Report of a Level 1 Flora and Vegetation survey at the Capel Dry Plant, Capel

Prepared for Iluka Resources Limited
November 2015

Ecoedge

PO Box 1180 Bunbury WA 6231
9721 1377 | enquiries@ecoedge.com.au

Version	Origin	Review	Review date	Ecoedge release approval	Issue date
V1	M. Strang	R. Smith	15/11/2015		
V2	R. Smith	M. Strang	23/11/2015		
V3	M. Strang	R. Smith	24/11/2015		
V4	M. Strang	R. Smith	25/11/2015		
V5	R. Smith	M. Strang	26/11/2015		
Final draft	M. Strang	A. Bishop / A. Riedmann (Iluka)	18/12/2015	M. Strang	26/11/2015
Final	A. Bishop / A. Riedmann (Iluka)	M. Strang, R. Smith	21/12/2015	M. Strang	22/12/2015

Executive Summary

Ecoedge was engaged by Iluka Resources Limited in August 2015 to undertake a Level 1 Flora and Vegetation Survey of remnant vegetation at the Capel Dry Plant to assist with potential future clearing permit applications. The Project Area, which includes Nature Reserve 3249, is 123.1 ha, of which approximately 24.6 ha is remnant native vegetation.

Field assessments were carried out on 21 and 29 September, and 5 and 12 October 2015.

Two hundred and fourteen taxa of vascular flora were identified within the Project Area, of which 54 (25.2%) were exotic species. Two weeds classified as Pest Plants under the under the *Biosecurity and Agriculture Management Act 2007* (**Asparagus asparagoides*, **Zantedeschia aethiopica)* were found within the Project Area, both in the C3 management Category.

Three species of Priority flora were found within Crown Reserve 3249 viz. *Stylidium paludicola* (P3), *Caladenia speciosa* (P4) and *Acacia semitrullata* (P4). No species of Declared Rare flora under the *Wildlife Conservation Act 1950* or plants listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* were found.

Eleven vegetation units dominated by trees or shrubs were identified within the Project Area, of which nine were naturally occurring.

Approximately 0.15 ha of the vegetation unit *Corymbia calophylla - Xanthorrhoea brunonis* open forest (CcXbOF) adjacent to the Capel Dry Plant (on the rail reserve) was in 'Good' or 'Very Good-Excellent' condition and is considered to have high conservation value because is inferred as a new occurrence of the Critically Endangered Threatened Ecological Community *Corymbia calophylla-Xanthorrhoea preissii* Woodlands and Shrublands (SCP 3c).

The vegetation unit *Acacia saligna-Hakea varia-Melaleuca viminea* tall shrubland (AsHvMvTS) has similarities to the FCT 'Dense shrublands on Clay Flats (SCP 9)' which is a Threatened Ecological Community with the risk status of 'Vulnerable'. Most of this unit was classed as 'Degraded', however just over 20% of this vegetation unit was assessed as 'Good'.

The vegetation units AfMpLCF, CcMrCF, EmAfMpCF and ErAfMpCF are inferred to represent examples of the Priority 1 Ecological Community '*Eucalyptus rudis*, *Corymbia calophylla* and *Agonis flexuosa* Closed Low Forest (of Spearwood Dune Wetlands)'. Almost all of the area of these communities was assessed as 'Good' or 'Very Good/Excellent' condition.

21.6 ha of the 123 ha Project Area comprises native vegetation in a range of condition classes. About 55% of the Project Area was classified as 'Completely Degraded' or 'Degraded' while 21.7% of the area was classed as 'Very Good to Excellent', the bulk of this being in Crown Reserve 3249.

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Statement of limitations

Reliance on Data

In the preparation of this report, Ecoedge has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

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1 Introduction

Ecoedge was engaged by Iluka Resources Limited ('Iluka') in August 2015 to undertake a Level 1 Flora and Vegetation Survey of remnant vegetation at the Capel Dry Plant to assist with potential future clearing permit applications. The Project Area, which includes Nature Reserve 3249, is 123.1 ha, of which approximately 21.6 ha is remnant native vegetation.

A previous survey of a 6.9 ha portion of the current Project Area was undertaken by Mattiske Consulting Pty Ltd in 2009. No Declared Rare or Priority Flora listed under the *Wildlife Conservation Act 1950* (*WC Act*) or under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EBPC Act*) were found during this survey, nor were any Threatened or Priority Ecological Communities identified.

This vegetation survey was undertaken in accordance with the Environmental Protection Authority (EPA) Guidance Statement 51, "Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia" (EPA, 2004).

The field assessment was carried out on 21 and 29 September, and 5 and 12 October 2015. This report compiles findings of the field survey.

1.1 Scope and objectives

The scope and objectives of the flora survey were to carry out a Level 1 flora and vegetation assessment to determine whether there are any significant flora values within the Project Area. The survey scope specified the following requirements:

- Conduct an assessment of flora and vegetation values within the Project Area;
- Conduct a review of other literature to summarise the values of flora and vegetation significance in the project area;
- Review the documented flora and vegetation of significance, based on Department of Parks and Wildlife (DPaW) records (databases);
- Conduct field assessments to:
    - identify the vascular flora species present;
    - determine the presence or absence of Declared Rare Flora (DRF), Priority or Significant Species; Record relevant information for each, including species, location, number of individuals/estimated population size;
    - assess conservation significance of vegetation and flora;
    - define and spatially map vegetation condition;
    - define and spatially map vegetation communities (achieved through the installation of a number of floristic relevés);

- define and map threatened and priority ecological communities; and
- a review of the local and regional significance of the plant communities in terms of their intrinsic value, extent and condition against Government of Western Australia (2013a)

1.2 Biogeographic region and location

The Project Area is situated within Perth Coastal Plain (SWA2) sub-region of the Swan Coastal Plain biogeographic region, as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Australian Government, 2009). The Project Area is located on the northwest outskirts of the Capel townsite (**Figure 1, Figure 2**), within road reserves, railway, crown land (Nature Reserve) and freehold land in the Shire of Capel.

1.3 Geology

Within the Swan Coastal Plain landform, the Project Area is situated on the Spearwood Dune Zone (211), the Bassendean Dune Zone (212) and Pinjarra Zone (213) (**Figure 3**). The Spearwood Dunes are of aeolian origin and are characterised by a series of limestone-capped peaks. They also feature low dunes and swales of shallow pale grey sands over yellow sands. The Bassendean Dunes lie in the centre of the Swan Coastal Plain (between the Spearwood Dunes and the Pinjarra Plain), and are the oldest of the three aeolian dune systems. They are generally of low relief, often with broad swales or relatively flat sand sheets between the low dunes (Government of Western Australia, 2000). The Pinjarra Zone is defined as alluvial deposits occurring between the Bassendean Dune Zone and the Darling Scarp, and colluvial and shelf deposits adjacent to the Darling Scarp. The soils are clayey to sandy alluvial with wet areas (Schoknecht, *et al*., 2004). There are seven Soil Mapping Units or soil phases occurring within the Project Area, these are described in **Table 1**[1]**.**

[1] The soils in the southern part of the Project Area, particularly along the railway reserve adjacent to the Capel Dry Plant were in fact red-brown loam and brown clay and did not fit the description of the soil mapped by Schoknecht *et al*. (2004).

Table 1. Soil Mapping Units occurring within the Project Area (Barnesby and Proulx-Nixon, 2000).

Soil Mapping Unit	Description
211Sp_S4b	Shallow to moderately deep siliceous yellow-brown and grey-brown sands with minor limestone outcrop.
212Bs_B1	Deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.
212Bs_B1a	Deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface; marri and jarrah dominant.
212Bs_B2	Well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
212Bs_B3	Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam.
213Pj_P1a	Deep acidic mottled yellow duplex (or 'effective duplex') soils. Shallow pale sand to sandy loam over clay; imperfect to poorly drained and generally not susceptible to salinity.
213Pj_P9	Shallowly incised stream channels of minor creeks and rivers with deep acidic mottled yellow duplex soils.

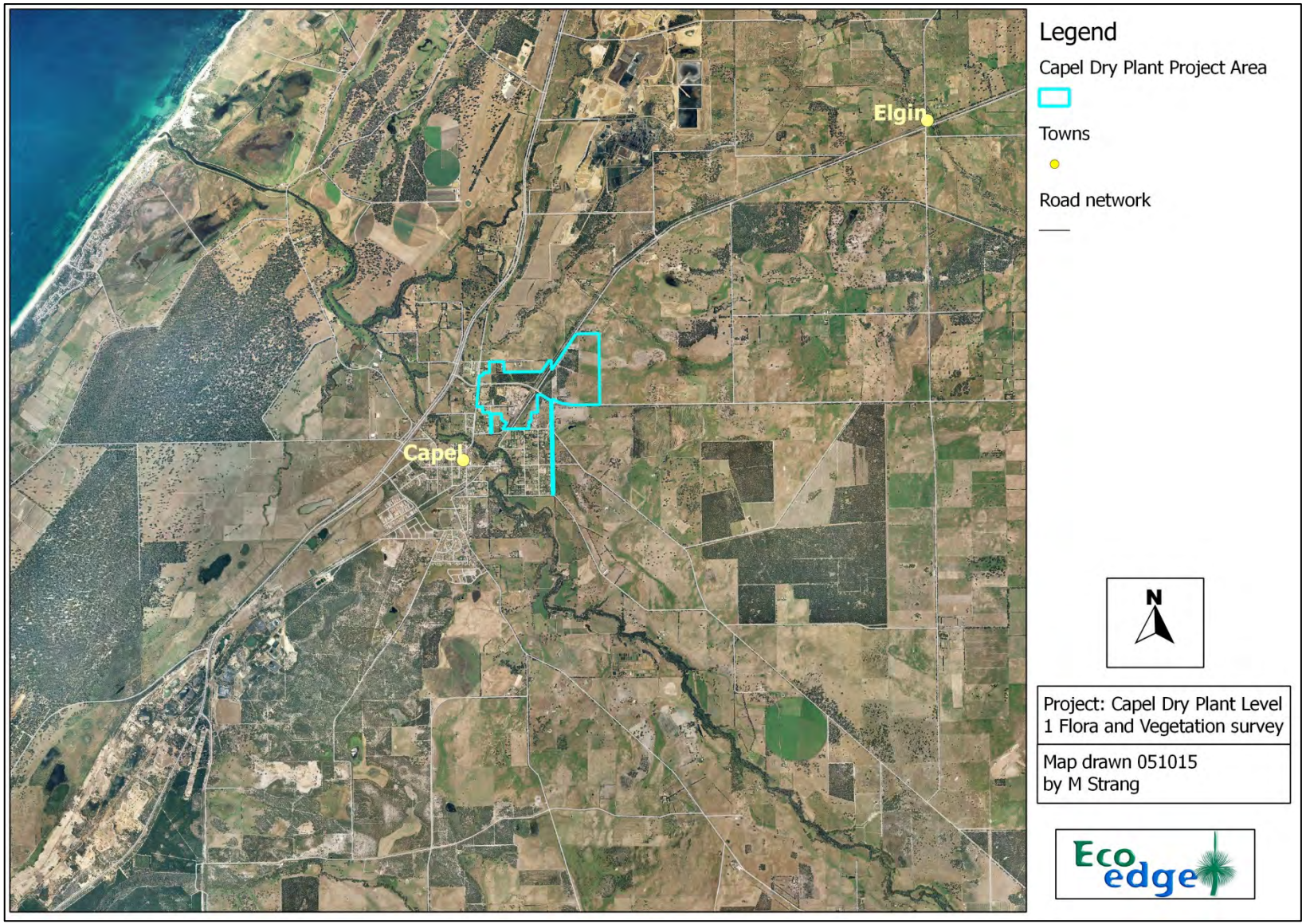

Figure 1. Aerial Photograph showing location of Project Area.

