.98	295.5	1031.07	179.37	487.07
2	11.48	3.94	169.61	102.07	267.2	193.2	136.24	88.53	246.71	37.68	126.86
3	17.76	3.79	123.49	32.35	153.75	46.66	116.91	89.57	176.03	20.8	111.22
4	20.3	4.39	119.62	21.94	140.13	28.71	121.59	97.59	173.06	18.18	116.56
5	20.81	3.99	123.31	17.63	139.08	21.47	129.01	105.59	179.11	17.72	124.1
6	20.58	3.5	129.15	14.83	141.91	17.35	136.92	113.11	187.81	18.01	131.94
7	20.49	2.69	135.52	11.26	146.37	12.81	143.36	119.61	193.99	17.94	138.38
8	21.17	2.75	140.89	7.3	150.3	8.11	147.25	124.39	195.96	17.26	142.46
9	22	0	146.1		154.48	0	150.13	128.38	196.31	16.4	**145.56**

*All variables beyond the Chao 2 Mean have been removed as they are not relevant.

APPENDIX 8: CONSERVATION SIGNIFICANCE OF FLORA AND VEGETATION OF THE SURVEY AREA – ATTRIBUTES AND SCORES

Notes for Tables A8.1 to A8.9:

- Local Area = Survey Area, Regional Area = Dandaragan Plateau (SWA01) subregion
- BVA = Beard vegetation association
- CSF = conservation significant flora
- CSR = conservation significance rating
- GDE = groundwater dependent ecosystem
- HVC = Heddle vegetation complex
- IDE = inflow dependent ecosystem
- IUCN = International Union for Conservation of Nature
- MVT = Maia vegetation type
- RP = reservation priority (Desmond, 2001)
- SWA01 = Dandaragan Plateau subregion
- Veg. = vegetation
- Ada = *Acacia drummondii* subsp. *affinis* (P3), G?d = *Grevillea* ?*drummondii* (potential P4), Hl = *Haemodorum loratum* (P3) and *Haemodorum* ?*loratum* (potential P3)
- P3 and P4 = Priority 3 Priority 4
- PEC = priority ecological community, TEC = threatened ecological community
- ha = hectare, % = percentage, # = number, > = greater than

Table A8.1: BVAs, regional significance – attributes, scores and ratings

Column 1		2		3		4		5		6		7	8
Number of subregions		Spread in SWA01 subregion		Pre-European extent remaining in SWA01 subregion		Current extent protected (IUCN I-IV) for conservation (proportion of pre-European extent) in SWA01 subregion		Current extent in all DPaW – Managed Land (proportion of current extent) in SWA01 subregion		Additional attributes		Regional CSR	Total score
Number	Score	Spread	Score	%	Score	%	Score	%	Score	Attribute	Score	Rating	Range
1	3	Limited	3	≤ 30	4	≤ 10	4	≤ 10	4	BVA is mapped in a TEC	2	High	17 to 22
2 to 10	2	Moderate	2	> 30 - 50	3	> 10 - 30	3	> 10 - 30	3	BVA is mapped in a PEC	1	Moderate	11 to 16
11+	1	Widespread	1	> 50 - 70	2	> 30 - 70	2	> 30 - 70	2	High reservation priority (Desmond, 2001)	1	Low	5 to 10
				> 70 - 100	1	> 70 - 100	1	> 70 - 100	1	None of these attributes	0		

Source: Column 1 – number of subregions from GoWA (2015); Column 2 – Beard's pre-European extent from DAFWA (2012a) and IBRA subregions from DotEE (2012); Columns 3 to 5 – extents from GoWA (2015); Column 6 – TEC and PECs from DPaW (2007-), reservation priority from Desmond (2001).

Table A8.2: Regional significance of BVA 1020

BVA	Number of subregions		Spread in SWA01 subregion		Current extent remaining in SWA01 subregion (proportion of pre-European extent)(%)		Current extent protected (IUCN I-IV) for conservation in SWA01 subregion (proportion of pre-European extent)(%)		Current extent in DPaW-Managed Lands in SWA01 subregion (proportion of current extent)(%)		Additional attributes		Total score	CSR - regional
	#	Score	Spread	Score	%	Score	%	Score	%	Score		Score		
1020	3	2	Limited	3	28.45	4	6.31	4	6.32	4	TEC, PEC, High RP	4	**21**	High

Table A8.3: BVAs, local significance – attributes, scores and ratings

Column 1		2		3		4		5		6	7
Current spread in the Local Area		Current extent remaining in Local Area (%)		Mapped within IUCN (I-IV) conservation protected lands in the Local Area		# of Conservation Significant Flora located in the BVA		Additional attributes		CSR - local	Total score range
Code	Score	Code	Score	Code	Score	Code	Score	Code	Score	Code	Range
Limited	3	≤ 30%	4	No	1	> 10 species	3	BVA is mapped in a TEC	2	High	11 to 15
Moderate	2	> 30 - 50%	3	Yes	0	6 - 10 species	2	BVA is mapped in a PEC	1	Moderate	6 to 10
Widespread	1	> 50 - 70%	2			1 to 5 species	1	High reservation priority (Desmond, 2001)	1	Low	2 to 5
		> 70 - 100%	1			None	0	None of these attributes	0		

