LEVEL 2 FLORA AND VEGETATION SURVEY

OF THE PROPOSED OCEAN REEF MARINA

SURVEY AREA

Prepared for

Strategen

on behalf of

City of Joondalup

Prepared by

Mattiske Consulting Pty Ltd

December 2013

STR1301/41/13

Mattiske Consulting Pty Ltd

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ABBREVIATIONS

BOM	Bureau of Meteorology
DPaW	Department of Parks and Wildlife
DOE	Department of the Environment
EP Act	Environmental Protection Act 1986
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FCT	Floristic Community Types
PEC	Priority Ecological Community
TEC	Threatened Ecological Community
WAPC	Western Australian Planning Commission
WC Act	Wildlife Conservation Act 1950

1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned in September 2013 by Strategen to undertake a Level 2 flora and vegetation survey of the proposed Ocean Reef Marina survey area, Figure 1. The survey area covers 59.18 hectares, of which, 33.37 hectares (56%) was mapped inside the application (impact) area. A total of 65 mapping sites were surveyed.

A total of 137 vascular plant taxa which are representative of 105 plant genera and 43 plant families were recorded within the survey area. The majority of the taxa recorded were representative of the Poaceae (20 taxa), Fabaceae (14 taxa), Asteraceae (12 taxa) and Myrtaceae (6 taxa) families. Perennials accounted for 91 taxa (66.5%), 33 taxa (24%) were annuals and 13 taxa (9.5%) were annual/perennial depending on local conditions.

No Declared Threatened Flora species were recorded within the survey area. Two Priority Flora species were recorded, namely *Grevillea* sp. Ocean Reef (P1)) and *Conostylis bracteata* (P3). A large population (>60 individuals) of *Grevillea* sp. Ocean Reef (P1) was recorded within an approximate 50 x 50 m area in the central consolidated dunes. This is the only known population of *Grevillea* sp. Ocean Reef (P1) in the database of the West Australian Herbarium. It is recommended that the application area boundary near Hodges Drive be revised to avoid potential impacts to this population. *Conostylis bracteata* (P3) was relatively common amongst the central consolidated dunes, being recorded in over 20% of the sites surveyed.

No Threatened Ecological Communities were inferred to occur within the survey area. Floristic aspects of three Priority Ecological Communities were inferred to occur within the survey area, these being SCP 24 Northern Spearwood shrublands and woodlands (P3); SCP 29a Coastal shrublands on shallow sands, southern Swan Coastal Plain (P3) and; SCP 29b Acacia shrublands on taller dunes, southern Swan Coastal Plain (P3). Within mapped extents of the survey area approximately 46% of SCP 24, 67% of SCP 29a and 31% of SCP 29b occur within the application (impact) area.

The survey area is located within the Bush Forever site – Coastal Strip from Burns Beach to Hillarys (Bush Forever site number 325). This Bush Forever site covers a total area of approximately 280.6 ha, of which, 28.2 ha occurs within the Proposed Ocean Reef Marina application (impact) area, reducing the total remaining area of this site by just over 10%.

Eleven vegetation communities were delineated and mapped across the survey area. The survey area generally comprised structurally intact coastal vegetation in a narrow strip between residential developments and the ocean. In many instances, however, the native understory had been replaced by exotics as a result of widespread and sustained weed invasion. Vegetation communities formed a mosaic of shrub/scrub and heath communities with occurrences linked to dune type and position. Vegetation community boundaries were often discontinuous, with boundaries resembling admixtures of two or more communities.

Two Pre-European vegetation associations occurred within the survey area, namely Guilderton_129 and Guilderton_1007. Mapped areas of Guilderton_129 vegetation associations occurred outside the application area. With respect to the current proposal, representation of Guilderton_1007 vegetation associations would be reduced by 0.18% across the Swan Coastal Plain IBRA Region and 17.75% within the City of Joondalup.

Two System 6 vegetation complexes occurred within the survey area, namely the Cottesloe Complex (central & south) and the Quindalup Complex. Mapped areas of the Cottesloe Complex (central & south) occurred outside the application area. With respect to the proposal, current representation of the Quindalup Complex would be reduced by 0.1% across the Swan Coastal Plain IBRA Region and 10.9% within the City of Joondalup. In reference to the Local Government Biodiversity Planning Guidelines Criteria 1b – Local Representation, under 10% of the Pre-European extent remains for the Cottesloe Complex (central & south) and 12.5% remains for the Quindalup Complex. With respect to current application area, LGA representation of the Quindalup Complex would be further reduced to 11.2%.

Of the 137 plant taxa recorded within the survey area, 49 species were introduced (36%). Of these, no introduced taxa have a Declared Pests status in the City of Joondalup. The high incidence of introduced taxa within the survey area was likely due to fragmentation, unauthorized clearing and dumping of refuse and proximity to residential areas.

Generally, common Swan Coastal plant species were recorded in the survey area, however, the structure and assemblages of those species were considered locally uncommon given the high degree of clearing associated with infrastructure and development on vast areas of the Swan Coastal Plain.

379000mE 379500mE 380000mE

6486500mN 6486000mN 6485500mN 6485000mN

Resolute Way

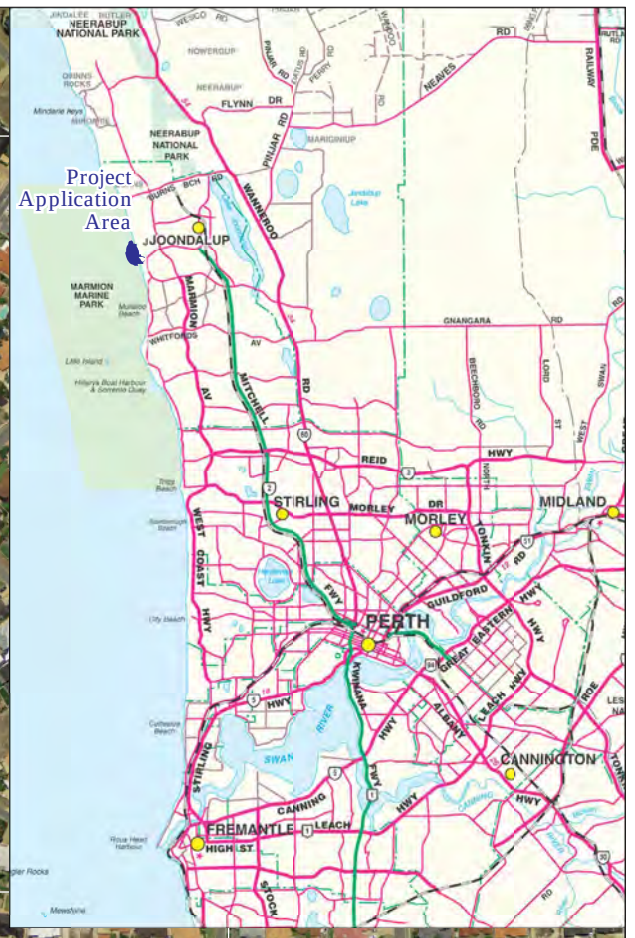
Ocean Reef Road

Hodges Drive

Swanson Way

Application Area

Vegetation Survey Limit



Notes:
Application area boundary - Taylor Burrell Barnett (29/10/2013)
Proposed development - Taylor Burrell Barnett (29/10/2013)
Aerial photography - Landgate (January 2013)
This figure to be read in conjunction with Mattiske Consulting Pty Ltd report numbered STR1301/41/13

Client: City of Joondalup

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MGA94 (Zone 50)
CAD Ref: g2155_f09.dgn
Date: Dec 2013 | Rev: B | A3

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Ocean Reef Marina

Locality

Showing Aerial Mosaic & Proposed Development

Figure: **1**

2. INTRODUCTION`

Mattiske Consulting Pty Ltd was commissioned in September 2013 by Strategen to undertake a Level 2 flora and vegetation survey of the proposed Ocean Reef Marina Development Area.

2.1 Location and Scope of Proposal

The Proposed Ocean Reef Marina survey area is located in the suburb of Ocean Reef on the Swan Coastal Plain, Perth Western Australia. It extends for approximately 1.6 km along the coastline, north of Northshore Drive and west of Ocean Reef Road (Figure 1). The total survey area covers approximately 59 hectares, of which, 56.4% occurs inside the application area.