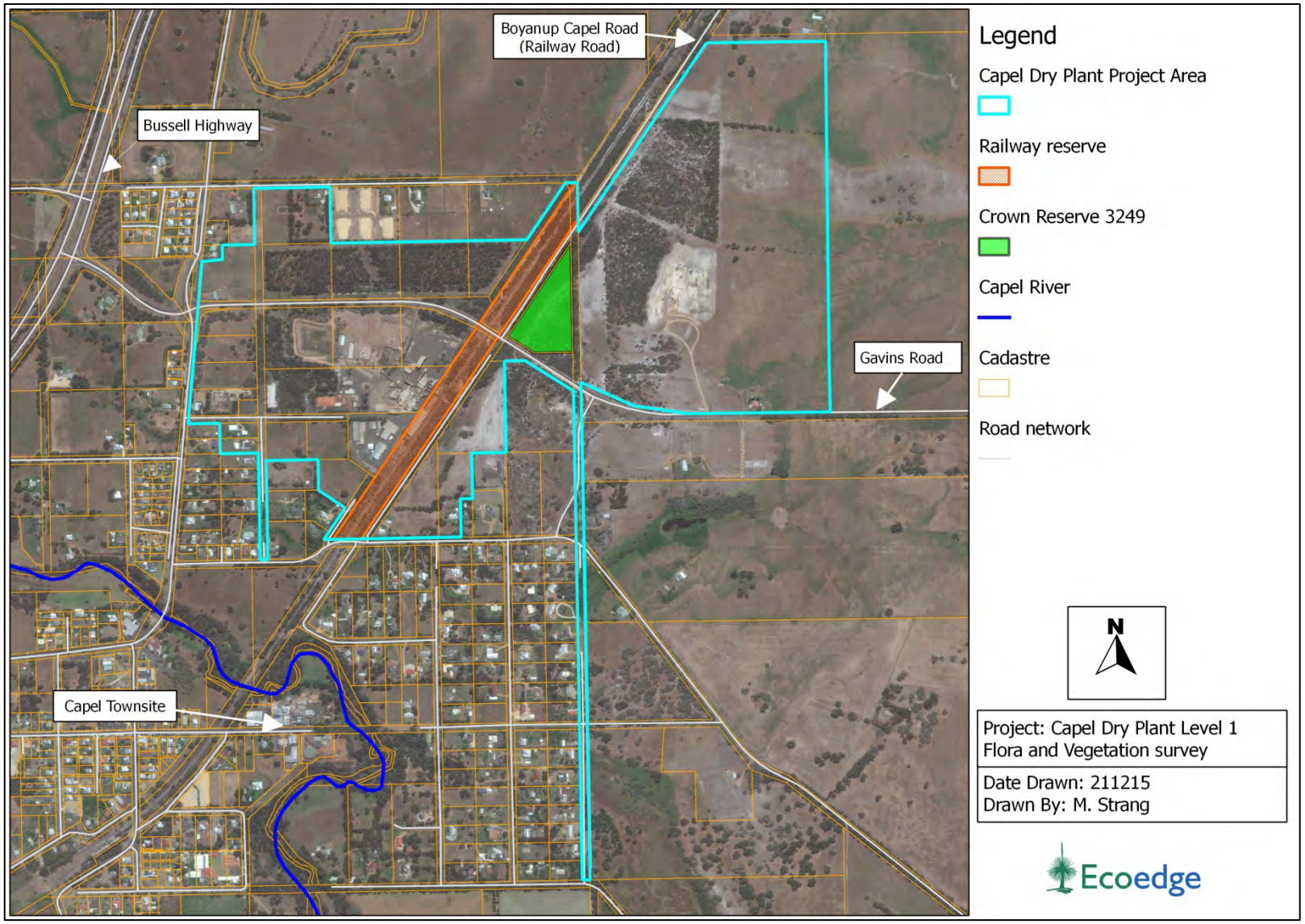

Figure 2. Location of the Project Area in relation to landscape features, the railway reserve and Nature Reserve 3249.

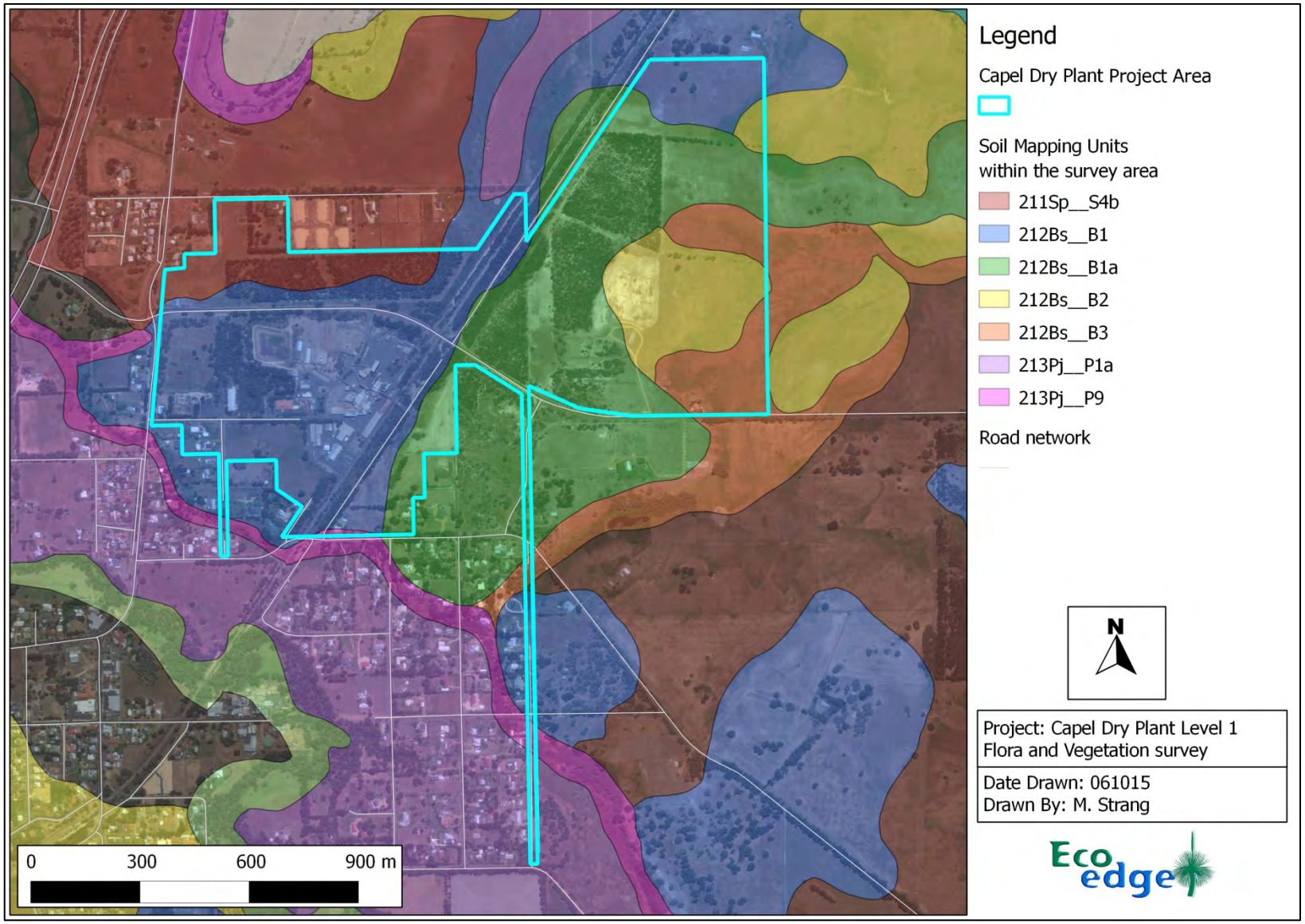

Figure 3. Soil Mapping Units occurring within the Project Area (Barnesby and Proulx-Nixon, 2000).

1.4 Vegetation

Variation in vegetation mainly reflects the variations in soil and moisture condition of a landscape. Historically, the vegetation types in the Project Area would have reflected the topography and soils, with the Swan Coastal Plain vegetation being distinct from that found on the slopes of the Darling Scarp.

Heddle *et al*. (1980) mapped the vegetation of part of the Drummond Botanical Sub-district at a very broad scale, describing a series of vegetation complexes that are related groups of vegetation associations found on particular landform-soil units. A total of 38 vegetation complexes were mapped on the Swan Coastal Plain. As shown in **Figure 4**, remnant vegetation within the Project Area was mapped as the Southern River, Guildford and Swan Complexes, which are described in **Table 2.**

Vegetation of the Southern River Complex is characterised by being in transition between the Pinjarra Plain and the Bassendean Dunes. This complex supports vegetation communities associated with the Bassendean Dunes but also those associated with pockets of alluvial and colluvial soils characteristic of the Pinjarra Plain.

Table 2. Vegetation Complexes mapped by Heddle *et al*. (1980) as occurring within the Project Area.

Vegetation Complex	Description
Southern River	This vegetation is described as open woodland of *Corymbia calophylla* - *Eucalyptus marginata* - Banksia species with fringing woodland of *Eucalyptus rudis* - *Melaleuca rhaphiophylla* along creek beds.
Guildford	A mixture of open forest to tall open forest of *Corymbia calophylla* - *Eucalyptus wandoo* - *Eucalyptus marginata* and woodland of *Eucalyptus wandoo* (with rare occurrences of *Eucalyptus lane-poolei*). Minor components include *Eucalyptus rudis* - *Melaleuca rhaphiophylla*.
Swan	Fringing woodland of *Eucalyptus rudis* - *Melaleuca rhaphiophylla* with localised occurrence of low open forests of *Casuarina obesa* and *Melaleuca cuticularis*.

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognised that the retention of 30%, or more, of the pre-clearing extent of each ecological community was necessary if Australia's biological diversity was to be protected (Environment Australia, 2001). This level of recognition is in keeping with the targets set in the EPA's Position Statement on the 'Environmental protection of native vegetation in

Western Australia: clearing of native vegetation, with particular reference to the agricultural area' (EPA, 2000). With regard to conservation status, the EPA has set a target of 15% of pre-European extent for each ecological community to be protected in a comprehensive, adequate and representative reserve system (EPA, 2006).

Table 3 lists the percentage remaining of each vegetation complex and the percentage of each vegetation complex in formal and formal plus informal reserves. It also lists whether each vegetation complex meets the Commonwealth's 30% target (Environment Australia, 2001) and the EPA's 15% target (EPA, 2006). As is evident in **Table 3** all of the vegetation complexes present within the Study Areas meet the Commonwealth's 30% target and the EPA's 15% target.

Table 3. Vegetation Complexes present in the Capel Dry Plant Project Area with regard to the EPA and Commonwealth retention targets (DEC 2007).

Vegetation Complex	% Remaining of pre-European	Is the 30% Target Met?	% in Formal Reserves	% in Formal + All Informal Reserves	Is the 15% Target Met?
Southern River	11.12%	No	4.0%	4.0%	No
Guildford	4.14%	No	0%	0%	No
Swan	13.11%	No	0%	0%	No

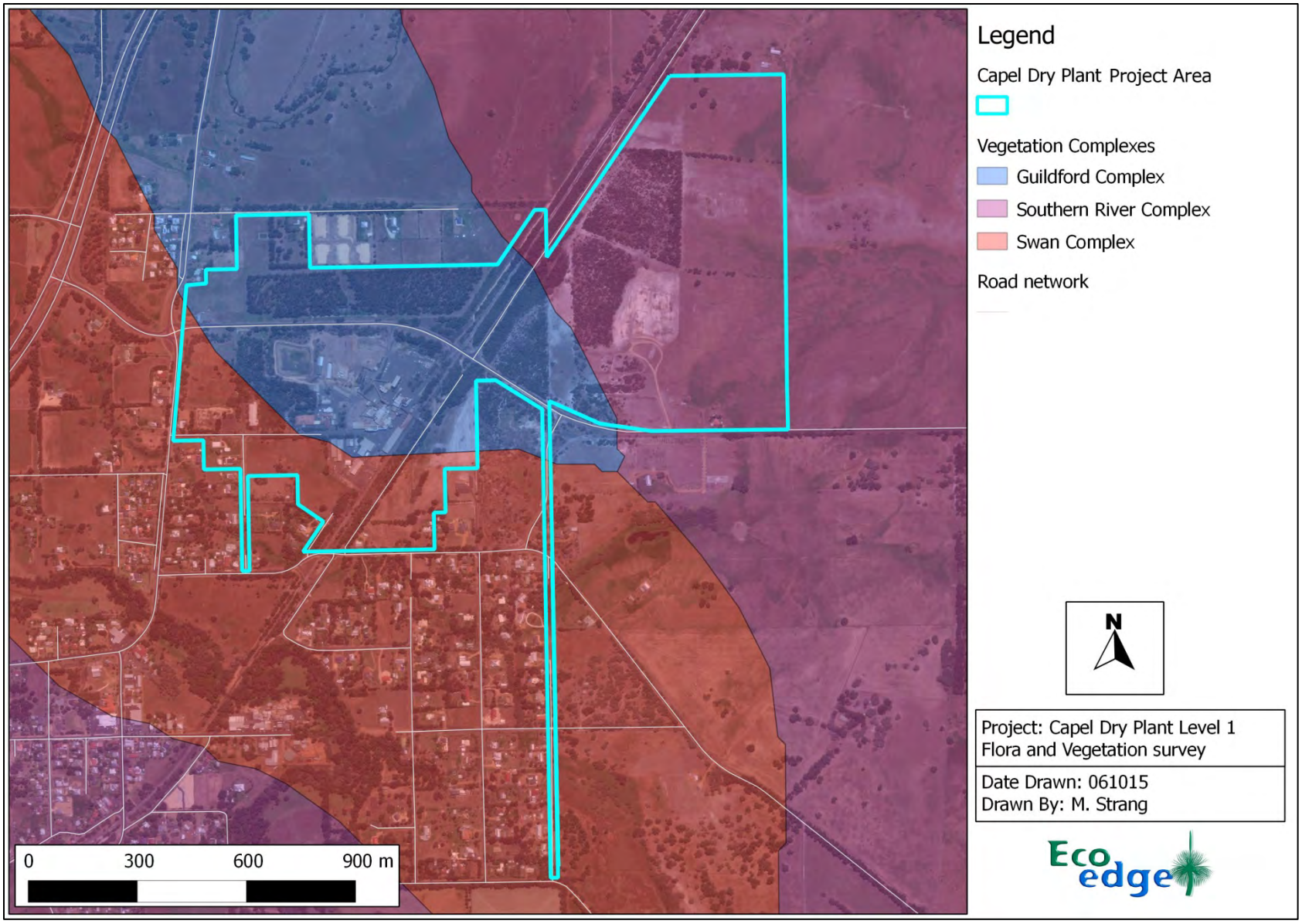

Figure 4. Vegetation complexes mapped by Heddle *et al*.(1980) as occurring within the Project Area.

1.5 Threatened and Priority Ecological Communities

Ecological communities are defined by Western Australia's Department of Parks and Wildlife (DPaW, previously the Department of Environment and Conservation (DEC)) as "...naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services." (DEC, 2010).