Source: Column 1 – Beard pre-European vegetation mapping from DAFWA (2012a) intersected with Maia Vegetation Types mapped in the Local Area (Degraded was not considered to be part of native vegetation extent in the Local Area); Column 2 – Local Area intersected with DAFWA (2012a) and Maia Vegetation Types mapped in the Local Area (Degraded was not considered to be part of native vegetation extent in the Local Area); Column 3 – Local Area intersected with Beard pre-European vegetation mapping from DAFWA (2012a) and DPaW managed lands with IUCN category I-IV from DPaW (2016a); Column 4 – CSF recorded by Maia during March and October 2016 and intersected with Beard's pre-European vegetation mapping from DAFWA (2012a); Column 5 - TEC and PECs from DPaW (2007-), reservation priority from Desmond (2001).

Table A8.4: Local significance of BVA 1020

BVA	Spread in the Survey Area (current extent)		Current extent remaining in Survey Area		Mapped within IUCN (I-IV) conservation protected lands in the Survey Area?		Number of conservation significant flora species located in the Survey Area within BVA		Reservation priority (Desmond, 2001)		BVA is mapped within a TEC/PEC		Total score	Local CSR
	Spread	Score	%	Score		Score	#	Score		Score		Score		
1020	Widespread	1	82.52	1	No	1	3 – Ada, G?d, Hl	1	High	1	TEC, PEC	3	**8**	Moderate

Table A8.5: HVC regional significance – attributes, scores and ratings

Column 1		2		3		4		5		6		7	8
Number of subregions		Spread in SWA01 subregion		Current extent remaining in SWA01 subregion (proportion of originally mapped extent)(%)		Current extent protected (IUCN I-IV) for conservation in SWA01 subregion (proportion of the originally mapped extent)(%)		Current extent in DPaW-managed lands in SWA01 subregion (proportion of current extent)(%)		Additional attributes		Regional CSR	Total score
Number	Score	Spread	Score	%	Score	%	Score	%	Score	Attribute	Score	Rating	Range
1	3	Limited	3	≤ 30	4	≤ 10	4	≤ 10	4	HVC is mapped in a TEC	2	High	16 to 21
2 to 10	2	Moderate	2	> 30 - 50	3	> 10 - 30	3	> 10 - 30	3	HVC is mapped in a PEC	1	Moderate	10 to 15
11+	1	Widespread	1	> 50 - 70	2	> 30 - 70	2	> 30 - 70	2	None of these attributes	0	Low	5 to 9
				> 70 -	1	> 70 - 100	1	> 70 -	1				

Source: Column 1 – Heddle vegetation complexes (HVC) from WALGA (2013) intersected with subregions from DotEE (2012); Column 2 –HVC from WALGA (2013) and IBRA subregions from DotEE (2012); Column3 – HVC from WALGA (2013) intersected with native vegetation extent from DAFWA (2012b) and IBRA subregions from DotEE (2012); Column 4 – HVC from WALGA (2013) intersected with DPaW managed lands with IUCN category I-IV from DPaW (2016a) and IBRA subregions from DotEE (2012); Column 5 - HVC from WALGA (2013) intersected with all DPaW managed lands from DPaW (2016a) and IBRA subregions from DotEE (2012); Column 6 - TEC and PECs from DPaW (2007-).

Table A8.6: Regional significance of the Moondah HVC

HVC	Number of subregions		Spread in SWA01 subregion		Current extent remaining in SWA01 subregion (proportion of originally mapped extent)(%)		Current extent protected (IUCN I-IV) for conservation in SWA01 subregion (proportion of the originally mapped extent)(%)		Current extent in DPaW-managed lands in SWA01 subregion (proportion of current extent)(%)		Additional attributes		Total score	Regional CSR
	#	Score	Spread	Score	%	Score	%	Score	%	Score		Score		
Moondah	3	2	Limited	3	46.00	3	10.11	3	12.04	3	Yes TEC and PEC	3	**17**	High