The survey area lies in the Swan Coastal Plain Unit of the Drummond Botanical Subdistrict, part of the greater South-West Botanical District (Beard, 1990). More recently, the vegetation of Western Australia has been assigned to bioregions and subregions under the Interim Biogeographic Regionalisation for Australia (IBRA), with the project area being within the Swan Coastal Plain subregion (SWA2) (DOE, 2013c).

The aim of the current survey was to define, quantify and qualify botanical values present within the Proposed Ocean Reef Marina survey area.

2.2 Climate

The Swan Coastal Plain has a typically Mediterranean climate with hot, dry summers and mild wet winters (Gentilli 1972; Beard 1990; Gibson *et al*., 1994). Annual rainfall ranges from a low of 700 mm to the north and rises to over 1000 mm at the base of the scarp to the south. Winter rains account for the majority of annual rainfall (Gibson *et al*., 1994). Figure 2 details rainfall and temperature data from the closest and most representative recording stations to the survey area (BOM, 2013). Rainfall data were sourced from both Tamala Park (Mindarie) and the Wanneroo recording stations due to gaps in both data sets. Temperature data for 2013 was largely unavailable for surrounding recording stations, therefore the 2012 temperature data from the Perth Metro station were used (Figure 2). This survey was conducted in October 2013 following unseasonably high rainfall in the preceding three months. Rainfall from February to June was unusual, exceeding expectations in March and May and below expectations for April and June (Figure 2).

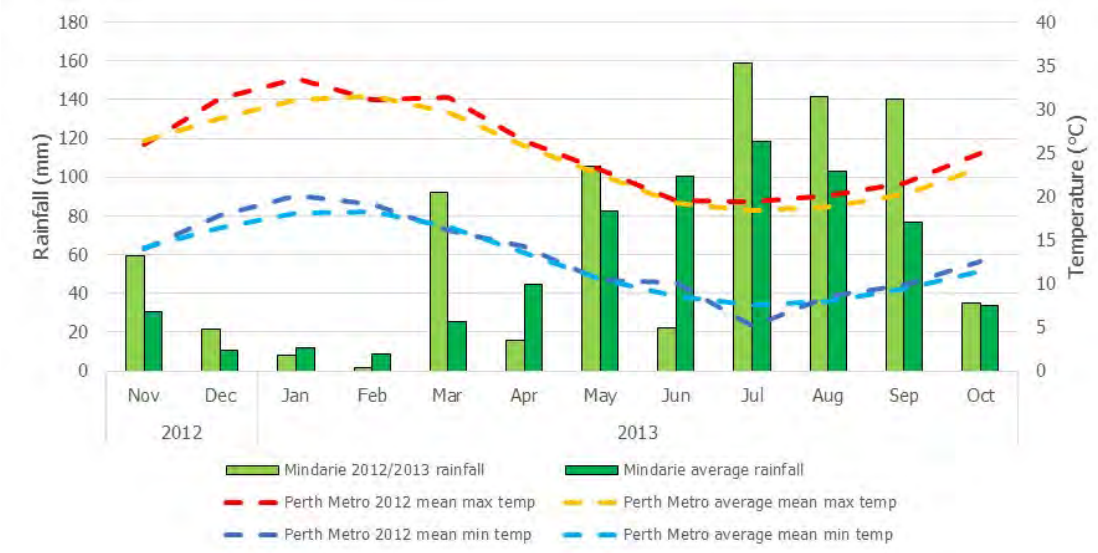


Figure 2: Rainfall and Temperature Data for the Tamala Park (Mindarie), Wanneroo and Perth Metro Recording Stations
Long term average rainfall and temperature data, together with monthly rainfall data for the period November 2012 to October 2013 are shown (BOM, 2013).

2.3 Soils and Topography

The Swan Coastal Plain comprises five major geomorphological systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward and McArthur 1980; Gibson *et al.*, 1994). Each major system is composed of further subdivisions in the form of detailed geomorphological units (Churchward and McArthur 1980; Semeniuk 1990; Gibson *et al.*, 1994).

The survey area is situated on two major geomorphological systems namely the Quindalup and Spearwood Dunes. The Quindalup dune system extends along the western margin of the plain and consists of calcareous sands (Beard, 1981; Gibson *et al.,* 1994). The Spearwood dune and plain system consists of leached and podzolized surface sands and yellow to reddish brown deeper sands.

2.4 Regional Vegetation

The Drummond Botanical Subdistrict is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (tuart), *Eucalyptus marginata* (jarrah) and *Corymbia calophylla* (marri) woodlands on less leached soils (Beard, 1990). The Drummond Botanical Subdistrict comprises twelve physiographic units (systems), with the survey area situated within the Guilderton System, a division of the more commonly known Quindalup Dune System.

The Guilderton System is described as a coastal dune complex typically comprising *Acacia* spp. thickets (most commonly *A. rostellifera* and *A. cyclops*) and *Acacia lasiocarpa – Melaleuca systena* dominated heaths on stabilised dunes. Less common and variable vegetation associations occur on mobile sands closer to the coast (Figure 3).

2.4.1 Swan Coastal Plain Bioregion (System 6 / part System 1) Vegetation

Regional scale vegetation complex mapping by Heddle *et al.* (1980) indicates that vegetation associations within the survey area are likely to belong to two broad vegetation complexes namely Cottesloe Complex (Central and South) and Quindalup Complex (Figure 4). A brief description of each vegetation complex is provided below:

Cottesloe Complex (Central and South) is predominantly a mixed Eucalypt forest consisting of *Eucalyptus gomphocephala, Eucalyptus marginata* and *Corymbia calophylla* with occasional dense stands of *Eucalyptus foecunda*. Common species in the second tree layer include *Banksia attenuata*, *Agonis flexuosa* and *Allocasuarina fraseriana*.

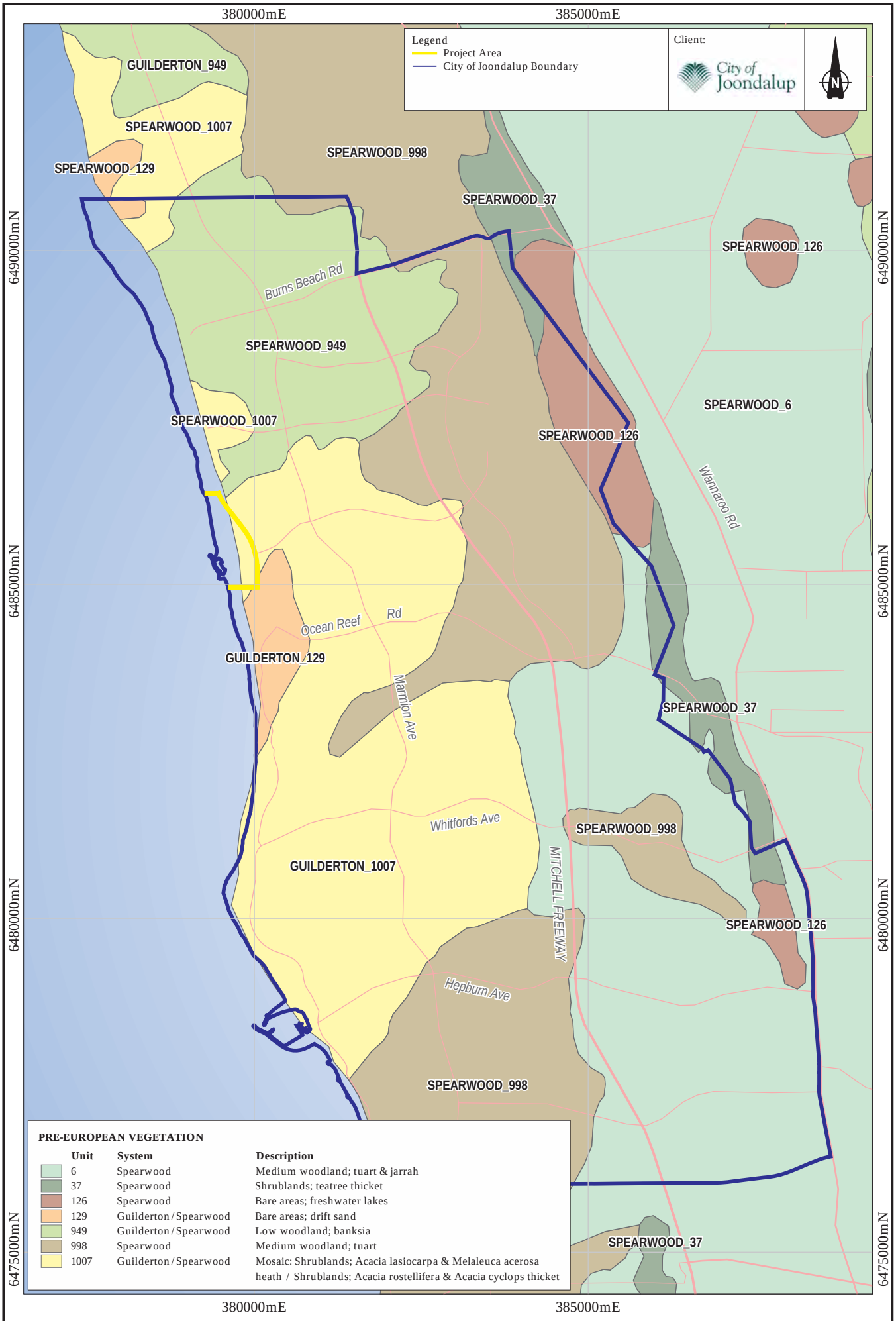
Quindalup Complex is a coastal dune complex containing four broad age related subdivisions. The two oldest Quindalup formations are most likely to occur within the survey area and contain a mix of *Acacia* species, *Melaleuca systena*, *Pimelea ferruginea* and occasional tall woodlands of *Agonis flexuosa*.