A threatened ecological community (TEC) is one which is found to fit into one of the following categories; 'presumed totally destroyed', Critically Endangered (CE), Endangered (E) or Vulnerable (V) (DEC, 2010). Possible threatened ecological communities that do not meet survey criteria are added to DPaW's Priority Ecological Community Lists under Priorities 1, 2 and 3 (referred to as P1, P2, P3). Ecological Communities that are adequately known, 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 (P4). These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (P5) (DEC, 2010). The current listing of Threatened and Priority Ecological Communities is specified in DPaW, 2015a and 2015b.

Threatened Ecological Communities can also be listed under the Commonwealth *EPBC Act* (Department of the Environment (DotE), 2015a; Department of Environment, Water, Heritage and the Arts (DEWHA), 1999). There are three categories of TEC under the *EPBC Act*: Critically Endangered (CE), Endangered (E) and Vulnerable (V). These are defined in **Table 4**.

Table 4. Categories of Threatened Ecological Communities under the *EPBC Act*.

Category	Definition
Critically endangered	If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
Endangered	If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
Vulnerable	If, at that time, an ecological, community is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium–term future (indicative timeframe being the next 50 years).

A Protected Matters Search Tool query for communities listed under the *EPBC Act* occurring within a 5 km radius of the Project Area was undertaken (DotE, 2015b, **Appendix 1**), and the current DPaW TEC and PEC listings were consulted (DPaW 2015a; 2015b).

Threatened and priority ecological communities known to occur within 5 km of the Project Area are listed in **Table 5.**

Table 5. Threatened ecological communities occurring within 5 km of the Project Area (Gibson *et al*., 1994; DPaW, 2015a; DotE, 2015b).

Community Name	Community Description	Status (WA)	Status (*EPBC Act*)
SCP 1b – Southern *Corymbia calophylla* woodlands on heavy soils	Dominated by *C. calophylla* and *Eucalyptus marginata. Acacia extensa, Hypocalymma angustifolium* and *Xanthorrhoea preissii* are important shrubs. Mainly occurs south of Capel.	VU	
SCP 3c – *Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain	*Corymbia calophylla – Xanthorrhoea preissii woodlands and shrublands.* Eucalyptus wandoo is an occasional dominant. This community occurs on heavy soils.	CR	EN
SCP 09 - Dense shrublands on clay flats	Shrublands or open woodlands of clay flats that are inundated for long periods.	VU	CR
SCP 21b - Southern *Banksia attenuata* woodlands	Structurally, this community type is normally *Banksia attenuata* or *Eucalyptus marginata – B. attenuata* woodland. Common taxa include *Acacia extensa, Jacksonia* sp. *Busselton, Laxmannia sessiliflora, Lysinema ciliatum* and *Johnsonia acaulis.*	P3	

1.6 Threatened and Priority Flora

Species of flora and fauna are defined as having Declared Rare (Threatened) or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment Regulation recognises these threats of extinction and consequently applies regulations towards population and species protection.

Declared Rare (Threatened) Flora species are gazetted under Subsection 2 of Section 23F of the *WC Act* and therefore it is an offence to 'take' or damage rare flora without Ministerial approval. Section 6 of the *WC Act* defines 'to take' as "… to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means."

Priority Flora are under consideration for future declaration as 'rare flora', dependent on more information. Species classified as Priority One to Three are in need of further survey to determine their status, while Priority Four species require monitoring every 5-10 years. **Table 6** presents the categories of Threatened and Priority Flora as defined by the *WC Act* (DPaW 2014).

Table 6. Definitions of Declared Rare and Priority List flora (DPaW, 2014).

Conservation code	Category
T (DRF)	Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such.
P1	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P3	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.
P4	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Under the *EPBC Act,* a species may be listed in one of six categories; the definitions of these categories are summarised in **Table 7** (DotE, 2015c).

Threatened or Priority flora occurring within 10 km of the Project Area generated from a NatureMap data search (DPaW, 2015c) are listed in **Table 8**. Taxa listed under the *EPBC Act* potentially occurring within 5 km of the Project Area (based on results of the Protected Matters Search Tool query) are listed in **Appendix 1**.

Table 7. Categories of Threatened Species under the *EPBC Act* (DotE, 2015c).

Category	Definition
Extinct (Ex)	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 (ExW)	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 known only to survive in cultivation, in captivity or as a naturalised 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.
Critically Endangered (CE)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (E)	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (V)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, 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 within a period of 5 years.

Table 8. List of Declared Rare and Priority List flora known to occur within 5 km of the Project Area.
(The *WC Act* Conservation Status is shown, *EPBC Act* status is in brackets.)

Species	Cons[2]. Status	Flowering	Habitat	Likelihood of Occurrence
Calectasia cyanea	T	Jun-Oct	White, grey or yellow sand, gravel.	Moderate
Diuris drummondii	T (V)	Nov-Jan	Low-lying depressions, swamps.	Moderate
Drakaea elastica	T (E)	Oct-Nov	White or grey sand. Low-lying situations adjoining winter-wet swamps.	Moderate/High
Verticordia densiflora var. *pedunculata*	T (E)	Dec or Jan	Grey/yellow sand, sandy loam. Winter-wet low-lying areas.	Moderate
Bolboschoenus medianus	P1	Sept-Dec	Mud. In water and on river banks.	Moderate
Amperea micrantha	P2	Oct-Nov	Sandy soils.	Moderate
Calytrix sp. Tutunup (G.J. Keighery & N. Gibson 2953)	P2	Oct	Yellow-grey clayey loam, red clayey loam, laterite, ironstone. Slopes and flats, winter-wet areas, grazed paddocks.	Low
Leucopogon sp. Busselton (D. Cooper 243)	P2	Aug-Sep	*Pericalymma ellipticum* wet shrubland, Marri-Jarrah woodland.	Moderate
Synaphea petiolaris subsp. *simplex*	P2	Sep-Oct	Sandy soils. Flats, winter-wet areas.	Moderate/High
Trichocline sp. Treeton (B.J. Keighery & N. Gibson 564)	P2	Nov-Jan	Sand over limestone, sandy clay over ironstone. Seasonally wet flats.	Low
Adelphacme minima	P3	Spring	Not confirmed	Low/Moderate
Boronia tetragona	P3	Oct-Dec	Black/white sand, laterite, brown sandy loam. Winter-wet flats, swamps, open woodland.	Moderate
Chamaescilla gibsonii	P3	Sep	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	Low

[2] Conservation

Species	Cons[3]. Status	Flowering	Habitat	Likelihood of Occurrence
Isopogon formosus subsp. *dasylepis*	P3	Jun-Dec	Sand, sandy clay, gravelly sandy soils over laterite. Often swampy areas.	Low/Moderate
Lasiopetalum membranaceum	P3	Sep-Dec	Sand over limestone.	Low
Loxocarya magna	P3	Sep or Nov	Sand, loam, clay, ironstone. Seasonally inundated or damp habitats.	Moderate/High
Meeboldina thysanantha	P3	Dec	Sand. Swamps.	Moderate/High
Pultenaea pinifolia	P3	Oct-Nov	Loam or clay. Floodplains, swampy areas.	Moderate/High
Stylidium paludicola	P3	Oct-Dec	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	Moderate
Synaphea hians	P3	Jul-Nov	Sandy soils. Rises.	Low
Tetratheca parvifolia	P3	Oct	Jarrah, woodland, wandoo woodland, gravelly soils.	Low
Thelymitra variegata	P3	Jun-Sep	Sandy clay, sand, laterite.	Low
Verticordia attenuata	P3	Dec-May	White or grey sand. Winter-wet depressions.	Moderate/High
Acacia flagelliformis	P4	May-Sep	Sandy soils. Winter-wet areas.	Moderate/High
Acacia semitrullata	P4	May-Oct	White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas.	Moderate/High
Aponogeton hexatepalus	P4	Jul-Oct	Mud. Freshwater: ponds, rivers, claypans.	Moderate/High
Caladenia speciosa	P4	Sep-Oct	White, grey or black sand.	Moderate/High
Eucalyptus rudis subsp. *cratyantha*	P4	Jul-Sep	Loam. Flats, hillsides.	Moderate/High
Franklandia triaristata	P4	Aug-Oct	White or grey sand.	Low
Stylidium striatum	P4	Oct-Nov	Brown clay loam over laterite. Hillslopes. Jarrah/Marri forest, Wandoo woodland.	Low
Thysanotus glaucus	P4	Oct-Mar	White, grey or yellow sand, sandy gravel.	Low

[2, 3] Conservation

Many of the species listed in **Table 7** could potentially occur within the Project Area, based on an assessment of their preferred habitats. All species listed would have either been flowering at the time of survey or could be identified in the field without flowers.

1.7 Ecological Linkages

Information for this section is taken from Molloy *et al*. (2009) and their report on the South West Regional Ecological Linkages (SWREL) Project.

Ecological linkages are defined as:

"*A series of (both contiguous and non-contiguous) patches which, by virtue of their proximity to each other, act as stepping stones of habitat which facilitate the maintenance of ecological processes and the movement of organisms within, and across, a landscape*."

Regional ecological linkages link protected patches of regional significance by retaining the best (condition) patches available as stepping stones for flora and fauna between regionally significant areas. This increases the long-term viability of all the constituent areas.

The SWREL report is the result of collaboration between the Western Australian Local Government Association's *South West Biodiversity Project* and the then Department of Environment and Conservation's *Swan Bioplan* to provide a tool for the identification of ecological linkages and guidance for the protection of linkages through planning policy documents.

Molloy *et al.* (2009) assessed and assigned 'proximity values' to all patches of remnant native vegetation as a way of indicating their distance from the nearest regional ecological linkage axis line. These values are defined in **Figure 5.** It should be noted however, that the proximity value of a patch of remnant vegetation to an ecological linkage is not intended to replace the need to consider the other biodiversity conservation values of that patch of remnant vegetation.

A regional ecological linkage axis line passes directly through the Project Area (**Figure 6**). While the axis line is situated slightly away from the vegetation along the railway line, it is most likely meant to align directly with this vegetation. As a result of the location of this axis line, vegetation within the Project Area is assigned to proximity category '1a', '1b', 1c and 2a, which are the four highest categories, and indicates that vegetation within the Project Area forms part of a regional ecological linkage.

Vegetation along the railway line within the Project Area links in the southwest to vegetation along the Capel River and in the north with vegetation in Nature Reserve 3249 and along the road reserve and railway line along Capel-Boyanup Road, eventually linking to State Forest 27 east of Boyanup.

While there is no statutory basis for regional ecological linkages identified through the SWREL project, the importance of ecological linkages have been recognised as an environmental policy consideration in EPA and Planning policy over the last decade (EPA, 2009 and references therein). In its statement regarding the SWREL Project, the EPA stated that even though Ecological Linkages are just one measure of the conservation values of a patch of remnant vegetation it expected that:

> *"In preparing plans and proposals for development, consideration will be given to both the site-specific biodiversity conservation values of patches of native vegetation, as well as the landscape function and core linkage significance of a patch in supporting the maintenance of ecological linkage"* (EPA, 2009).

Figure 5. Linkage proximity values assigned to patches of remnant vegetation within a landscape (Molloy *et al*., 2009).
Note: in Figure 5, 'linkage' refers to the linkage axis line.

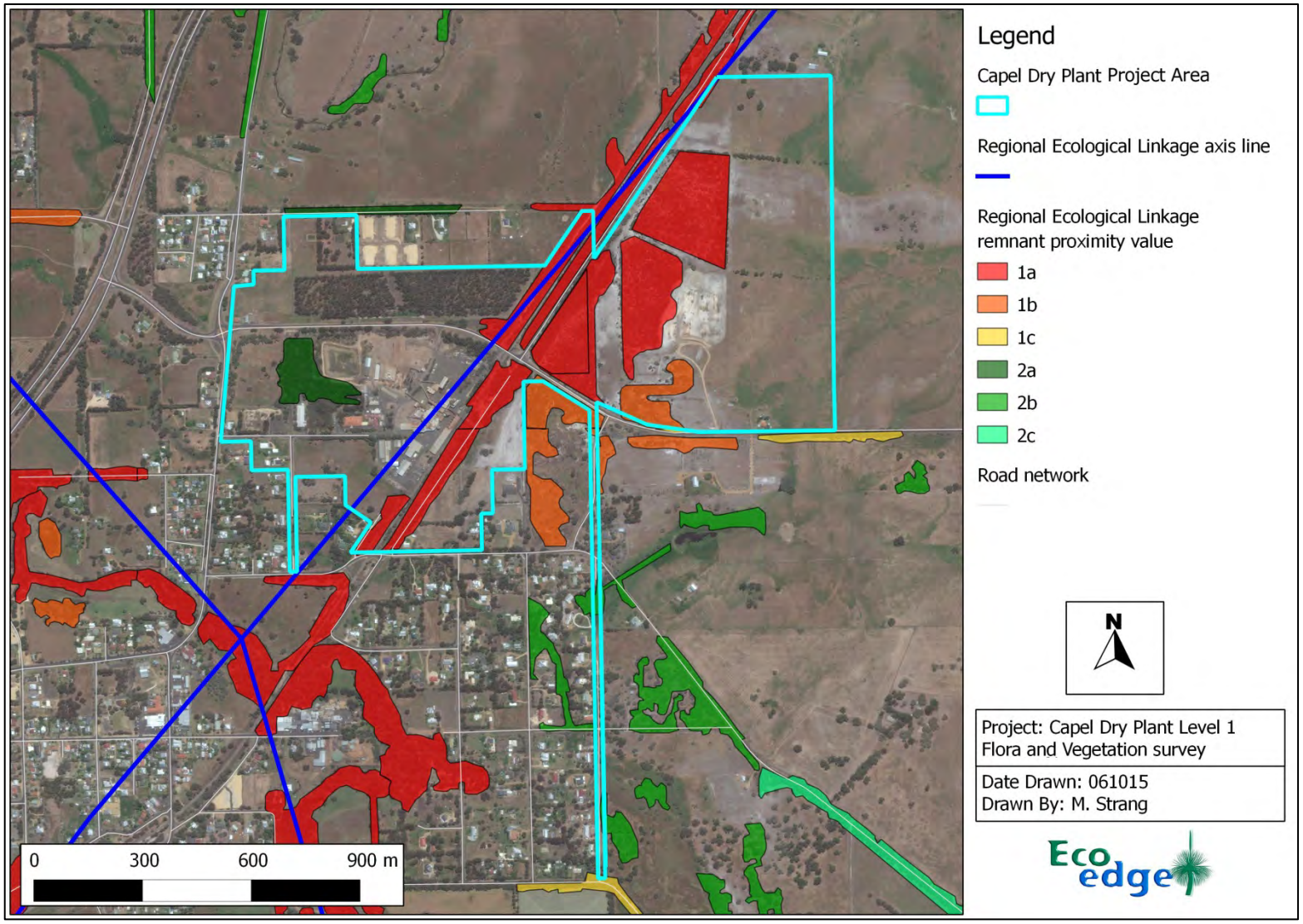

Figure 6. The Project Area in relation to regional ecological linkages (Molloy *et al.*, 2009).