Table A8.7: HVC local significance – attributes, scores and ratings

Column 1		2		3		4		5		6	7
Current spread in the Local Area		Current extent remaining in Survey Area (%)		Mapped within IUCN (I-IV) conservation protected lands in the Survey Area?		# of conservation significant flora species in the HVC		Additional attributes		CSR - local	Total score range
Code	Score	Code	Score	Code	Score	Code	Score	Code	Score	Code	Range
Limited	3	≤ 30%	4	No	1	> 10 species	3	HVC is mapped in a TEC	2	High	10 to 14
Moderate	2	> 30 - 50%	3	Yes	0	6 - 10 species	2	HVC is mapped in a PEC	1	Moderate	6 to 10
Widespread	1	> 50 - 70%	2			1 to 5 species	1	None of these	0	Low	2 to 5
		> 70 - 100%	1			None	0				

Source: Column 1 – Heddle vegetation complexes (HVC) from WALGA (2013) intersected with Maia Vegetation Types mapped in the Local Area (Degraded was not considered to be part of native vegetation extent in the Local Area); Column 2 –HVC from WALGA (2013) and intersected with the Local Area and Maia Vegetation Types mapped in the Local Area (Degraded was not considered to be part of native vegetation extent in the Local Area); Column3 – Local Area intersected with HVC from WALGA (2013) and DPaW managed lands with IUCN category I-IV from DPaW (2016a); Column 4 – CSF recorded by Maia during March and October 2016 and intersected with HVC from WALGA (2013); Column 5 - TEC and PECs from DPaW (2007-).

Table A8.8: Local significance of Moondah HVC

HVC	Spread in the Local Area (current extent)		Current extent of remaining in Local Area		Mapped within IUCN (I-IV) conservation protected lands in the Local Area		# of conservation significant flora species located in the Local Area within LS		HVC is mapped within a TEC/ PEC		Total score	CSR - local
	Spread	Score	%	Score		Score	#	Score		Score		
Moondah	Widespread	1	82.52	1	No	1	3 – Ada, G?d, Hl	1	TEC and PEC	3	**7**	Moderate

Table A8.9: Maia vegetation types significance - attributes, scores and ratings

Cover in area assessed		Highest ranked CSF recorded in MVT		# of CSF Species located in MVT		# of weed species in MVT		Vegetation condition		Evident outside Survey Area?		Other attributes re local area	
%	Score	Rank	Score	#	Score	#	Score	Rating	Score	Yes/No	Score	Attribute	Score
0.1 to 5	7	T	6	5 or >	5	none	5	2	5	Yes	0	TEC	5
6 to 10	6	P1	5	4	4	1 to 5	4	3	4	No	1	PEC (P1)	4
11 to 20	5	P2	4	3	3	6 to 10	3	4	3			PEC (P2)	3
21 to 40	4	P3	3	2	2	11 to 15	2	5	2			PEC (P3)	2
41 to 60	3	P4	2	1	1	16 to 20	1	6	1			PEC (P4)	1
61 to 80	2	P5	1	None	0	>20	0	7	0			?TEC	1
81 to 100	1	None	0									?PEC	1
												None	0

CSR	Total Score
Rating	Range
High	**23 to 34**
Moderate	**12 to 22**
Low	**1 to 11**

Table A8.10: Local significance of vegetation types mapped by Maia – scores

MVT	Cover		Score	Highest ranked CSF recorded in quadrats	Score	# of CSF species in MVT	Score	# of weed species in MVT	Score
	ha	%							
*Et***MWL** (1)	2.71	8.32	**7**	None	**0**	0	**0**	20	**1**
*CcEm***F** (2)	16.09	49.42	**3**	P3	**3**	3	**3**	18	**1**
*EmCc***F** (3)	8.06	24.77	**4**	P3	**3**	3	**3**	14	**2**

MVT	Dominant veg condition	Score	Occurs outside Local Area?	Score	Any other attributes?	Score	Total score	CSR rating
*Et***MWL** (1)	3	**4**	Yes	**0**	TEC, PEC (P3)	**7**	19	Moderate
*CcEm***F** (2)	3	**4**	Yes	**0**	?TEC, ?PEC	**2**	16	Moderate
*EmCc***F** (3)	3	**4**	Yes	**0**		**0**	16	Moderate

CSR	Total Score
Rating	Range
High	**23 to 34**
Moderate	**12 to 22**
Low	**1 to 11**

Table A8.11: Banksia Woodlands of the Swan Coastal Plain ecological community and Maia vegetation type *Et*MWL (1)