2.5 Western Australia's Flora – A Legislative Perspective

Western Australia has a unique and diverse flora, and is recognised as one of the world's 34 biodiversity hotspots (Myers *et al.* 2000). In this context, Western Australia possesses a high degree of species richness and endemism. This is particularly pronounced in the south-west region of the state. There are currently over 12,000 plant species known to occur within Western Australia (DPaW 2013a), and scientific knowledge of many of these species is limited.

The legislative protection of flora within Western Australia is principally governed by three Acts. These are:

- The *Wildlife Conservation Act 1950*;
- The *Environmental Protection Act 1986*; and
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.



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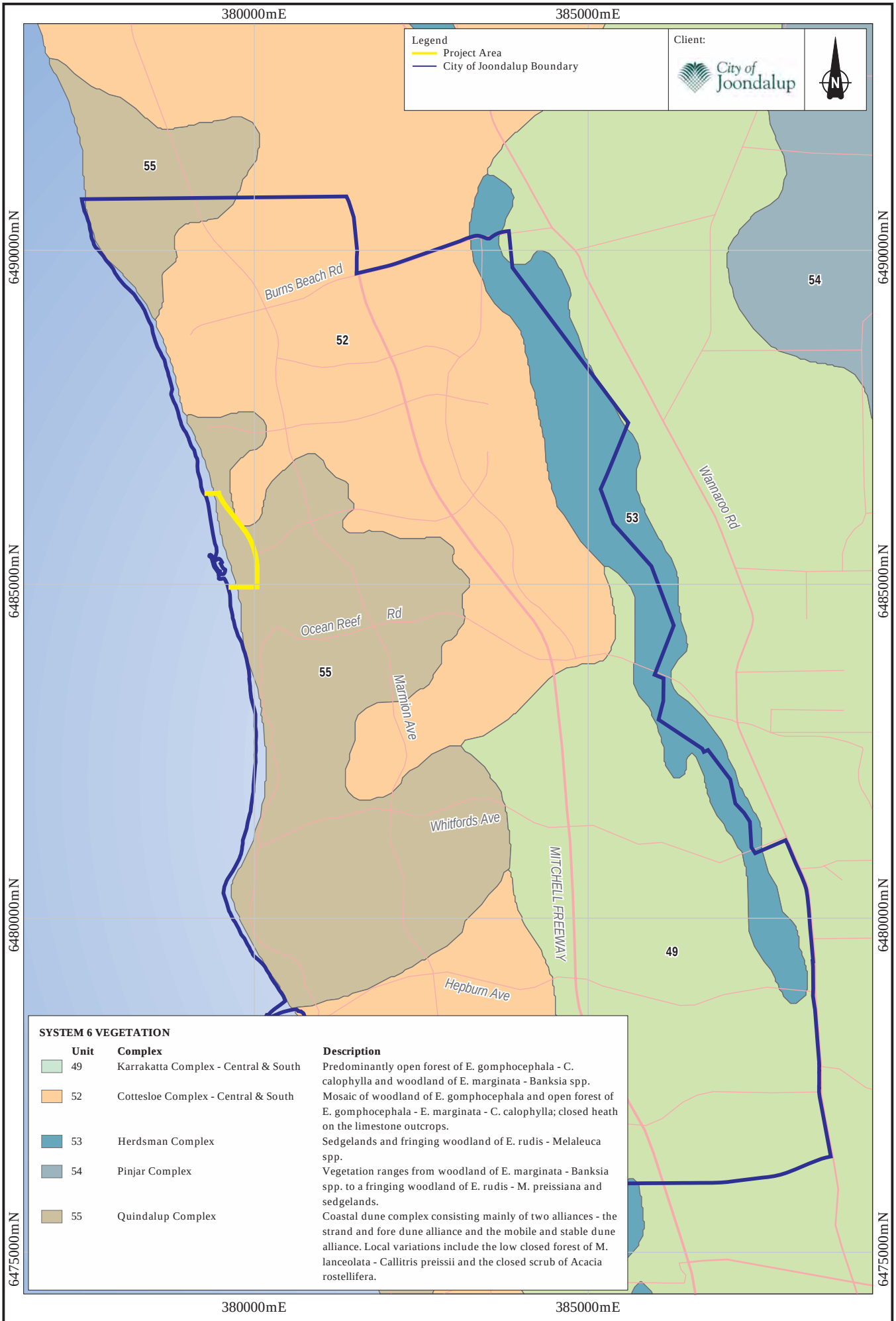
Ocean Reef Marina

Pre-European Vegetation

City of Joondalup

Figure: **3**



SYSTEM 6 VEGETATION

Unit	Complex	Description
49	Karrakatta Complex - Central & South	Predominantly open forest of E. gomphocephala - C. calophylla and woodland of E. marginata - Banksia spp.
52	Cottesloe Complex - Central & South	Mosaic of woodland of E. gomphocephala and open forest of E. gomphocephala - E. marginata - C. calophylla; closed heath on the limestone outcrops.
53	Herdsman Complex	Sedgelands and fringing woodland of E. rudis - Melaleuca spp.
54	Pinjar Complex	Vegetation ranges from woodland of E. marginata - Banksia spp. to a fringing woodland of E. rudis - M. preissiana and sedgelands.
55	Quindalup Complex	Coastal dune complex consisting mainly of two alliances - the strand and fore dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of M. lanceolata - Callitris preissii and the closed scrub of Acacia rostellifera.

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Ocean Reef Marina

System 6 Vegetation

City of Joondalup

Figure: **4**

The unique flora of Western Australia is potentially under threat due to historical clearing practices associated with agricultural, mining and human habitation activities. As a consequence of these historical clearing practices a number of flora species have become threatened or have the potential to become threatened as their habitat is impacted by human activity. In addition, some areas of the State have been affected by past clearing practices such that entire ecological communities are under threat.

The following sections describe these threatened and priority flora and ecological communities, and outline the legislative protection afforded to them.

At the State level, the *Wildlife Conservation Act 1950 (WC Act*) provides for taxa of native flora (and fauna) to be specially protected because they are subject to identifiable threats. Protection of these taxa has been identified as being warranted because they may become extinct, are threatened, or are otherwise in need of special protection. Ecological communities that are deemed to be threatened are afforded protection under the *Environmental Protection Act 1986 (EP Act)*. Listings of threatened species and communities are reviewed annually by the Western Australian Threatened Species Scientific Committee (TSSC), which is a body appointed by the Minister for the Environment and supported by the DPaW. The TSSC reviews threatened and specially protected flora (and fauna) listings on an annual basis. Recommendation for additions or deletions to the listings of specially protected flora (and fauna) is made to the Minister for the Environment by the TSSC, via the Director General of the DPaW, and the WA Conservation Commission. Under Schedule 1 of the *WC Act*, the Minister for the Environment may declare that a class or description of flora to be threatened flora throughout the State, by notice published in the *Government Gazette* (DPaW 2013b).