2 Methods

2.1 Desktop Study

Prior to the field survey, a 'desktop survey' was carried out by downloading from NatureMap (DPaW, 2015c) a list of all flora (including rare flora) occurring within 10 km of the Project Area. A Protected Matters Search Tool report was also generated, detailing all species listed under the *EPBC Act* (DotE, 2015b) (**Appendix 1**). A download of data from the DEFL and W.A. Herbarium databases (dated September 2015) of records occurring within 5 km of the Project Area was also accessed. This data was used to establish the list of DRF and Priority flora to target during the survey, as well as providing a list of what other plant taxa might be encountered during the survey.

Vegetation condition was assessed against the method of Keighery (1994) (**Table 9**).

Table 9. Vegetation condition ratings according to Keighery (1994).

Score	Description
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good (4)	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded (6)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

2.2 Field Survey

The initial assessment was carried out on 21 and 29 September 2015. The random meander method as described in Cropper (1993) was used to search for rare flora. Follow-up visits to the site occurred on 5 and 12 October to gather more information on late-flowering species and to gather information for refining vegetation mapping. A comprehensive list of native and introduced species was compiled. Photographs were taken and notes on species composition, vegetation structure and vegetation condition were compiled at fifty three unmarked relevés within the Project Area to be used, along with aerial photography, in mapping vegetation type and condition.

In addition to the unmarked relevés, a 100 m^2 floristic quadrat was marked out by metal stakes within an area of *Corymbia calophylla-Xanthorrhoea brunonis* open forest CcXbOF rated as "very good-excellent" condition. A species list of the flora within this area was compiled to assist with further analysis of the status of this community.

Flora species that were not identified in the field were collected or photographed for later identification. Taxonomy and conservation status of flora species was checked against Department of Parks and Wildlife databases (DPaW, 2015d and 2015e). No attempt was made to identify all of the 'amenity' species planted near the Iluka offices or other buildings within the Project Area.

2.3 Survey limitations

Potential limitations with regard to the assessment are addressed in **Table 10**.

Table 10. Limitations with regard to assessment adequacy and accuracy.

Aspect	Constraint	Comment
Scope	No	The survey scope was prepared in consultation with the client and was designed to comply with EPA requirements.
Proportion of flora identified	Negligible	The survey was carried out in September and October- a time which experience has shown to be the prime flowering time for flora on the southern Swan Coastal Plain. It is estimated that 90-95% of species in the remnant vegetation were identified.
Availability of contextual information	Low	Comprehensive regional surveys of remnant vegetation, as well as more localised surveys, have been carried out on the southern Swan Coastal Plain.
Completeness of the survey	Negligible	Vegetation within the Project Area was thoroughly search on foot. Further assessments outside the spring season would add to the completeness of the species list but probably only marginally affect the conclusions presented.
Skill and knowledge of the botanists	Negligible	The senior field botanist conducting the survey has had extensive experience in botanical survey in south west Australia over a period of 25 years.
Climatic conditions	Moderate	Winter rainfall for the Project Area was only about 70% of the long-term average and this had a noticeable effect on flowering period.

3 Results

3.1 Flora

Two hundred and fourteen taxa of vascular flora were identified within the Project Area, of which 54 (25.2%) were exotic species (**Appendix 2**). These exotic species are mainly those which are naturalised, or semi-naturalised within the remnant vegetation: as explained above, 'amenity' species planted near offices and other buildings were not identified. The plant family with the highest representation was the Fabaceae with 27 species (including 11 species of *Acacia*), of which seven were exotic. The next highest representation at the family level were Myrtaceae (19 species, including 2 exotics), Poaceae (18: 11), Cyperaceae (15: 1), Proteaceae (14) and Orchidaceae (13).

Two weeds classified as C3 (management) Category Pest Plants under the under the *Biosecurity and Agriculture Management Act 2007* (**Asparagus asparagoides* (Bridal Creeper), **Zantedeschia aethiopica* (Arum Lily)) were found within the Project Area. The location of these weeds within the Project Area is shown in **Figure 7**.

3.2 Rare Flora

3.2.1 *Drakaea elastica* (DRF)

Two separate occurrences of the DRF orchid species *Drakaea elastica* are shown by the Declared Endangered Flora (DEFL) database to be present within the Project Area. Both of these records are more than five years old (2006, 2009). Due to inaccurate latitude and longitude information associated with the records, they are shown in a different location than they were actually found (based on the description of their location in the DEFL record) when mapped.

The 2006 collection, when mapped using the coordinates provided with the record, is shown to be located south 125 m south of the junction of Gavins Road and Capel-Boyanup Road, when in actual fact according to the description given with the record the *Drakaea elastica* plant occurred on the 'north verge' at the junction of the two roads. In addition, a precise description of their location provided with the 2009 collection also allows the actual location of the three *D. elastica* plants sighted at that time to be found.

A thorough search of the locations of the two *D. elastica* occurrences recorded in DEFL failed to find any of the plants. The site of the 2006 collection at the junction of Gavins Road and Capel-Boyanup Road appears to have been impacted by physical disturbance since that time and it is likely that this sub-population (3B) is extinct. The three plants recorded for the 2009 DEFL collection "38 m uphill from SECWA pole No 302 within 1 m E of dead banksia tree" are also possibly no longer extant, this area having been severely impacted by *Phytophthora* dieback disease.

3.2.2 *Stylidium paludicola* (P3)

Four of the Priority 3 species, *Stylidium paludicola*, were found 125 m north of the junction of Gavins Road and Capel-Boyanup Road within Crown land reserve 3249 (**Figure 7, Figure 8** and **Table 11**). These are close to a 2003 WA Herbarium collection record for the same species.

3.2.3 *Caladenia speciosa* (P4)

Three plants of the Priority 4 orchid *Caladenia speciosa* were found within *Banksia attenuata – B. ilicifolia* woodland in Crown land reserve 3249 (**Figure 7**, **Figure 9** and **Table 11**)

3.2.4 *Acacia semitrullata* (P4)

Acacia semitrullata (Priority 4) was found in four locations within *Banksia attenuata – B. ilicifolia* woodland in Crown land reserve 3249 (**Figure 7**, **Figure 10** and **Table 11**).

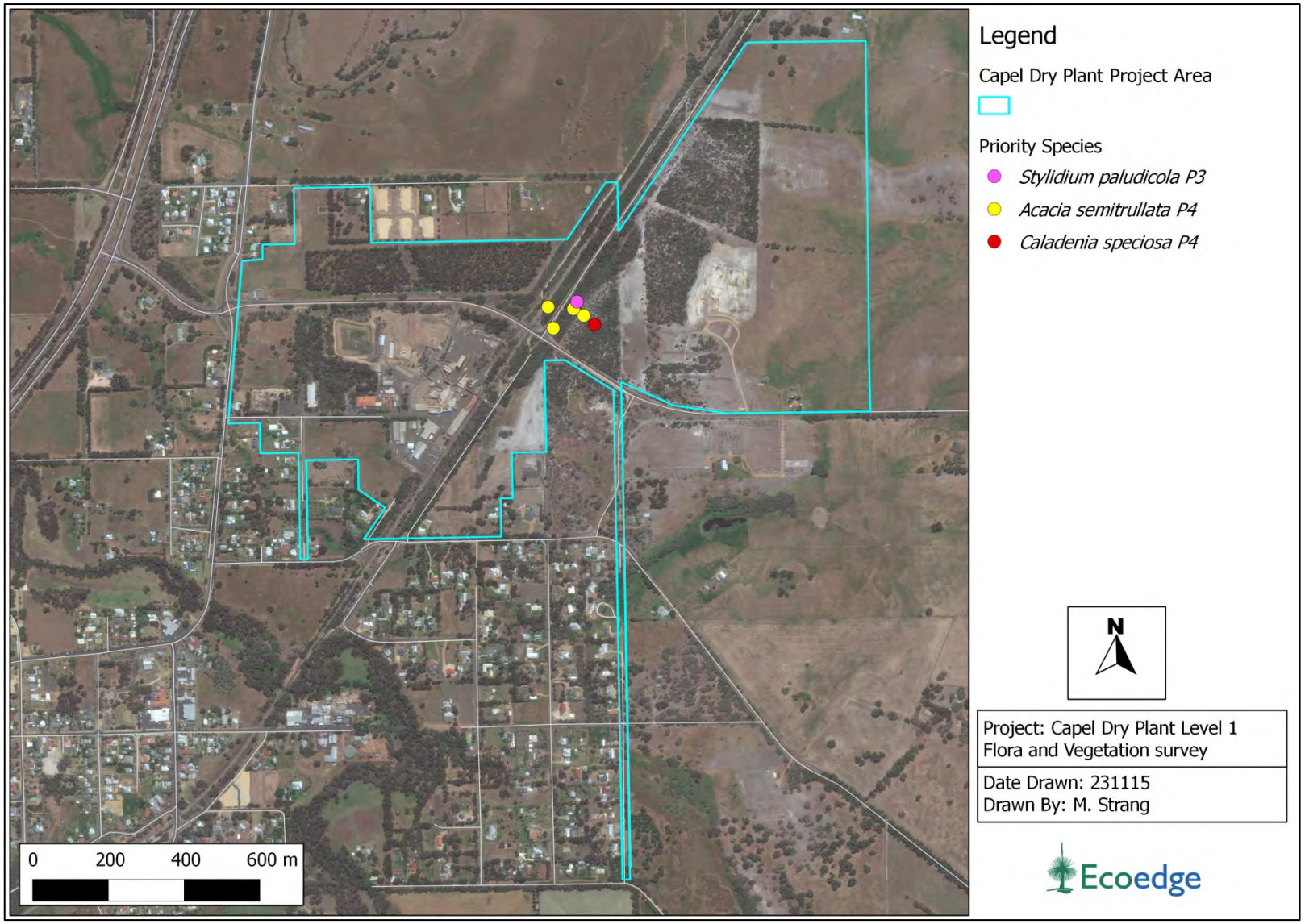

Figure 7. Locations of Priority flora species with the Capel Dry Plant Project Area.

Figure 8. *Stylidium paludicola* (P3).

Figure 9. *Caladenia speciosa* (P4).

Figure 10. *Acacia semitrullata* (P4).

Table 11. Coordinates of Priority flora found within the Project Area.

Species	Easting	Northing	No. of plants
Stylidium paludicola (P3)	367686.94	6287508.64	4
Caladenia speciosa (P4)	367732.26	6287448.21	3
Acacia semitrullata (P4)	367703.83	6287473.09	1
	367676.28	6287489.09	1
	367622.97	6287437.55	1
	367608.75	6287495.31	1

3.3 Conservation Status of the DRF and Priority Flora within the Project Area

Crown land reserve (Nature Reserve) 3249 contained all of the Priority species that were found during this survey, and where two sub-populations of the DRF species *Drakaea elastica* were previously located. *Drakaea elastica* was declared as Rare Flora under the Western Australian *WC Act* in July 1988 and is ranked as Critically Endangered (CR) under World Conservation Union criteria due to the severe fragmentation of populations and the continuing decline in the area, extent and quality of habitat and number of mature individuals (DotE, 2015e).

It is possible that the two sub-populations *of D. elastica* within the Project Area have declined because of declining autumn-winter rainfall in the south west of Western Australia (BOM, 2015) and a decline in overstorey cover within Reserve 3249. Dieback disease has been active within the reserve and has removed the *Banksia* overstorey in the vicinity of one of the sub-populations. Increased survival of *D. elastica* in more shaded compared to more exposed sites has been observed and may be related to increased heat stress in exposed sites (Carstairs and Coates, 1994).

Stylidium paludicola was recently listed as Priority Three under DPaW Conservation Codes for Western Australian Flora. It is found in seasonally wet localities in grey to black peaty sand over clay. *S. paludicola* has a scattered distribution in a region (the Swan Coastal Plain from Bullsbrook to Capel) marked by extensive land clearing and subject to ongoing development pressures. Only a small number of populations are known from nature reserves and population sizes and threats are not known. Further survey is required (Wege, 2014).