Banksia Woodlands of the Swan Coastal Plain ecological community - key diagnostic characteristics, condition thresholds and minimum patch size	Relevance to MVT *Et*MWL (1)
Step 1 - Key diagnostic characteristics	
Location and physical environment	
The Banksia Woodlands ecological community primarily occurs in the Swan Coastal Plain IBRA bioregion.	The Survey Area occurs on the Swan Coastal Plain IBRA bioregion and the Dandaragan Plateau subregion.
○ This covers the coastal plain from around Jurien Bay south, through Perth, to around Dunsborough. It also includes the Dandaragan Plateau.	
○ Pockets of the Banksia Woodlands ecological community also extend into the adjacent lower parts of the Darling and Whicher escarpments that lie within the Jarrah Forest IBRA bioregion to the immediate east and south of the Swan Coastal Plain.	
AND	
Soils and landform	
The Banksia Woodlands ecological community:	
○ typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands;	MVT *Et***MWL** (1) was recorded on white sands.
○ is also common on sandy colluvium and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau; and	
○ in other less common scenarios (e.g. tranisitional substrates, sandflats).	
AND	
Structure	
The structure of the ecological community is a low woodland to forest with these features:	
○ A distinctive upper sclerophyllous layer of low trees (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the Banksia species identified below; **AND**	MVT *Et***MWL** (1) lacks the characteristic dominant *Banksia* stratum and is dominated by *Eucalyptus todtiana* mallees, an associated species for the community. Woodland dominated by *Banksia attenuata* was noted in a relatively undisturbed patch of vegetation in an adjacent lot to the south of the Survey Area. The area in which MVT *Et***MWL** (1) occurs has been disturbed and this has most likely affected the floristic composition of the MVT.
○ Typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup	

Banksia Woodlands of the Swan Coastal Plain ecological community - key diagnostic characteristics, condition thresholds and minimum patch size	Relevance to MVT *Et*MWL (1)
sands;	
○ Emergent trees of medium or tall (>10 m) height Eucalyptus or Allocasuarina species may sometimes be present above the Banksia canopy; **AND**	
○ A often highly species-rich understorey that consists of a layer of sclerophyllous shrubs of various heights and a herbaceous ground layer of cord rushes, sedges and perennial and ephemeral forbs, that sometimes includes grasses. The development of a ground layer may vary depending on the density of the shrub layer and disturbance history.	
AND	
Composition	
The canopy is most commonly dominated or co-dominated by *Banksia attenuata* (candlestick banksia, slender banksia) and/or *B. menziesii* (firewood banksia). Other *Banksia* species that dominate in some examples of the ecological community are *B. prionotes* (acorn banksia) or *B.ilicifolia* (holly-leaved banksia); **AND**	
The patch must include at least one of the following diagnostic species:- *Banksia attenuata* (candlestick banksia), *Banksia menziesii* (firewood banksia), *Banksia prionotes* (acorn banksia), *Banksia ilicifolia* (holly-leaved banksia); **AND**	
If present, the emergent tree layer often includes *Corymbia calophylla* (marri), *Eucalyptus marginata* (jarrah), or less commonly *Eucalyptus gomphocephala* (tuart); **AND**	
Other trees of a medium height that may be present, and may be codominant with the Banksia species across a patch, include *Eucalyptus todtiana* (blackbutt, pricklybark), *Nuytsia floribunda* (Western Australian Christmas tree), *Allocasuarina fraseriana* (western sheoak), *Callitris arenaria* (sandplain cypress), *Callitris pyramidalis* (swamp cypress) and *Xylomelum occidentale* (woody pear); **AND**	
The understorey typically contains a high to very high diversity of shrub and herb species that often vary from patch to patch. Some of the more widespread and potentially characteristic species present in the ecological community are outlined above in Section 1 of the Approved Conservation Advice.	
And in descriptions of vegetation types that relate to the Banksia Woodlands (e.g. Gibson *et al.*, 1994).	
Step 2 - Condition thresholds	
To be considered as part of the ecological community, a patch should meet at least the Good (4) Condition category based on Keighery (1994) Vegetation Condition Scale (GoWA, 2000).	The average condition rating for MVT *Et***MWL** (1) was 3 (vegetation structure altered) which is within the condition threshold.

Banksia Woodlands of the Swan Coastal Plain ecological community - key diagnostic characteristics, condition thresholds and minimum patch size	Relevance to MVT *Et*MWL (1)
Step 3 - Minimum patch size	
Where patches meet different levels of condition, different minimum patch sizes apply:	MVT *Et***MWL** (1) is mapped over 2.71 ha which meets the minimum patch size for the condition rating of 3 (vegetation structure altered).
(1) "Pristine" Pristine or nearly so – no minimum patch size	
(2) "Excellent" Vegetation structure intact – 0.5 ha	
(3) "Very Good" Vegetation structure altered – 1 ha	
(4) "Good" Vegetation structure altered but retains basic vegetation structure – 2 ha	
Step 4 - Further information to assist in determining the presence of the ecological community and significant impacts	
Other factors such as land use history, structural form of the patch, landscape position, ecological connectivity, patch continuity are also considered when determining the presence of the ecological community.	The understorey within this MVT has been previously cleared and is lacking the characteristic *Banksia* woodland component of the ecological community. Connectivity to a relatively undisturbed patch of *Banksia* woodland in the adjacent lot to the south of the Project Area is cut off by an access driveway to the neighbouring site on the adjacent lot.