At the Commonwealth level, under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, a nomination process exists, to list a threatened species or ecological community. Additions or deletions to the lists of Threatened species and communities are made by the Minister for Sustainability, Environment, Water, Populations and Communities, on advice from the Federal Threatened Species Scientific Committee. *EPBC Act* lists of Threatened flora and ecological communities are published on the DOE website (2013a, 2013b).

2.5.1 Threatened and Priority Flora

Flora within Western Australia that is considered to be under threat may be classed as either threatened flora or priority flora. Where flora has been gazetted as threatened flora under the *WC Act*, it is an offence “to take” such flora without the written consent of the Minister. The *WC Act* states that “to take” flora includes to gather, pluck, 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 constitute species which are considered to be under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. Such species are considered to potentially be under threat, but do not have legislative protection afforded under the *WC Act*. The DPaW categorises priority flora according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such species, with P1 listed species being the most threatened, and P5 the least. Priority flora species are regularly reviewed, and may have their priority status changed when more information on the species becomes available. Appendix A1 sets out definitions of both threatened and priority flora (DPaW 2013c).

At the Commonwealth level, under the *EPBC Act*, threatened species can be listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent, by the Commonwealth Minister for the Department of the Environment. Refer to Appendix A2 for a description of each of these categories of threatened species. Under the *EPBC Act*, a person must not take an action that has or will have a significant impact on a listed threatened species without approval from the Commonwealth Minister for the Department of the Environment, unless those actions are not prohibited under the Act.

The current *EPBC Act* list of Threatened flora may be found on the DOE (2013a) website.

2.5.2 Threatened and Priority Ecological Communities

An ecological community is defined as a naturally occurring biological assemblage that occurs in a particular type of habitat composed of specific abiotic and biotic factors. At the State level, ecological communities may be considered as threatened once they have been identified as such by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. A TEC is defined, under the *EP Act*, as an ecological community listed, designated or declared under a written law or a law of the Commonwealth as threatened, endangered or vulnerable. There are four State categories TECs: presumed totally destroyed (PD); critically endangered (CR); endangered (EN); and vulnerable (VU) (DPaW, 2013d). A description of each of these categories of TECs is presented in Appendix A3. TECs are gazetted as such (DPaW, 2013e).

At the Commonwealth level, some Western Australian TECs are listed as threatened, under the *EPBC Act*. Under the *EPBC Act*, a person must not take an action that has or will have a significant impact on a listed threatened ecological community without approval from the Commonwealth Minister for the Department of the Environment, unless those actions are not prohibited under the Act. A description of each of these categories of TECs is presented in Appendix A4. The current *EPBC Act* list of TECs can be located on the DOE (2013b) website.

Ecological communities identified as threatened, but not listed as TECs, can be classified as PECs. These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. The DPaW categorises priority ecological communities according to their conservation priority, using five categories, P1 to P5, to denote the conservation priority status of such ecological communities, with P1 communities being the most threatened and P5 the least. Appendix A5 sets out definitions of priority ecological communities (DPaW 2013d). A list of current PECs can be viewed at the DPaW (2013f) website.

2.5.3 Clearing of Native Vegetation

Under the *EP Act*, the clearing of native vegetation requires a permit to do so, from the DPaW or the Department of Mines and Petroleum, unless that clearing is exempted under specific provisions listed in Schedule 6 of the Act, or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Under the *EP Act*, "native vegetation" means indigenous aquatic or terrestrial vegetation, and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation. Under the *EP Act*, Section 51A, "clearing" means the killing or destruction of, the removal of, the severing or ringbarking of trunks or stems of, or the doing of any other substantial damage to, some or all of the native vegetation in an area, and includes the draining or flooding of land, the burning of vegetation, the grazing of stock, or any other act or activity, that causes any of the aforementioned consequences or results.

Under the *EP Act*, ten principles are set out, under which native vegetation should not be cleared. These principles state that native vegetation should not be cleared, if:

a. it comprises a high level of biological diversity;
b. it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;
c. it includes, or is necessary for the continued existence of, threatened flora;
d. it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community;
e. it is significant as a remnant of native vegetation in an area that has been extensively cleared;
f. it is growing in, or in association with, an environment associated with a watercourse or wetland;
g. the clearing of the vegetation is likely to cause appreciable land degradation;
h. the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;
i. the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or
j. the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 5, sets out prescribed clearing actions that do not require a clearing permit, as defined in Section 51C of the *EP Act*.

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, under Regulation 6 –"Environmentally sensitive areas" are defined as "the area covered by vegetation within 50 m of threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the threatened flora is located".

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* - Regulation 6 (Environmentally sensitive areas), the area covered by a TEC, is similarly considered an Environmentally sensitive area and therefore non-permitted, unless Ministerial approval is granted.

2.6 Declared (Plant) Pest Organisms

The *Biosecurity and Agriculture Management Act 2007* (*BAM Act*), Section 22, makes provision for a plant taxa to be listed as a declared pest organism in respect of parts of, or the entire State. According to the *BAM Act*, a declared pest is defined as a prohibited organism (Section 12), or an organism for which a declaration under section 22 (2) of the Act is in force.

Under section 26 (1) of the *BAM Act*, a person who finds a declared plant pest must report, in accordance with subsection (2), the presence or suspected presence of the declared pest to the Director General or an inspector of the Department of Agriculture and Food Western Australia.

Under the *Biosecurity and Agriculture Management Regulations 2013*, declared plant pests are placed in one of three control categories, C1 (exclusion), C2 (eradication) or C3 (management), which determines the measures of control which apply to the declared pest (Appendix A6). According to section 30 (3) of the *BAM Act*, the owner or occupier of land, or a person who is conducting an activity on the land, must take the prescribed control measures to control the declared pest if it is present on the land.

The current listing of declared pest organisms and their control category is available on the Western Australian Organism List, at the Biosecurity and Agriculture Management website of the Department of Agriculture and Food Western Australia (2013).

2.7 Local and Regional Significance

Flora or vegetation may be locally or regionally significant in addition to statutory listings by the State or Federal Government.

In regards to flora; species, subspecies, varieties, hybrids and ecotypes may be significant other than as threatened flora or priority flora, for a variety of reasons, including:

- a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status
- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution; and
- being poorly reserved (Environmental Protection Authority 2004).

Vegetation may be significant because the extent is below a threshold level and a range of other reasons, including:

- scarcity;
- unusual species;
- novel combinations of species;
- a role as a refuge;
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- being representative of the range of a unit (particularly, a good local and/or regional example of a unit in "prime" habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- a restricted distribution (Environmental Protection Authority 2004).

Vegetation communities are locally significant if they contain Priority Flora species or contain a range extension of a particular taxon outside of the normal distribution. They may also be locally significant if they are very restricted to one or two locations or occur as small isolated communities. In addition,

vegetation communities that exhibit unusually high structural and species diversity are also locally significant.

Vegetation communities are regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of threatened Flora.

Determining the significance of flora and vegetation may be applied at various scales, for example, a vegetation community may be nationally significant and governed by statutory protection as well as being locally and regionally significant.

3. OBJECTIVES

The aim of the current survey was to undertake a Level 2 Flora and Vegetation assessment of the proposed Ocean Reef Marina. Specifically, the objectives include:

- Collect and identify the vascular plant species present in the survey area;
- Collect and identify the Declared Threatened and Priority vascular plant species ;
- Review the conservation status of the vascular plant species recorded by reference to current literature and current listings by the DPaW (2013a) and plant collections held at the Western Australian State, and listed on the DOE (2013a) under the *EPBC Act* (Commonwealth);
- Record information regarding the GPS co-ordinates and number of plants for any known or potential Declared Threatened Flora and Priority Flora located during the survey;
- Undertake the flora survey to standards set out in Guidance Statement 51 (Environmental Protection Authority 2004);
- Lodge Threatened and Priority Flora Report Forms with the Department of Parks and Wildlife for all recorded localities of Declared Threatened Flora and Priority Flora species;
- Define and map native vegetation communities, Floristic Community Types and their condition;
- Review the local and regional significance of vegetation communities and vegetation associations recorded within the survey area; and
- Prepare a report summarising the findings.