Both *Caladenia speciosa* and *Acacia semitrullata*, being in the Priority 4 category, are considered to have been adequately surveyed or for which sufficient knowledge is available, and are considered not currently threatened or in need of special protection, but could be if present circumstances change (DPaW, 2014). These species are usually represented on conservation lands, as is the case with their occurrence within the Project Area.

3.4 Pest Plants

Two exotic species found within the Project Area; Bridal Creeper (**Asparagus asparagoides*) and Arum Lily (**Zantedeschia aethiopica*) are Declared Pest Plants within the C3 (management) Category for the whole of Western Australia. The distribution of these pest plants is shown in **Figure 11**.

3.5 Vegetation Units

Eleven vegetation units dominated by trees or shrubs were identified within the Project Area (**Table 12, Figure 12**). One of these units, which is not discussed further, is dominated by plantations of exotic species of trees such as Blue Gum (*Eucalyptus globulus*). Another unit (Code named 'Cc/Er_pasture') is composed primarily of exotic weed or pasture species with an overstorey primarily of *Corymbia calophylla* (Marri), but also in places by *Eucalyptus rudis* subsp. *cratyantha* (Flooded Gum). *E. rudis* subsp. *cratyantha* is classified as Priority 4 because much of its original habitat has been cleared and the trees that are left are often subjected to multiple disturbances, such as a drying climate, grazing by livestock and severe attack by insects.

The vegetation units ('floristic community types': FCTs) of the southern Swan Coastal Plain were originally defined by Gibson *et al.* (1994) 'the Swan Coastal Plain survey'). Webb *et al*. (2009) in their report on the flora and vegetation of the Busselton Plain describe a number of communities that were not identified by the survey by Gibson *et al.*

The vegetation of sites on the Swan Coastal Plain can be placed within established FTCs by the use of data from floristic quadrats followed by multivariate analysis, or by comparison of a list of species from a vegetation unit at the new site with a list of the characteristic species of the floristic community types defined by Gibson *et al*. (1994). However, because not all remnant vegetation was sampled during the Swan Coastal Plain survey there are vegetation units (particularly wetland communities) that do not fit neatly into any of the defined FCTs.

In **Table 13**, below, the vegetation units of the Project Area are paired with their closest match from the communities described in Gibson *et al*. (1994) or the communities of Webb *et al*. (2009) (if a close fit could not be found in the former source). The matches were based on a comparison of the species composition of the vegetation units of the Project Area (**Appendix 3**) with the FCTs described in Gibson *et al*. (1994) or the communities of Webb *et al*. (2009). Photographs of the vegetation units are included in **Appendix 4.**

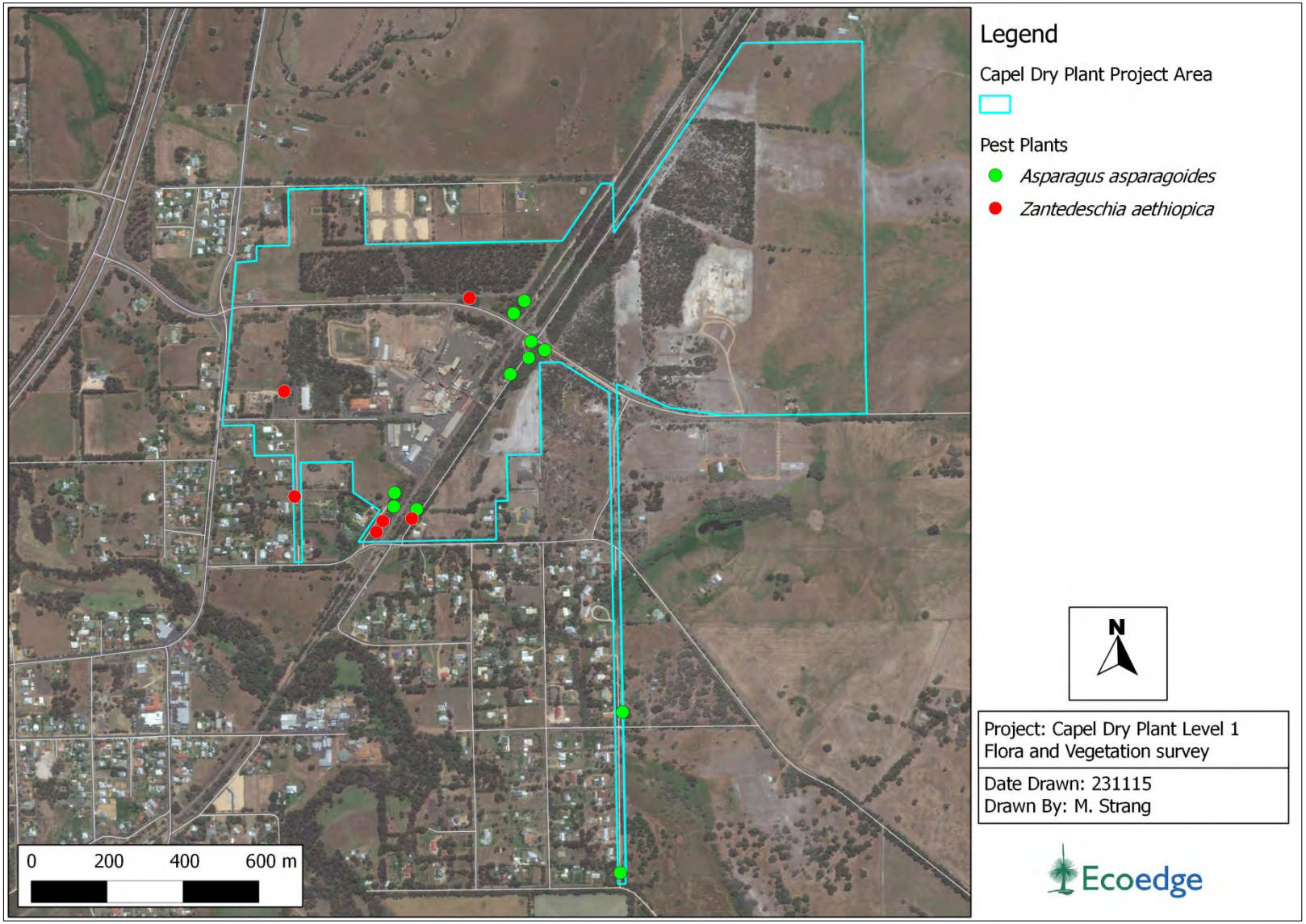

Figure 11. Location of pest plants within the Project Area.

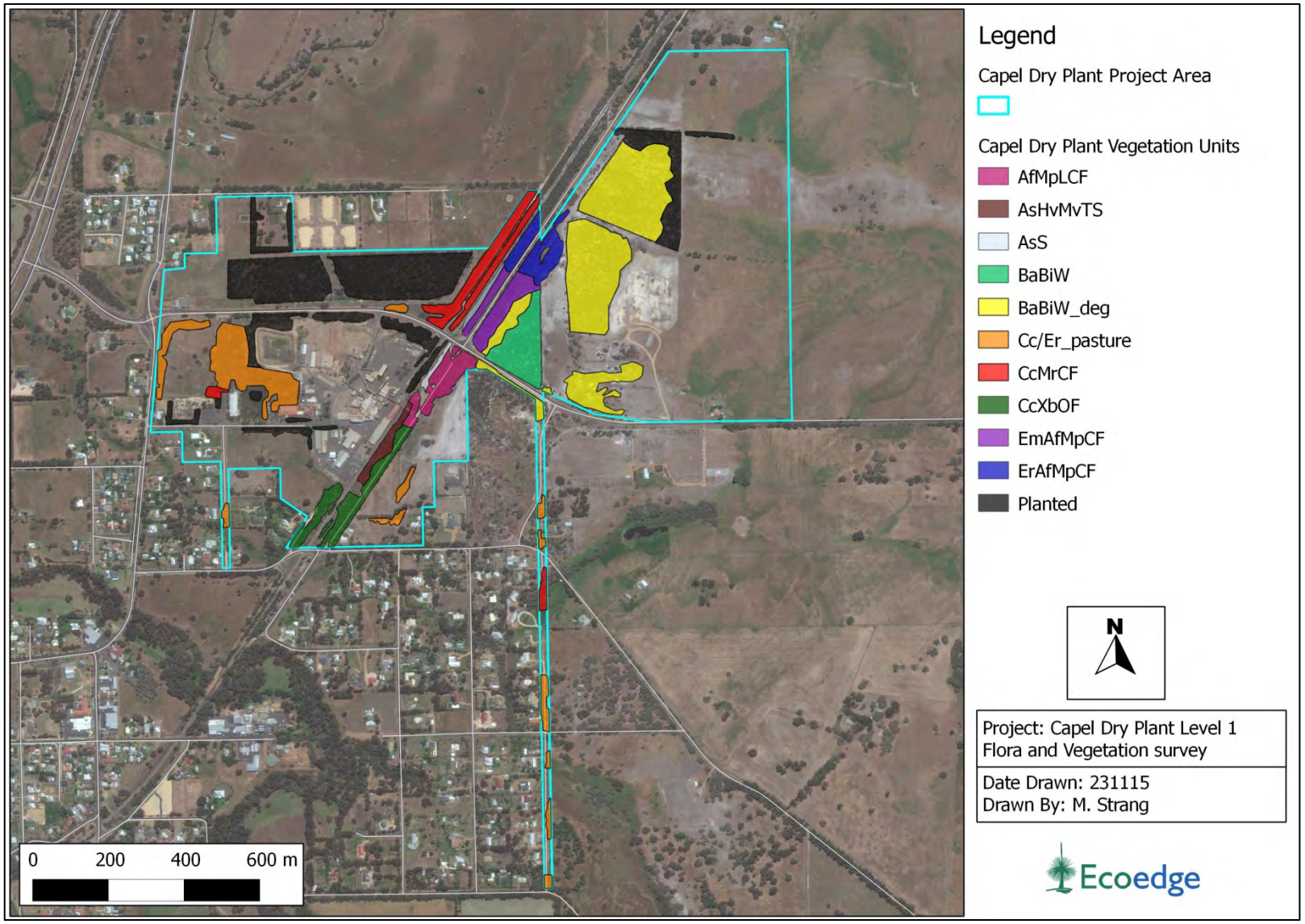

Figure 12. Vegetation units in the Project Area.

Table 12. Vegetation Units within the Project Area.

CODE	NAME	DESCRIPTION
AfMpLCF	*Agonis flexuosa-Melaleuca preissiana* low closed forest	Low forest of *Agonis flexuosa* and *Melaleuca preissiana* (with occasional emergent *Corymbia calophylla*) over a sparse shrub understorey including *Astartea scoparia Dasypogon bromeliifolius*, *Xanthorrhoea gracilis* and exotic grasses including **Eragrostis curvula* on grey sand with thick leaf litter.
AsHvMvTS	*Acacia saligna-Hakea varia-Melaleuca viminea* tall shrubland	Tall shrubland of *Acacia saligna*, *Astartea scoparia*, *Hakea varia*, *Melaleuca viminea* and *Viminaria juncea* with occasional low shrubs of *Synaphea petiolaris* over a sparse herbaceous understorey that includes *Austrostipa mollis*, *Caesia micrantha*, **Eragrostis curvula*, **Sparaxis bulbifera* and **Watsonia meriana* on brown clay.
AsS	*Astartea scoparia* shrubland	Shrubland to open heath of *Astartea scoparia* over sedgeland of *Lepidosperma longitudinale* and *Meeboldina* spp.
BaBiW	*Banksia attenuata-Banksia ilicifolia* woodland	Woodland/low woodland of *Banksia attenuata* and *B. ilicifolia* with emergent *Eucalyptus marginata* over tall open shrubland including *Kunzea glabrescens* over *Allocasuarina humilis*, *Dasypogon bromeliifolius*, *Hibbertia hypericoides*, *Hypocalymma robustum*, *Stirlingia latifolia* over open herbs, grasses and sedges including *Burchardia congesta*, *Conostylis aculeata*, **Ehrharta calycinus* and **Ursinia anthemoides* on grey sand
BaBiW_deg	*Banksia attenuata-Banksia ilicifolia* woodland (degraded)	Woodland/low woodland or tall shrubland of *Banksia attenuata*, *B. ilicifolia* over *Kunzea glabrescens* (with emergent *Eucalyptus marginata* – often dead) over a sparse understorey including the shrubs *Dasypogon bromeliifolius* and *Hibbertia vaginata* and a mainly introduced herbaceous layer including **Arctotheca calendula*, **Ehrharta longiflora*, **Hypochaeris glabra* and **Ursinia anthemoides* on grey sand.
Cc/Er_pasture	*Corymbia calophylla* or *Eucalyptus rudis* over pasture or weeds	*Corymbia calophylla* or occasionally *Eucalyptus rudis* over mainly exotic grasses including **Avena fatua*, **Ehrharta longiflora*, **E. calycina*, **Eragrostis curvula* on red-brown loam
CcMrCF	*Corymbia calophylla-(Eucalyptus rudis)-Melaleuca rhaphiophylla* closed forest	Closed forest/low forest to open forest of *Corymbia calophylla* and *Eucalyptus rudis* (occasional) over *Melaleuca rhaphiophylla* over open shrubland of *Astartea scoparia*, *Acacia saligna* and *Viminaria juncea* over sedgeland of *Baumea vaginalis*, *Cyathochaeta avenacea* and *Lepidosperma longitudinale* with (in degraded areas) exotic herbs and grasses including **Acacia longifolia*, **Asparagus asparagoides*, **Plantago lanceolata* and **Watsonia meriana* on red-brown or grey-brown clay loam
CcXbOF	*Corymbia calophylla -Xanthorrhoea brunonis* open forest	Open forest of *Corymbia calophylla* over an open shrubland of *Xanthorrhoea brunonis*, *Hibbertia hypericoides* and *Synaphea petiolaris* (occasional) over a layer of herbs, grasses and sedges including *Agrostocrinum scabrum*, *Caesia micrantha*, *Austrostipa mollis*, *Cyathochaeta avenacea* and *Mesomelaena tetragona* with a varying admixture of exotic shrubs and herbs including **Acacia longifolia*, **Asparagus asparagoides*, **Sparaxis bulbifera*, **Watsonia meriana*, **Ehrharta calycina*, **Eragrostis brownii* and **Plantago lanceolata* on red-brown clay-loam.
EmAfMpCF	*Eucalyptus marginata-Agonis flexuosa-Melaleuca preissiana* closed forest	Closed forest of *Eucalyptus marginata* (scattered) over *Agonis flexuosa* and *Melaleuca preissiana* over open shrubland of *Acacia extensa, A. pulchella, Adenanthos meisneri*, *Astartea scoparia, Dasypogon bromeliifolius, Jacksonia furcellata* and *Xanthorrhoea brunonis* over open herbs and sedges including *Anarthria prolifera, Drosera menziesii* and *Opercularia hispidula* on grey-brown loamy sand
ErAfMpCF	*Eucalyptus rudis-Agonis flexuosa-Melaleuca preissiana* closed forest	Closed forest to open forest of *Eucalyptus rudis* (emergent) over *Agonis flexuosa*, *Calostachyus lanceolata* and *Melaleuca preissiana* over shrubland of *Astartea scoparia* and *Kunzea glabrescens* over herbland of *Pteridium esculentum* on grey sand with thick leaf litter.
Planted	Plantation of exotic eucalypts and other amenity species	

Table 13. Comparison of the Vegetation Units from the Project Area with FCTs described by Gibson et al. (1994) and Webb et al. (2009).

CODE	NAME	FLORISTIC COMMUNITY TYPE (Gibson *et al.*, 1994)	PLANT COMMUNITY (Webb *et al*., 2009)
AfMpLCF	*Agonis flexuosa-Melaleuca preissiana* low closed forest	Some similarities to *Melaleuca preissiana* Damplands (SCP 04) – however the presence of *Agonis flexuosa* as a co-dominant sets the Project Area vegetation unit apart.	Capel River Communities: the incised floodplain tends to support *Eucalyptus patens*, *Eucalyptus calophylla*, *Agonis flexuosa* and *Melaleuca preissiana*. ('Further survey work of the river vegetation is needed.')
AsHvMvTS	*Acacia saligna-Hakea varia-Melaleuca viminea* tall shrubland	Similarities to Dense shrublands on Clay Flats (SCP 9) which is a Threatened Ecological Community (Vulnerable).	
AsS	*Astartea scoparia* shrubland		Probably a degraded variant of AsHvMvTS or EmAfMpCF where it occurs north of Gavins Road. Appears to have been a result of disturbance associated with construction of the railway.
BaBiW	*Banksia attenuata-Banksia ilicifolia* woodland	Most similar to Southern *Banksia attenuata* Woodlands (SCP 21b) – Priority Ecological Community (Level 3)	
BaBiW_deg	*Banksia attenuata-Banksia ilicifolia* woodland (degraded)	A degraded variant of BaBiW	
CcMrCF	*Corymbia calophylla-(Eucalyptus rudis)-Melaleuca rhaphiophylla* closed forest	Some similarities to Wet Forests and Woodlands (SCP 11)	*Eucalyptus rudis*, *Corymbia calophylla* and *Agonis flexuosa* Closed Low Forest (of Spearwood Dune Wetlands) – Priority Ecological Community (Level 1)
CcXbOF	*Corymbia calophylla -Xanthorrhoea brunonis* open forest	No close matches, but most similar to *Corymbia calophylla-Xanthorrhoea preissii* Woodlands and Shrublands (SCP 3c) which is a Threatened Ecological Community (Critically Endangered).	
EmAfMpCF	*Eucalyptus marginata-Agonis flexuosa-Melaleuca preissiana* closed forest	Some similarities to Wet Forests and Woodlands (SCP 11)	*Eucalyptus rudis*, *Corymbia calophylla* and *Agonis flexuosa* Closed Low Forest (of Spearwood Dune Wetlands) – Priority Ecological Community (Level 1)
ErAfMpCF	*Eucalyptus rudis-Agonis flexuosa-Melaleuca preissiana* closed forest	Some similarities to Wet Forests and Woodlands (SCP 11)	*Eucalyptus rudis*, *Corymbia calophylla* and *Agonis flexuosa* Closed Low Forest (of Spearwood Dune Wetlands) – Priority Ecological Community (Level 1)

3.6 Vegetation Condition

Just under 25 ha of the 123 ha Project Area consists of remnant native vegetation or plantations of amenity trees, of which 21.6 ha comprises native vegetation in a range of condition classes. About 55% of the Project Area was classified as 'Completely Degraded' or 'Degraded' (**Table 14, Figure 13**). At the other end of the scale, 21.7% of the area was classed as 'Very Good to Excellent', with the bulk of this being in Crown Reserve 3249.

Table 14. Distribution of Vegetation Condition by Category within the Project Area.

Condition Score	Area (ha)	%
Completely Degraded	5.71	26.43
Degraded	6.43	29.80
Degraded/Good	1.35	6.26
Good	2.46	11.42
Good/Very Good	0.94	4.37
Very Good/Excellent	4.69	21.72
Totals	**21.59**	**100.00**

The main cause of degradation within the Project Area has been the invasion of aggressive weeds which have out-competed native species and caused a reduction in the species-richness of the remnant vegetation. Weed invasion has been facilitated by a long history of physical disturbance within much of the Project Area. A long history of livestock grazing is evident in the *Banksia* woodland remnants (outside of Crown Reserve 3249) where most of the native understorey species have consequently disappeared. *Phytophthora* dieback disease has also contributed to degradation within the *Banksia* woodland.

There has also been degradation of the remnant vegetation adjacent to the Dry Processing Plant on the railway reserve associated with a long history of physical disturbance.

3.7 *Phytophthora* dieback disease

The following general observations were made during the field survey in relation to *Phytophthora* dieback disease. The soil-borne pathogen *Phytophthora cinnamomi* is potentially present over a large portion of the Project Area due to the long history of soil movement and disturbance. However, it is likely that much of the Project Area would be mapped as 'Uninterpretable' because, mainly due to the effects of past grazing, many of the understorey species susceptible to *Phytophthora* are no longer present. Samples taken from recent deaths or dying plants are required in order to confirm presence or absence of the pathogen. However, because the pathogen has very likely been present for many years and therefore had its impact on the vegetation, there are unlikely to be new deaths resulting from it (except in Reserve 3249). While there is visual evidence that the disease is present on the SECWA easement adjacent to Nature Reserve 3249 and that this infestation is

spreading upslope, it does not appear to have infiltrated far into the Nature Reserve as yet. This is indicated by the high proportion of susceptible species still present in healthy condition. Also, if the disease is present within the CcXbOF community (inferred to be the TEC SCP3c) within the railway reserve, it does not appear to be causing significant impact. Studies have found (e.g. Shearer and Crane, 2011) that plant death related to *Phytophthora cinnamomi* disease is reduced, or inhibited, in fertile loams similar to those found in the railway reserve, and therefore has a reduced impact on native species occurring on these soils.

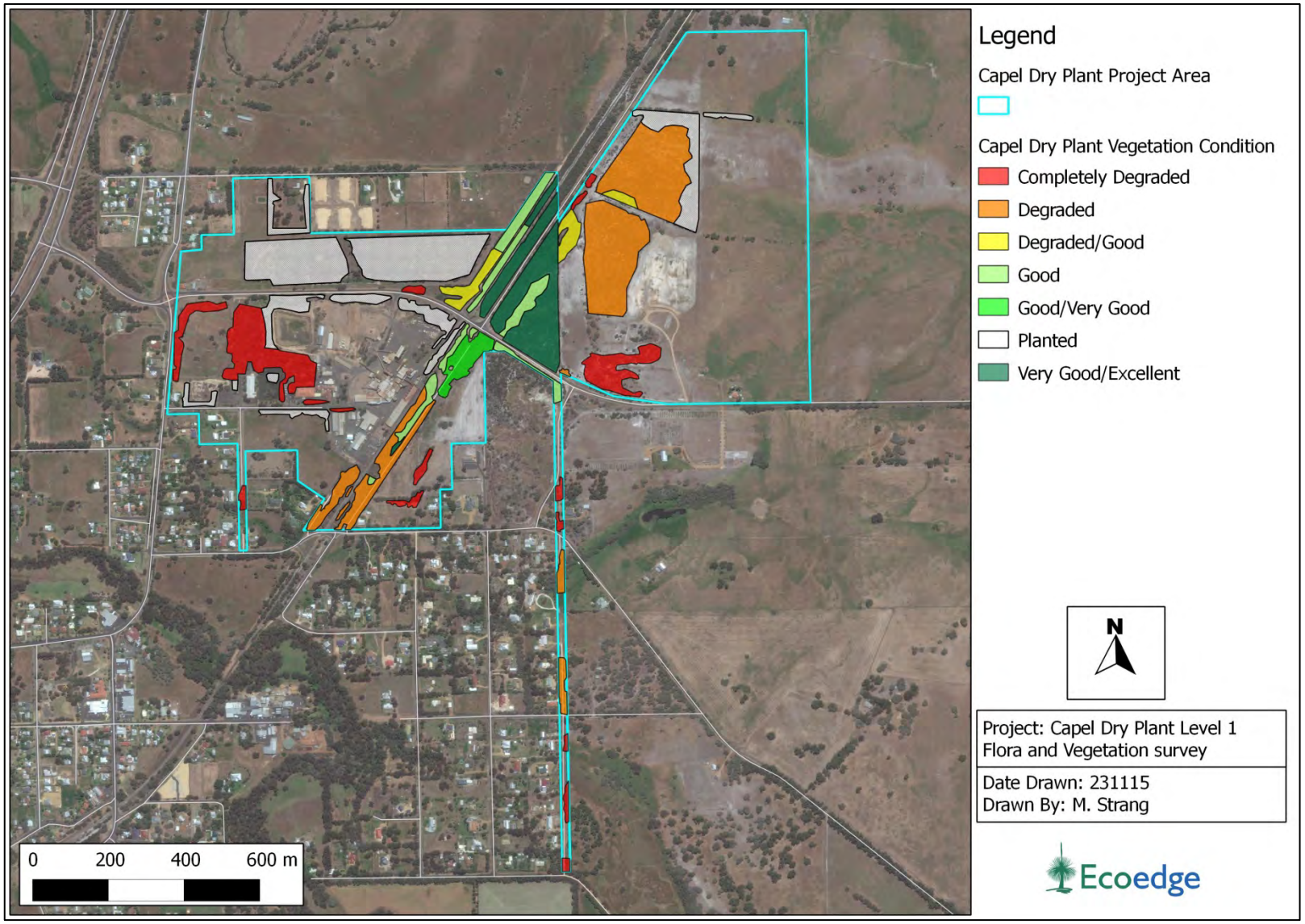

Figure 13. Condition of the vegetation within the Project Area.

3.9 Conservation Status of the Vegetation Units

3.9.1 *Corymbia calophylla -Xanthorrhoea brunonis* open forest (CcXbOF)

This vegetation unit is situated along the railway line immediately to the east and south east of the Capel Dry Plant. The soil within the area covered by this unit, instead of being Bassendean 'B1' ('deep bleached grey sands') as mapped for the area by Schoknecht *et al*. (2004) (**Table 1**, **Figure 2**, above), are actually red-brown clay-loam or brown clay typical of some Pinjarra Plain soil-types of alluvial origin. It appears that this part of the Project Area lies at the northern edge of the Capel River floodplain (the river itself is situated less than 400 m south of the southern part of the Project Area). Consistent with the clay-loam soil type, the vegetation is predominantly an open forest dominated by Marri (*Corymbia calophylla*) together with some Jarrah (*Eucalyptus marginata*).

Most of the approximately 1.8 ha of vegetation mapped as CcXbOF was assessed as in 'Degraded' condition (see Section 3.6, above) - only 1,550 m^2 or 8.65% of the total was assessed as 'Good' or 'Very Good – Excellent'. This community has been heavily invaded by exotic species, such as the bulb-forming **Sparaxis bulbifera* and **Watsonia meriana*, the grass **Eragrostis curvula*, the creeper **Asparagus asparagoides* and the small tree **Acacia longifolia*. Consequently, many of the native understorey species have disappeared. However, in the areas where the vegetation was rated as 'Good' or 'Very Good-Excellent' condition, sufficient of the understorey taxa remained that the floristic composition could be compared to the FCTs of Gibson *et al.* (1994).