4. METHODS

Prior to undertaking survey work, a desktop search for Declared Threatened and Priority flora and Threatened and Priority Ecological Communities that have the potential to occur within the survey area was undertaken using Florabase and NatureMap (DPaW 2013a; 2013g).

Assessment of flora and vegetation of the survey area was undertaken by three experienced Botanists from Mattiske Consulting Pty Ltd on the 14th, 16th and 17th of October 2013. A total of 65 sampling sites were selected using high resolution aerial photographic maps of the survey area as supplied by CAD Resources and opportunistic field selection (Appendix B). Survey sites consisted of pegged 10 x 10 m quadrats. All geographical coordinates cited in this report are based on the GDA94 datum. The survey was undertaken in accordance with the recommendations made in Guidance Statement 51 (Environmental Protection Authority 2004).

The flora and vegetation was described and sampled systematically at each survey site, and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site the following floristic and environmental parameters were recorded:

- GPS location;
- topography;
- percentage and type of litter cover;
- soil type and colour;
- percentage of bare ground;
- outcropping rocks and their type;
- notes on disturbance and vegetation condition
- site photograph
- time since fire; and
- number, height and percentage cover of species.

All plant specimens collected during the field surveys were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. Plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the DPaW (2013a; 2013c).

PRIMER v6 (Plymouth Routines in Multivariate Ecological Research) statistical analysis software was used to analyse species-by-site data and discriminate sites on the basis of their species composition (Clarke and Gorley 2006). To down weight the relative contributions of quantitatively dominant species a presence/absence transformation was applied to the data set. Introduced species were excluded from analysis. Singletons were excluded from analysis. Transformed data were analysed using a series of multivariate analysis routines including Hierarchical Clustering (CLUSTER), Analysis of Similarities (ANOSIM) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography and delineate the plant communities. Combining these methods increased the understanding of site inter-relations and thus the ability to accurately delineate those sites based on species composition.

To identify possible TECs and PECs in the survey area, vegetation units were compared to Floristic Community Types (FCT's) defined by Gibson *et al*. (1994). Comparisons were made using appropriate multivariate analyses comparing current data to that of Gibson *et al*. (1994) species by quadrat data, and inferences based on dominant species and geomorphology. The degraded nature of much of the survey area coupled with the broad nature of FCT's lead many vegetation units to characterise admixtures and transition zones between FCT's. In addition, areas were mapped based on extrapolated quadrat data from a single flora assessment, rather than accumulated species data over successive seasons within known vegetation community types as per Gibson *et al.* (1994). Consequently, assigned FCT's within the survey area are inferred and not absolute, i.e. a vegetation code assigned to an FCT is inferred to resemble floristic aspects of that FCT as defined by Gibson *et al*. (1994).

An assessment of the survey against a range of factors which may have had an impact on the outcomes of the current survey was made (Table 1). Based on this assessment, the present survey has not been subject to constraints which would affect the thoroughness of the survey, and the conclusions which have been formed.

Table 1: Potential Flora and Vegetation Survey Limitations for Survey Area

Potential Survey Limitation	Impact on Survey
Sources of information and availability of contextual information (*i.e.* pre-existing background versus new material)	**Not a constraint:** Adequate background information was sourced to provide detailed contextual information for the current project. Adequate supplementary material was utilised to compare and contrast current data with that of previous work across the Swan Coastal Plain (e.g. Floristic Community Types). Pre European and System 6 vegetation extents do not match that of up-to-date aerial photography. There is a large discrepancy between the actual shoreline and the shoreline mapped in these spatial databases. As a result, Pre-European and System 6 mapping and resultant impact figures do not provide an accurate quantitative representation of the actual area covered by relevant associations within the survey area. These figures have been extrapolated to reflect the size of the actual survey area and as such their use needs to be treated with a degree of caution.
Scope (*i.e.* what life forms, *etc.*, were sampled)	**Not a constraint:** Vascular flora was the focus of the survey. These were thoroughly sampled.
Proportion of flora collected and identified (based on sampling, timing and intensity)	**Not a constraint:** The proportion of flora collected and identified was adequate for a Level 2 flora and vegetation survey. It was estimated that approximately 78% of the flora potentially present within the survey area were sampled. Of the 137 taxa recorded 24% were annual species, indicating that survey timing was appropriate.
Completeness and further work which might be needed (was the relevant survey area fully surveyed?)	**Not a constraint:** Sites were pre-selected using aerial photography to ensure all vegetation communities subjectively identified were sampled, with multiple replications. Where necessary, additional sites were chosen in the field. The number and extent of *Grevillea* sp. Ocean Reef (P1) within the survey area was thoroughly assessed.
Mapping reliability	**Not a constraint:** Adequate coverage of the area was made during the present survey. High quality aerial maps were used for both the survey work and subsequent vegetation community mapping. Mapping boundaries were often discontinuous with mapping boundaries resembling admixtures of one or more vegetation communities. This is, however, a recognised limitation of vegetation mapping particularly with coastal scrub/heath.
Timing, weather, season, cycle	**Not a constraint:** Surveys were conducted following above average rainfall in the three months preceding the survey. There were no interruptions to field work due to weather or timing issues.
Disturbances (fire flood, accidental human intervention, *etc.*)	**Not a constraint:** A large number of unauthorised tracks and squatter shacks occur within the survey area. Clearing associated with these factors, though widespread, constitutes a relatively small area. As such they were not viewed as adversely impacting vegetation structure and thus the ability to delineate vegetation communities within affected areas.
Intensity (in retrospect, was the intensity adequate?)	**Not a constraint:** Survey intensity was considered to have been thorough. More than adequate quantitative and spatial replication of sites was achieved across the survey area and within each vegetation community.
Resources (were there adequate resources to complete the survey to the required standard?)	**Not a constraint:** Resources, in terms of time, equipment, support and personnel were adequate to undertake and complete the survey.
Access problems (*i.e.* ability to access survey area)	**Not a constraint:** All sections of the survey area were easily accessible by foot.
Experience levels (*e.g.* degree of expertise in plant identification to taxon level)	**Not a constraint:** Ecologists and botanists have undertaken previous surveys in the local and wider area and were very familiar with the flora and vegetation.

5. RESULTS

5.1 Desktop Survey

5.1.1 Declared Threatened and Priority Flora with Potential to Occur within the Survey Area

Two Threatened Flora species pursuant to Schedule 1 of the *WC Act* and as listed by the DPaW (2013b) were recorded within the bounds of the desktop search (Table 2). The bounds of the desktop search were defined as a 10 km search radius from the centre of the current survey area. Both of these species are also listed under the *EPBC Act* (DOE, 2013a).

A total of twelve Priority Flora species as listed by the DPaW (2013h) were identified by the desktop search as having the potential to occur within the survey area. This included three Priority 1, three Priority 2, five Priority 3 and one Priority 4 flora species (Table 2).

Table 2: Threatened and Priority Flora Species with Potential to Occur within the Proposed Ocean Reef Marina Survey Area
SCC = State Conservation Code (Appendix A1); FCC = Federal Conservation Code (Appendix A1)

SPECIES	FAMILY	SCC	FCC	HABITAT
Eucalyptus argutifolia	Myrtaceae	T	Vul	Slopes, gullies and limestone ridges of shallow sandy soils over limestone
Marianthus paralius	Pittosporaceae	T	-	White sand over limestone on coastal cliffs
Baeckea sp. Limestone	Myrtaceae	P1	-	Yellow/grey sand over limestone
Grevillea sp. Ocean Reef	Proteaceae	P1	-	Brown/grey sand in coastal dunes
Leucopogon maritimus	Ericaceae	P1	-	White/grey sand in coastal dunes, associated with limestone
Acacia benthamii	Fabaceae	P2	-	Brown/grey sand on limestone breakaways
Austrostipa mundula	Poaceae	P2	-	Grey sands in coastal areas
Tetraria sp. Chandala	Cyperaceae	P2	-	Peat sands in wet depressions
Conostylis bracteata	Haemodoraceae	P3	-	Sand over limestone on coastal dunes
Hibbertia spicata subsp. *leptotheca*	Dilleniaceae	P3	-	Sand over limestone in coastal areas
Pimelea calcicola	Thymelaeaceae	P3	-	Sand over limestone in coastal areas
Sarcozona bicarinata	Aizoaceae	P3	-	Cream/grey sand on limestone outcrops
Thelymitra variegata	Orchidaceae	P3	-	Sand, clay and gravel
Jacksonia sericea	Fabaceae	P4	-	Brown/grey sand over limestone

Descriptions of Threatened and Priority Flora identified by the desktop search (Table 2) are as follows:

***Eucalyptus argutifolia* (Threatened) – Myrtaceae**
This species is described as a mallee growing to 4m high, with smooth bark and producing white flowers from March to April. It generally grows in grey/brown sand in association with limestone on breakaways, slopes and gullies. There are thirty nine records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). Three of these records occur within 8.5km of the survey area. It is possible this species will occur within the survey area.

***Marianthus paralius* (Threatened) – Pittosporaceae**
This almost prostrate, woody shrub eventually becomes scandent growing on low, limestone cliffs by the coast in white sand, producing red flowers from September to November. There are six records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). Two of these records occur within 3.5km of the survey area. It is possible this species will occur within the survey area.

***Baeckea* sp. Limestone (Priority 1) – Myrtaceae**
This species is described as an erect compact or open shrub, growing to 2m high and has been recorded as producing white to pinkish flowers from November to January. It is generally recorded growing in yellow/grey sand in association with limestone on slopes and ridges. There are seventeen records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). The closest of these records occurs 4km to the east of the survey area. It is possible this species will occur within the survey area.

***Grevillea* sp. Ocean Reef (Priority 1) – Proteaceae**
This poorly collected species is described as a possibly clonal spreading shrub, growing to 2m high, recorded growing in sand dunes of brown/grey sand. Only three records of this taxon exist in the database of the Western Australian Herbarium (DPaW 2013a). All three records of this species occur within the survey area.

***Leucopogon maritimus* (Priority 1) – Ericaceae**
This species is described as a low spreading shrub growing to 0.3m high, recorded producing white flowers from April to August and in November. It is generally recorded growing in white/yellow sand on coastal dunes, often in association with limestone. There are seventeen records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). The closest of these records is 3km to the south. It is possible this species will occur within the survey area.

***Acacia benthamii* (Priority 2) – Fabaceae**
This species is described as a shrub growing to 1m, producing yellow flowers from August to September. Typically growing on limestone breakaways, it is also found in grey/brown sand on variable topography along the Swan Coastal Plain. There are thirty four records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). The closest of these records is 6km to the east. It is unlikely this species will occur within the survey area.

***Austrostipa mundula* (Priority 2) – Poaceae**
This species is described as a perennial, caespitose grass growing to 0.5m high, recorded producing brown/purple flowers in September and October. It is recorded growing in grey/cream sands, often associated with limestone, on coastal dunes, ridges and plains. There are nine records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). The closest of these records is 3.5km to the east. It is possible this species will occur within the survey area.

***Tetraria* sp. Chandala (Priority 2) – Cyperaceae**
This poorly collected species is described as a perennial, rhizomatous sedge growing to 1.5m high, recorded producing brown flowers in July, February and September. There are only three records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a), all of which were found growing in peaty sand associated with wet areas. It is unlikely this species will occur in the survey area.

***Conostylis bracteata* (Priority 3) – Haemodoraceae**
This species is described as a perennial, rhizomatous, tufted or shortly proliferous grass like herb, producing yellow flowers from August to September. Generally found growing in sand associated with limestone on sand dunes. There are eleven records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). Six of these records occur within 4.5km of the survey area, the closest of which is 2km to the south. It is likely this species will occur within the survey area.

***Hibbertia spicata* subsp. *leptotheca* (Priority 3) – Dilleniaceae**
This species is described as an erect or spreading shrub growing to 0.5m high, producing yellow flowers from July to October. Generally growing in a variety of sand types, often associated with limestone, near the coast on ridges, outcrops and cliffs. There are thirty six records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). Two of these records occur 2km to the north. It is likely this species will occur within the survey area.

***Pimelea calcicola* (Priority 3) – Thymelaeaceae**
This species is described as an erect to spreading shrub growing to 1m high, producing pink flowers from September to November. Generally growing in grey/yellow sand often associated with limestone, on ridges and flats near the coast. There are twenty six records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). The closest of these records occurs 3km to the north. It is possible this species will occur within the survey area.

***Sarcozona bicarinata* (Priority 3) – Aizoaceae**
This under collected species has been described as a short lived perennial, succulent herb, growing to 0.1m high and spreading to 0.3m across. All four records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a) were recorded growing in grey/cream sand on limestone outcrops. The closest of these records occurs 2km to the north of the survey area. It is possible this species will occur within the survey area.

***Thelymitra variegata* (Priority 3) – Orchidaceae**
This species is described as a tuberous, perennial herb growing to 0.35m high, producing distinctive orange, red, purple and pink flowers from June to September. Commonly associated with various sand, sandy clay and laterite gravel soils. There are twenty eight records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). The closest of these records occurs 6km to the east. It is unlikely this species will occur within the survey area.

***Jacksonia sericea* (Priority 4) – Fabaceae**
This species is described as a low spreading shrub, growing to 0.6m high, producing orange flowers usually from December or January to February. Commonly recorded in grey/brown sand over limestone. There are fifty five records of this taxon in the database of the Western Australian Herbarium (DPaW 2013a). Nine of these records occur within 4km of the survey area. It is possible this species will occur within the survey area.

5.1.2 Threatened and Priority Ecological Communities Potentially Occurring within the Survey Area

One TEC and three PECs were identified as having the potential to occur within the Proposed Ocean Reef Marina survey area (DPaW 2013e); a brief description and details are provided below and in Table 3. The TEC is not listed under the federal *EPBC Act* (DOE, 2013b).

SCP 26a *Melaleuca huegelii - Melaleuca acerosa* shrublands on limestone ridges (EN) (TEC) occurs on skeletal soils on ridge slopes and tops on the northern Swan Coastal Plain. The community is dominated by *Melaleuca huegelii*, *M. systena, Banksia sessilis* over *Grevillea preissii, Acacia lasiocarpa and Spyridium globulosum.* Other common species include: *Daucus glochidiatus, Desmocladus flexuosus* and *Trachymene pilosa* (Gibson *et al.,* 1994; Department of Environment and Conservation, 2005). SCP 26a has been recorded 11 km to the north of the survey area and may possibly occur in the survey area.

SCP 24 Northern Spearwood shrublands and woodlands (P3) (PEC) occurs on the deeper soils of the Swan Coastal Plain north from Woodman Point, generally in the Cottesloe unit of the Spearwood system. Described as heath communities with scattered *Eucalyptus gomphocephala,* with the heath community typically consisting of; *Banksia sessilis, Calothamnus quadrifidus* and *Schoenus grandiflorus* (DPaW 2013f). Other common species include; *Hardenbergia comptoniana, Xanthorrhoea preissii, Conostylis aculeata* and *Lomandra maritima* (Gibson *et al*. 1994). SCP 24 has been recorded 6.2 km to the north and 7 km to the south of the survey area and may possibly occur in the survey area.

SCP 29a Coastal shrublands on shallow sands (P3) (PEC) occurs on shallow sands over limestone in coastal areas (DPaW 2013f). Considered to have no dominant species, important species include; *Spyridium globulosum, Rhagodia baccata*, and *Olearia axillaris*. Other common species include; *Eremophila glabra*, *Leucopogon parviflorus*, *Gastrolobium nervosum* and *Poa porphyroclados* (Gibson *et al*. 1994). SCP 29a has been recorded 2.5 km to the north of the survey area and is likely to occur in the survey area.

SCP 29b Acacia shrublands on taller dunes (P3) (PEC) occurs along the Swan Coastal Plain coastal strip from Seabird to south of Mandurah. Considered to have no consistently dominant species, important species include; *Acacia rostellifera, Acacia lasiocarpa, Rhagodia baccata* and *Melaleuca systena* (DPaW 2013f). Other common species include; *Gompholobium tomentosum, Hemiandra pungens, Olearia axillaris, Phyllanthus calycinus* and *Conostylis candicans* (Gibson *et al*. 1994). SCP 29b has been recorded 6.5 km to the north of the survey area and is likely to occur in the survey area.