A 100 m^2 floristic quadrat was marked out by metal stakes within the area of CcXbOF rated as "very good-excellent" condition and a species list made of the flora within it to assist with further analysis of the status of this community. A comparison of the species occurring within the CcXbOF vegetation unit with the two most likely Swan Coastal Plain Survey FCTs; *Corymbia calophylla-Xanthorrhoea preissii* Woodlands and Shrublands (SCP 3c) and Southern *Corymbia calophylla* Woodlands on Heavy Soils (SCP 1b) showed that it was closer to SCP 3c. The CcXbOF vegetation unit contains 12 out of the 22 'typical' and 'common' taxa (54.5%) of SCP 3c compared to 10 of the 38 'typical' and 'common' taxa (26.3%) of SCP 1b. Although the CcXbOF does not contain *Xanthorrhoea preissii*, one of the 'typical' species of SCP 3c, the two closest listed occurrences of this FCT to the Project Area (along Boyanup-Capel Road and Boyanup West Road) also contain *X. brunonis* rather than *X. preissii* (DEC, 2007).

In summary, there is about 1.8 ha of vegetation unit CcXbOF adjacent to the Capel Dry Plant. While much of this was classed as 'Degraded' and many of the native understorey species having been replaced by weeds, 0.15 ha was in 'Good' or 'Very Good-Excellent' condition. While this is only a small proportion of the total area of the vegetation unit, it is considered to have high conservation value because it is inferred to be a new occurrence of the Critically Endangered Threatened Ecological Community *Corymbia calophylla-Xanthorrhoea*

preissii Woodlands and Shrublands (SCP 3c). The remainder of vegetation unit CcXbOF categorised as 'Degraded' condition is not considered belong to the Threatened Ecological Community SCP 3c because most of the native understorey species have been replaced by exotic species.

3.9.2 *Acacia saligna-Hakea varia-Melaleuca viminea* tall shrubland (AsHvMvTS)

As noted in **Table 13**, this vegetation unit has similarities to the FCT 'Dense shrublands on Clay Flats (SCP 9)' which is a Threatened Ecological Community with the risk status of 'Vulnerable'. Most of this unit was classed as 'Degraded' with much of the ground layer occupied by weeds such as **Watsonia meriana*, or almost bare of a ground layer. Just over 20% of this vegetation unit was assessed as 'Good'. Further assessment may be required to establish whether the part of this vegetation unit that is in 'Good' condition also constitutes an occurrence of a TEC.

3.9.3 Priority Ecological Communities in Crown Reserve 3249

It is inferred that the vegetation units AfMpLCF, CcMrCF, EmAfMpCF and ErAfMpCF within the Project Area represent examples of the Priority 1 Ecological Community '*Eucalyptus rudis*, *Corymbia calophylla* and *Agonis flexuosa* Closed Low Forest (of Spearwood Dune Wetlands)'. Almost all of the area of these communities was assessed as 'Good' or 'Very Good/Excellent' condition. Consultation with DPaW may be required to resolve the status of these communities.

4 Discussion and Conclusions

A spring flora survey of the Project Area identified two hundred and fourteen taxa of vascular flora, of which 54 (25.2%) were exotic species. The total of at least 160 native species in just over 20 ha of native vegetation represents a relatively high level of diversity (R. Smith, unpublished data) and may be ascribed to the number of different habitat types present within the Project Area.

The plants comprising the two recorded sub-populations of the DRF species *Drakaea elastica* were not found during the current survey and they may be extinct. However, the presence of these two sub-population records will need to be taken into account with regard to any proposed works by Iluka that involve ground disturbance.

The location of the populations of priority species within Crown Reserve 3249 found during the survey (*Caladenia speciosa*, *Stylidium paludicola* and *Acacia semitrullata*) also need to be taken into account if any ground disturbance is planned within their vicinity.

Ten vegetation units dominated by native trees or shrubs were identified within the Project Area. One of these units (Cc/Er_pasture) was (by definition) classified as 'Completely Degraded' throughout. The species composition of the other nine vegetation units was compared to the FCTs defined by Gibson *et al*. (1994) for the southern Swan Coastal Plain,

or if there was not a close match with any of these, to the communities described by Webb *et al*. (2009).

One of the vegetation units, *Corymbia calophylla-Xanthorrhoea brunonis* open forest (CcXbOF), had its closest match with and is therefore inferred as the Critically Endangered TEC *Corymbia calophylla-Xanthorrhoea preissii* Woodlands and Shrublands (SCP 3c). Although CcXbOF contains just over half of the 'typical' and 'other common' species listed for the TEC SCP 3c, its position at the southernmost end of the range for that TEC could be posited as the reason for this difference. In particular, a strong case can be made that the 470 m^2 of this vegetation unit that was rated as 'Very Good-Excellent' condition is a new occurrence of SCP 3c.

Another vegetation unit, *Acacia saligna-Hakea varia-Melaleuca viminea* tall shrubland (AsHvMvTS), which occurs on brown clays immediately adjacent to the Dry Processing Plant, also resembles a TEC, in this case 'Dense shrublands on Clay Flats (SCP 9), which is rated as 'Vulnerable'. However most of this community was classed as 'Degraded', with only about 20% being rated as 'Good' condition. Because of the generally poor condition of this vegetation unit (and its relatively low species-richness), the case for it being proposed as a new occurrence of the TEC SCP 9 is not as strong as that for the *Corymbia calophylla-Xanthorrhoea brunonis* open forest community. Advice from DPaW may be required to make a determination about its status.

Four vegetation units within the Project Area (AfMpLCF, CcMrCF, EmAfMpCF and ErAfMpCF) are inferred as examples of the Priority 1 Ecological Community '*Eucalyptus rudis*, *Corymbia calophylla* and *Agonis flexuosa* Closed Low Forest (of Spearwood Dune Wetlands)'. Generally the condition of these communities is very good.

5 Recommendations

- Vegetation along the railway line within the Project Area links in the southwest to vegetation along the Capel River and in the north with vegetation in Nature Reserve 3249 and along the road reserve and railway line along Capel-Boyanup Road, eventually linking to State Forest 27 east of Boyanup. As such, it is recommended that where feasible, vegetation categorised as '1a' or '1b' be retained, so as to minimise the loss of linkage value as much as is possible.

- Care should be exercised during any activities undertaken within parts of the CcXbOF vegetation unit (inferred to be the Critically Endangered TEC *Corymbia calophylla-Xanthorrhoea preissii* Woodlands and Shrublands (SCP 3c)), and particularly the area rated as 'Very Good – Excellent', so that the conservation status of this plant community is maintained. The same also applies to the four vegetation units within the Project Area that are inferred to be examples of the Priority 1 Ecological Community '*Eucalyptus rudis*, *Corymbia calophylla* and *Agonis flexuosa* Closed Low

Forest (of Spearwood Dune Wetlands)' (AfMpLCF, CcMrCF, EmAfMpCF and ErAfMpCF), and to the vegetation unit *Acacia saligna-Hakea varia-Melaleuca viminea* tall shrubland (AsHvMvTS).

- The vegetation unit *Acacia saligna-Hakea varia-Melaleuca viminea* tall shrubland (AsHvMvTS) has similarities to the FCT 'Dense shrublands on Clay Flats (SCP 9)' which is a Threatened Ecological Community with the risk status of 'Vulnerable'. Most of this unit was classed as 'Degraded', however just over 20% of this vegetation unit was assessed as 'Good'. Further assessment may be required to establish whether the part of this vegetation unit that is in 'Good' condition also constitutes an occurrence of a TEC.

- Consultation with DPaW is recommended to resolve the status of the vegetation communities inferred as occurrences of TECs and/or PECs.

- It is recommended that a *Phytophthora* dieback assessment be undertaken before any works involving the movement of soil or plant material are carried out.

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Appendix 1. Protected Matters Search Tool Report

Australian Government

Department of the Environment

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.

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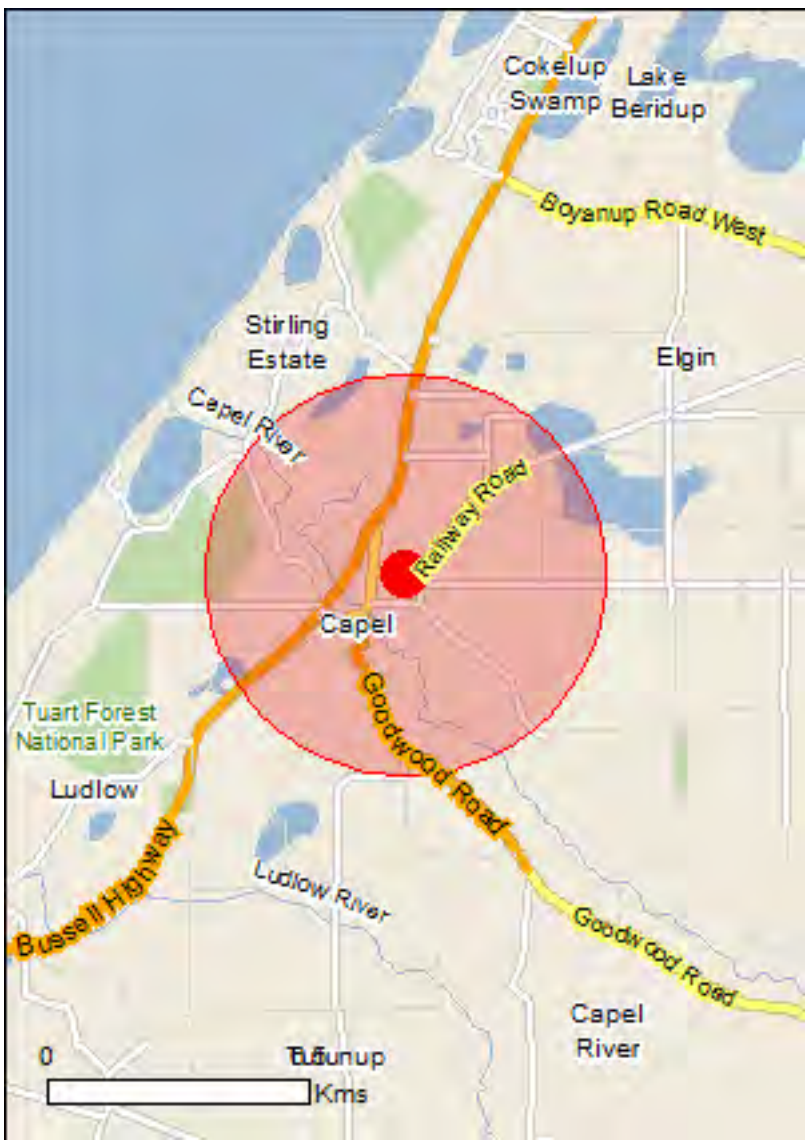

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

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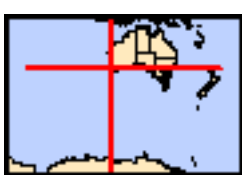

Summary

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:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	26
Listed Migratory Species:	7

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/index.html

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	9
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:	4
Regional Forest Agreements:	None
Invasive Species:	26
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Vasse-wonnerup system	Within 10km of Ramsar

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii		
Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Breeding known to occur within area
Calyptorhynchus latirostris		
Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Mammals		
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Pseudocheirus occidentalis		
Western Ringtail Possum, Ngwayir [25911]	Vulnerable	Breeding known to occur within area
Setonix brachyurus		
Quokka [229]	Vulnerable	Species or species habitat may occur within area
Plants		
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Banksia nivea subsp. uliginosa		
Swamp Honeypot [82766]	Endangered	Species or species habitat likely to occur within area
Banksia squarrosa subsp. argillacea		
Whicher Range Dryandra [82769]	Vulnerable	Species or species habitat may occur within area
Brachyscias verecundus		
Ironstone Brachyscias [81321]	Critically Endangered	Species or species habitat may occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Caladenia procera Carbunup King Spider Orchid [68679]	Critically Endangered	Species or species habitat may occur within area
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. C Coastal Plain (R.D.Royce 4872) Royce's Waxflower [86887]	Vulnerable	Species or species habitat likely to occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Darwinia whicherensis Abba Bell [83193]	Endangered	Species or species habitat may occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Gastrolobium papilio Butterfly-leaved Gastrolobium [78415]	Endangered	Species or species habitat may occur within area
Lambertia echinata subsp. occidentalis Western Prickly Honeysuckle [64528]	Endangered	Species or species habitat may occur within area
Petrophile latericola Laterite Petrophile [64532]	Endangered	Species or species habitat may occur within area
Synaphea stenoloba Dwellingup Synaphea [66311]	Endangered	Species or species habitat known to occur within area
Verticordia densiflora var. pedunculata Long-stalked Featherflower [55689]	Endangered	Species or species habitat likely 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
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

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]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Capel	WA
Tuart Forest	WA
Unnamed WA03249	WA
Unnamed WA50190	WA

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		
Anas platyrhynchos Mallard [974]		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 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

Name	Status	Type of Presence 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
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 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
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may 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

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.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

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

-33.54517 115.57243

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:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA 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, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-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.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix 2. List of vascular flora found within the Project Area at Capel.