Table 3: Threatened and Priority Ecological Communities with Potential to Occur within the Proposed Ocean Reef Marina Survey Area
(Mitchell *et al*. 2002; DPaW 2013d). SCC = State Conservation Code; FCC = Federal Conservation Code (Appendix A1)

SCP	Description	SCC	FCC
SCP26a	Melaleuca huegelii - Melaleuca acerosa shrublands on limestone ridges (TEC)	EN	-
SCP24	Northern Spearwood shrublands and woodlands (PEC)	P3	-
SCP29a	Coastal shrublands on shallow sands (PEC)	P3	-
SCP29b	Acacia shrublands on taller dunes (PEC)	P3	-

5.1.3 Areas of Significant Vegetation Located within and/or Adjacent to the Survey Area

The following section provides an overview of areas identified during the desktop survey as holding significant and/or noteworthy vegetation within or adjacent to the survey area.

The survey area is located within the Bush Forever site: Coastal Strip from Burns Beach to Hillarys (Bush Forever site number 325) (WAPC, 2000b). The Bush Forever site contains, or is inferred to contain, the Floristic Community Types (FCT); SCP 16 Highly saline seasonal wetlands, SCP 27 Species poor mallees and shrublands on limestone, SCP 29a Coastal shrublands on shallow sands, SCP 29b *Acacia* shrublands on taller dunes, S 11 Northern *Acacia rostellifera- Melaleuca systena* shrublands, S 13 Northern *Olearia axillaris-Scaevola crassifolia* shrublands and S 14 *Spinifex longifolius* grasslands and low shrublands. The Bush Forever site is part of a semi-contiguous vegetated coastal strip containing shoreline with soft (sandy) and hard (limestone rocks) areas and what some consider the best remaining example of a 'limestone ridge forming cliffs' in the Perth metropolitan area (Western Australian Planning Commission, 2000b).

Bush Forever site 325 covers a total area of approximately 280.56 ha. Of which, 28.22 ha occurs within the Proposed Ocean Reef Marina application area, reducing the total remaining area of site 325 by just over 10%.

5.1.4 Previous Surveys of Relevance to the Proposed Ocean Reef Marina Survey Area

Previous surveys relevant to this survey area include:

- "Flora and Vegetation Assessment of Lot 1029; Bushplan Site 325, City of Joondalup" (Unpublished report prepared by Mattiske Consulting Pty Ltd for the Planning Group Pty Ltd, 2000)
- "Ocean Reef Marina Supplementary Flora Survey, 2009" (Unpublished report prepared by Natural Area Management and Services for Snow Mountains Engineering Corporation 2009)
- "Tamala Park Development Area Level 2 Flora, Vegetation and Graceful Sun Moth Survey" (Technical report prepared by Syrinx Environmental Pl for Tamala Park Regional Council, 2010)

In June 2000 Mattiske Consulting Pty Ltd (Mattiske) conducted a flora and vegetation survey of Lot 1029, part of which lies within the Proposed Ocean Reef Marina survey area. The Mattiske survey identified no Threatened or Priority Flora within Lot 1029 survey area. A total of 56 flora species from 8 families and 49 genera were identified. Mattiske identified and mapped six vegetation communities within the Bushland Forever Site 325, five of which occurred within Lot 1029. Mattiske recorded localised variation in vegetation condition, but found the majority of the survey area to be in "very good" to "excellent" condition (Mattiske Consulting Pty Ltd, 2000).

In September 2009 Natural Area Management and Services (NAMS) conducted a flora and vegetation survey of the northern section of the Proposed Ocean Reef Marina survey area, completing the entire Proposed Ocean Reef Marina survey area which begun in 2008. NAMS identified no Threatened or Priority Flora within the survey area. Their survey identified four small areas of the PEC 'coastal shrublands on shallow sands, southern Swan Coastal Plain' (SCP 29a). Two areas of the PEC were in the north of the survey area (approximately 400 m^2), one in the central area and one in the south of the survey area (both approximately 250 m^2). The NAMS survey identified a number of stands of *Alyogyne huegelii* var. *glabrescens*, a species listed in Bush Forever documents as locally significant (Western Australian Planning Commission, 2000b). However, recent searches of Florabase (DPaW 2013h) and Naturemap (DPaW 2013g) have identified *Alyogyne huegelii* var. *glabrescens* as wide spread along the south west coast, from Cape Leeuwin to north of Geraldton. NAMS recorded the vegetation condition from "completely degraded" to "very good" (Natural Area Management and Services, 2009).

In September 2009 and March 2010 Syrinx Environmental Pl (Syrinx) conducted a level 2 flora and vegetation survey of the proposed Tamala Park Development area, approximately 6 km north of the Proposed Ocean Reef Marina survey area. No Threatened Flora were recorded and two Priority Flora species were recorded; *Fabronia hampeana* (Priority 2) and *Sarcozona bicarinata* (Priority 3). A total of 199 species (151 native species) were recorded within the survey area. No TECs or PECs were identified. Syrinx identified twelve vegetation communities within the survey area. An assessment of the conservation significance of the flora and vegetation concluded it to be locally significant with attributes of regional significance (Syrinx Environmental Pl, 2010).

5.2 Field Survey

A total of 65 survey sites, both pre-selected and opportunistic, were established in the Level 2 assessment of flora and vegetation of the proposed Ocean Reef Marina survey area. Refer to Appendix B for geographic locations of each survey site.

5.2.1 Flora

A total of 137 vascular plant taxa which are representative of 105 plant genera and 43 plant families were recorded within the proposed Ocean Reef Marina survey area. The majority of the taxa recorded were representative of the Poaceae (20 taxa), Fabaceae (14 taxa), Asteraceae (12 taxa) and Myrtaceae (6 taxa) families (Appendix C). Of the 137 plant taxa recorded within the survey area, 49 species were introduced (exotic). The introduced taxa were represented by 16 plant families, the most common of which was Poaceae (13 taxa) and Asteraceae (9 taxa).

Of the 137 plant taxa recorded within the survey area, 91 (66.5%) were perennials, 33 (24%) were annuals and 13 (9.5%) were annual/perennial depending on local conditions.

5.2.2 Accumulated Species – Sites Surveyed (Species-Area Curve)

A species accumulation plot using species accumulation analysis by Colwell (2006) with field data from 2013 was prepared to evaluate the adequacy of sampling. The species accumulation plot was compared to a theoretical asymptotic value determined using Michaelis-Menten (Chao 2004) modelling. As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. The survey effort can be considered adequate when the asymptotic value of the species accumulation plot approaches the theoretical asymptotic value.

The species accumulation curve (Figure 5), based on the species accumulation analysis of Colwell (2006) was used to evaluate the adequacy of sampling. The asymptotic value was determined using Michaelis-Menten modelling. Using this analysis, the incidence based coverage estimator of species richness (ICE) (Chao 2004) was calculated to be 176. Based on this value, and the total of 137 species recorded during the survey, approximately 78% of the flora species potentially present within the survey area were recorded.

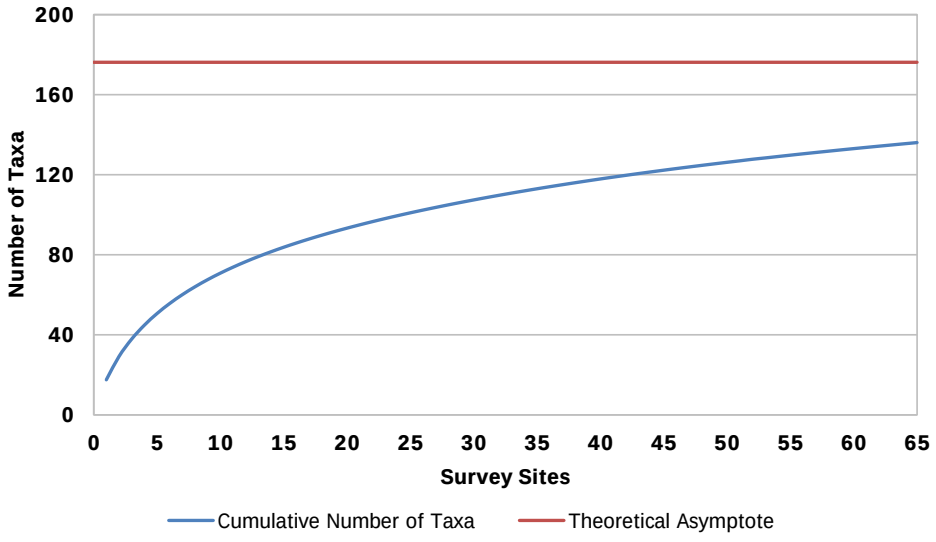

Figure 5: Species Accumulation Plot for the Proposed Ocean Reef Marina Survey Area
Field survey data was used to calculate both a species accumulation curve and a theoretical maximum number of species (asymptotic value) within the survey area.