FAMILY	SPECIES	NATURALISED	CONSV. CODE
Anarthriaceae	*Anarthria prolifera*		
	Lyginia barbata		
Apiaceae	*Centella asiatica*		
	Zantedeschia aethiopica	*	
Araliaceae	*Trachymene pilosa*		
Asparagaceae	*Asparagus asparagoides*		
	Chamaescilla corymbosa		
	Lomandra purpurea		
	Thysanotus dichotomus		
	Thysanotus manglesianus		
	Thysanotus tenellus		
Asphodelaceae	*Aloe vera*	*	
Asteraceae	*Arctotheca calendula*	*	
	Carduus tenuiflorus	*	
	Conyza bonariensis	*	
	Cotula turbinata	*	
	Dittrichia graveolens	*	
	Hypochaeris glabra	*	
	Lagenophora huegelii		
	Rhodanthe citrina		
	Sonchus oleraceus	*	
	Ursinia anthemoides	*	
Boryaceae	*Borya scirpoidea*		
Brassicaceae	*Raphanus raphanistrum*	*	
Caryophyllaceae	*Stellaria media*	*	
Casuarinaceae	*Allocasuarina humilis*		
Centrolepidaceae	*Aphelia drummondii*		
Colchicaceae	*Burchardia congesta*		
Cyperaceae	*Baumea vaginalis*		
	Chorizandra enodis		
	Cyathochaeta avenacea		
	Cyperus eragrostis	*	
	Ficinia nodosa		
	Lepidosperma longitudinale		
	Lepidosperma pubisquameum		
	Lepidosperma squamatum		
	Mesomelaena tetragona		
	Schoenus bifidus		
	Schoenus curvifolius		
	Schoenus efoliatus		
	Schoenus rigens		
	Schoenus subbulbosus		
	Tetraria octandra		
Dasypogonaceae	*Dasypogon bromeliifolius*		

FAMILY	SPECIES	NATURALISED	CONSV. CODE
Dennstaedtiaceae	*Pteridium esculentum*		
Dilleniaceae	*Hibbertia cuneiformis*		
	Hibbertia diamesogenos		
	Hibbertia hypericoides		
	Hibbertia racemosa		
	Hibbertia vaginata		
Droseraceae	*Drosera bulbigena*		
	Drosera erythrorhiza		
	Drosera menziesii subsp. *penicillaris*		
	Drosera pallida		
Ericaceae	*Conostephium pendulum*		
	Leucopogon australis		
	Leucopogon glabellus		
Fabaceae	*Acacia applanata*		
	Acacia dealbata	*	
	Acacia extensa		
	Acacia iteaphylla	*	
	Acacia longifolia	*	
	Acacia microbotrya		
	Acacia podalyriifolia	*	
	Acacia pulchella var. *pulchella*		
	Acacia saligna		
	Acacia semitrullata		4
	Acacia stenoptera		
	Callistachys lanceolata		
	Daviesia angulata		
	Daviesia physodes		
	Daviesia preissii		
	Eutaxia virgata		
	Gastrolobium capitatum		
	Gastrolobium ebracteolatum		
	Gompholobium marginatum		
	Gompholobium tomentosum		
	Hardenbergia comptoniana		
	Hovea trisperma		
	Jacksonia furcellata		
	Jacksonia horrida		
	Kennedia prostrata		
	Ornithopus compressus	*	
	Ornithopus pinnatus	*	
	Trifolium dubium	*	
	Viminaria juncea		
Geraniaceae	*Erodium botrys*	*	
	Geranium dissectum	*	
	Pelargonium capitatum	*	

FAMILY	SPECIES	NATURALISED	CONSV. CODE
Goodeniaceae	*Dampiera linearis*		
Goodeniaceae	*Scaevola calliptera*		
Haemodoraceae	*Anigozanthos manglesii*		
	Conostylis aculeata subsp. *aculeata*		
	Haemodorum laxum		
	Haemodorum simplex		
	Haemodorum spicatum		
	Phlebocarya ciliata		
Hemerocallidaceae	*Agrostocrinum scabrum*		
	Caesia micrantha		
	Johnsonia lupulina		
	Stypandra glauca		
Iridaceae	*Babiana angustifolia*	*	
	Gladiolus angustus	*	
	Patersonia occidentalis		
	Romulea rosea	*	
	Sparaxis bulbifera	*	
	Sparaxis pillansii	*	
	Watsonia meriana var. *bulbillifera*	*	
	Iridaceae sp.	*	
Juncaceae	*Juncus holoschoenus*		
	Juncus microcephalus	*	
	Juncus pallidus		
Lamiaceae	*Hemiandra pungens*		
Lauraceae	*Cassytha glabella*		
Lentibulariaceae	*Utricularia multifida*		
Loranthaceae	*Nuytsia floribunda*		
Menyanthaceae	*Ornduffia parnassifolia*		
Moraceae	*Ficus carica*	*	
Myrtaceae	*Agonis flexuosa*		
	Astartea scoparia		
	Babingtonia camphorosmae		
	Calytrix flavescens		
	Corymbia calophylla		
	Eucalyptus globulus	*	
	Eucalyptus gomphocephala		
	Eucalyptus marginata		
	Eucalyptus rudis subsp. *cratyantha*		4
	Hypocalymma robustum		
	Kunzea glabrescens		
	Leptospermum laevigatum	*	
	Melaleuca incana		
	Melaleuca preissiana		
	Melaleuca rhaphiophylla		
	Melaleuca thymoides		

FAMILY	SPECIES	NATURALISED	CONSV. CODE
Myrtaceae	*Melaleuca viminea*		
	Pericalymma ellipticum var. *ellipticum*		
	Taxandria linearifolia		
Onagraceae	*Oenothera glazioviana*	*	
Orchidaceae	*Caladenia flava*		
	Caladenia latifolia		
	Caladenia speciosa		4
	Diuris brumalis		
	Elythranthera brunonis		
	Microtis media		
	Pterostylis recurva		
	Pterostylis sp. crinkled leaf (G.J. Keighery 13426)		
	Pterostylis vittata		
	Pyrorchis nigricans		
	Thelymitra antennifera		
	Thelymitra cornicina		
	Thelymitra macrophylla		
Oxalidaceae	*Oxalis glabra*	*	
	Oxalis pes-caprae	*	
Papaveraceae	*Fumaria bastardii*	*	
	Fumaria capreolata	*	
Philydraceae	*Philydrella drummondii*		
Phyllanthaceae	*Phyllanthus calycinus*		
Pittosporaceae	*Billardiera variifolia*		
Plantaginaceae	*Plantago lanceolata*	*	
Poaceae	*Amphipogon turbinatus*		
	Austrostipa campylachne		
	Austrostipa compressa		
	Austrostipa mollis		
	Avena fatua	*	
	Briza maxima	*	
	Bromus diandrus	*	
	Cenchrus clandestinus	*	
	Cortaderia selloana	*	
	Cynodon dactylon	*	
	Ehrharta calycina	*	
	Ehrharta longiflora	*	
	Eragrostis curvula	*	
	Holcus lanatus	*	
	Microlaena stipoides		
	Neurachne alopecuroidea		
	Paspalum dilatatum	*	
	Tetrarrhena laevis		
Polygonaceae	*Rumex conglomeratus*	*	

FAMILY	SPECIES	NATURALISED	CONSV. CODE
Proteaceae	*Adenanthos meisneri*		
	Adenanthos obovatus		
	Banksia attenuata		
	Banksia dallanneyi		
	Banksia ilicifolia		
	Banksia littoralis		
	Hakea lissocarpha		
	Hakea prostrata		
	Hakea varia		
	Persoonia longifolia		
	Petrophile linearis		
	Stirlingia latifolia		
	Synaphea petiolaris subsp. *petiolaris*		
	Xylomelum occidentale		
Ranunculaceae	*Ranunculus muricatus*	*	
Restionaceae	*Harperia lateriflora*		
	Hypolaena exsulca		
	Meeboldina coangustata		
	Meeboldina roycei		
	Stenotalis ramosissima		
Rhamnaceae	*Spyridium globulosum*		
Rubiaceae	*Opercularia apiciflora*		
	Opercularia hispidula		
Rutaceae	*Philotheca spicata*		
Solanaceae	*Solanum nigrum*	*	
Stylidiaceae	*Stylidium androsaceum*		
	Stylidium brunonianum		
	Stylidium paludicola		3
	Stylidium repens		
	Stylidium schoenoides		
Xanthorrhoeaceae	*Xanthorrhoea brunonis*		
	Xanthorrhoea gracilis		
	Xanthorrhoea preissii		
Zamiaceae	*Macrozamia riedlei*		

Appendix 3. Species x vegetation unit matrix

VEGETATION UNIT	AfMpLCF	AsHvMvTS	AsS	BaBiW	BaBiW_deg	CcMrCF	CcXbOF	EmAfMpCF	ErAfMpCF
Acacia extensa	1							1	1
Acacia pulchella var. *pulchella*				1	1			1	1
Acacia saligna		1	1		1	1	1		
Acacia stenoptera			1			1			
Adenanthos meisneri				1				1	
Agonis flexuosa	1							1	1
Agrostocrinum scabrum							1	1	
Allocasuarina humilis				1					
Anarthria prolifera								1	
Anigozanthos manglesii				1					
Astartea scoparia	1	1	1			1	1	1	1
Astroloma ciliatum							1		
Austrostipa mollis							1		
Babingtonia camphorosmae							1		
Banksia attenuata				1	1				
Banksia dallanneyi							1		
Banksia ilicifolia				1	1				
Banksia littoralis						1			
Baumea vaginalis						1		1	
Burchardia congesta				1	1				
Caesia micrantha		1					1		
Caladenia flava									1
Caladenia latifolia									1
Callistachys lanceolata									1
Calytrix flavescens					1				
Chamaescilla corymbosa	1								
Conostephium pendulum				1					
Conostylis aculeata subsp. *aculeata*					1				
Corymbia calophylla	1					1	1	1	

VEGETATION UNIT	AfMpLCF	AsHvMvTS	AsS	BaBiW	BaBiW_deg	CcMrCF	CcXbOF	EmAfMpCF	ErAfMpCF
Cyathochaeta avenacea						1	1		
Dampiera linearis		1				1	1	1	
Dasypogon bromeliifolius	1			1	1			1	
Daviesia preissii							1		
Drosera erythrorhiza				1				1	
Drosera menziesii subsp. *penicillaris*								1	
Drosera pallida								1	
Elythranthera brunonis				1	1				
Eucalyptus marginata				1	1		1	1	
Eucalyptus rudis						1		1	1
Ficinia nodosa						1			
Gladiolus angustus							1		
Gompholobium marginatum							1		
Haemodorum laxum							1		
Haemodorum spicatum	1								
Hakea varia		1				1	1		
Hardenbergia comptoniana					1			1	1
Hemiandra pungens				1	1				
Hibbertia cuneiformis	1								
Hibbertia hypericoides				1	1		1		
Hibbertia vaginata				1					
Hovea trisperma								1	
Hypocalymma robustum				1					
Hypolaena exsulca				1					
Jacksonia furcellata								1	
Juncus pallidus	1					1			
Kennedia prostrata									1
Kunzea glabrescens				1	1			1	1
Lepidosperma longitudinale	1					1			1
Lepidosperma pubisquameum							1		
Leucopogon australis	1								

VEGETATION UNIT	AfMpLCF	AsHvMvTS	AsS	BaBiW	BaBiW_deg	CcMrCF	CcXbOF	EmAfMpCF	ErAfMpCF
Lyginia barbata	1				1				
Macrozamia riedlei				1	1				
Meeboldina roycei			1						1
Melaleuca preissiana	1		1					1	1
Melaleuca rhaphiophylla						1			
Melaleuca thymoides				1				1	
Melaleuca viminea		1					1		
Mesomelaena tetragona		1					1		
Microlaena stipoides	1								
Neurachne alopecuroidea							1		
Nuytsia floribunda							1	1	
Opercularia apiciflora							1		
Opercularia hispidula						1		1	
Ornduffia parnassifolia						1			
Patersonia occidentalis		1		1		1	1		
Philotheca spicata								1	
Phlebocarya ciliata					1			1	
Phyllanthus calycinus							1		
Pteridium esculentum					1	1		1	1
Pterostylis sp. crinkled leaf (G.J. Keighery 13426)								1	
Pterostylis vittata	1			1					
Pyrorchis nigricans				1					
Scaevola calliptera						1		1	
Sparaxis bulbifera		1					1		
Stirlingia latifolia				1	1				
Stypandra glauca							1		
Synaphea petiolaris subsp. *petiolaris*	1		1				1		
Taxandria linearifolia						1			1
Tetraria octandra							1		
Tetrarrhena laevis	1								
Thelymitra cornicina							1		

VEGETATION UNIT	AfMpLCF	AsHvMvTS	AsS	BaBiW	BaBiW_deg	CcMrCF	CcXbOF	EmAfMpCF	ErAfMpCF
Utricularia multifida		1							
Viminaria juncea		1	1			1			
Xanthorrhoea brunonis							1	1	
Xanthorrhoea gracilis	1						1		
Xylomelum occidentale				1	1				

Appendix 4. Photographs of Vegetation Units in the Capel Dry Plant Project Area

Agonis flexuosa-Melaleuca preissiana low closed forest (AfMpLCF)

Acacia saligna-Hakea varia-Melaleuca viminea tall shrubland (AsHvMvTS)

Astartea scoparia shrubland (AsS)

Banksia attenuata-Banksia ilicifolia woodland (BaBiW)

Banksia attenuata-Banksia ilicifolia woodland (degraded) (BaBiW_deg)

Corymbia calophylla-(Eucalyptus rudis)-Melaleuca rhaphiophylla closed forest (CcMrCF)

Corymbia calophylla -Xanthorrhoea brunonis open forest (CcXbOF) – Very Good-Excellent condition

Corymbia calophylla -Xanthorrhoea brunonis open forest (CcXbOF) – Degraded condition

Eucalyptus marginata-Agonis flexuosa-Melaleuca preissiana closed forest (EmAfMpCF)

Eucalyptus rudis-Agonis flexuosa-Melaleuca preissiana closed forest (ErAfMpCF)