5.2.3 Threatened and Priority Flora

No Declared Threatened Flora species pursuant to subsection (2) of section 23F of the *WC Act* and as listed by the DPaW (2013a) were recorded within the Proposed Ocean Reef Marina survey area.

Two Priority Flora species pursuant to subsection (2) of section 23F of the *WC Act* and as listed by the DPaW (2013a) were recorded within the Proposed Ocean Reef Marina survey area. One species was the Priority 1 *Grevillea* sp. Ocean Reef and the other the Priority 3 *Conostylis bracteata*: a brief description of these taxa and a table of their locations are listed below (Table 4).

***Grevillea* sp. Ocean Reef (P1) – Proteaceae**
The three records of this taxon in Western Australian Herbarium database (DPaW, 2013h) describe it as a dense, erect, spreading shrub, observed to grow up to 2m high and 3m wide. Described as possibly clonal, however flowers and fruit were collected in this survey. All three specimens from the Western Australian Herbarium database were collected within the current survey area.

***Conostylis bracteata* (P3) – Haemodoraceae**
This species is described as a rhizomatous, tufted or shortly proliferous perennial grass like or herb, growing to 0.45m and producing yellow flowers from August to September. It is generally found in sand and limestone on consolidated sand dunes in coastal areas on the Swan Coastal Plain. There are eleven records of this taxon in the database of the Western Australian Herbarium (DPaW 2013h).

Table 4: GPS Locations of *Grevillea* sp. Ocean Reef (P1) and *Conostylis bracteata* (P3) within the Proposed Ocean Reef Marina Survey Area

Species	Survey Site	Geographic Location (GDA94_Z50)		Population
		Easting	Northing	
Grevillea sp. Ocean Reef (P1)	Opportunistic site	379828	6485609	40
Grevillea sp. Ocean Reef (P1)	Opportunistic site	379815	6485580	18
Grevillea sp. Ocean Reef (P1)	Opportunistic site	379859	6485571	10
Conostylis bracteata (P3)	7	379471	6486262	300
Conostylis bracteata (P3)	8	379895	6485328	60
Conostylis bracteata (P3)	10	379501	6486201	50
Conostylis bracteata (P3)	12	379557	6486162	25
Conostylis bracteata (P3)	15	379561	6486103	12
Conostylis bracteata (P3)	18	379554	6486005	90
Conostylis bracteata (P3)	20	379488	6485979	12
Conostylis bracteata (P3)	36	379738	6485737	27
Conostylis bracteata (P3)	38	379707	6485630	25
Conostylis bracteata (P3)	41	379985	6485464	50
Conostylis bracteata (P3)	42	379885	6485514	90
Conostylis bracteata (P3)	59	379791	6485021	12
Conostylis bracteata (P3)	61	379999	6485020	50
Conostylis bracteata (P3)	65	379393	6486402	12

5.2.4 Plants of Taxonomic Significance

Following formal communication with DPaW staff on the 5/12/13, Michael Hislop on behalf of sedge specialist Russell Barrett notes that until formal detailed evaluation and identification occurs at the WAH, it is recommended that *Tetraria* sp. (JC031, 16/10/2013) be treated as a currently unrecognised taxon.

This species was recorded at site 08 within vegetation community H3, a diverse closed heath mapped to the south-east of the survey area (Table 5).

Table 5: Plants of Taxonomic Significance Recorded within the Proposed Ocean Reef Marina Survey Area

Species	Survey Site	Geographic Location (GDA94_Z50)		Population
		Easting	Northing	
Tetraria sp. (JC031, 16/10/2013), possible new taxon (M. Hislop, Pers. Comm., 5/12/2013)	08	379895	6485328	10

5.2.5 Flora with Extensions to Their Range

One species, *Hybanthus debilissimus,* recorded during the field survey represents an extension to the currently known range for this species (Table 6). The occurrence and scale of range extensions were determined by comparing recorded locations in the current survey with that of species' distributions presented by WAH Florabase records. A brief description of this species is provided below.

Hybanthus debilissimus is described as a perennial herb, generally low growing, up to 0.3 m, producing blue-purple flowers from August to December and favoring lateritic soils. The closest record of this species in the database of the Western Australian Herbarium occurs approximately 80 km south of the Proposed Ocean Reef Marina Survey Area (DPaW 2013h). *H. debilissimus* is widespread to the south of survey area and as such represents a minor range extension; i.e. this record serves to extend known populations 80 km north, rather than a clear spatial divergence.

Table 6: Flora with Extensions to Their Known Range Recorded within the Proposed Ocean Reef Marina Survey Area

Species	Survey Site	Geographic Location (GDA94_Z50)		Population
		Easting	Northing	
Hybanthus debilissimus	24	379639	6485917	3

5.2.6 Other Flora of Conservation Significance

A list of other flora of conservation significance recorded within the proposed Ocean Reef Marina survey area was compiled highlighting species near known northern or southernmost ranges and/or poorly collected species (Gibson *et al*. 1994; WAPC 2000b; DPaW 2013h; Table 7).

Table 7: Other Flora of Conservation Significance Recorded within the Proposed Ocean Reef Marina Survey Area (Gibson *et al*. 1994; WAPC 2000b; DPaW 2013h).

Species	Significance
Allocasuarina lehmanniana subsp. *lehmanniana*	Southern extent of its Northern population.
Hibbertia cuneiformis	Northern extent of known range.
Melaleuca cardiophylla	Southern extent of known coastal range.
Spinifex x alterniflorus	Poorly collected. Northern population of disjunct known range. Has been used for dune rehabilitation/stabilisation.

5.2.7 Threatened and Priority Ecological Communities

No Threatened Ecological Communities were inferred to occur within the proposed Ocean Reef Marina survey area.

Three Priority Ecological Communities were inferred to occur within the proposed Ocean Reef Marina survey area, these being SCP 24 Northern Spearwood shrublands and woodlands (FCT 24; Gibson et al. 1994: SCC – P3); SCP 29a Coastal shrublands on shallow sands, southern Swan Coastal Plain (FCT 29a; Gibson et al. 1994: SCC – P3) and; SCP 29b Acacia shrublands on taller dunes, southern Swan Coastal Plain (FCT 29b; Gibson et al. 1994: SCC – P3; Figure 6).

Obvious limitations are associated with determining and mapping the presence of Floristic Community Types within the survey area. Structurally vegetation remains largely intact with key species present, however, due to widespread and sustained weed invasion the ground layer has in many instances been completely replaced by exotic species (mostly dense annuals). As a result, species richness (per quadrat) in the current survey was markedly lower than that recoded by Gibson *et al.* (1994). In addition, vegetation mapping requires the extrapolation of quadrat data to generalise vegetation communities and map 'like' vegetation over relatively small spatial scales. Significant groupings of quadrats and resultant delineation of vegetation communities are primarily determined *a-priori*. Comparing this type of data with that of Gibson *et al.* (1994), which contains accumulated species data over successive seasons within known vegetation communities across the Swan Coastal Plain, is problematic. Unsurprisingly, comparative analysis between survey quadrats and vegetation communities in the current survey and that of Gibson *et al.* (1994) species by quadrat data show significant dissimilarities, a false negative (Appendix H; resemblance matrix and ANOSIM results can be provided on request).

An inference based system has thus been applied, whereby floristic aspects of survey quadrats and vegetation communities delineated in the current survey are inferred to resemble key characteristics of FCT's as described by Gibson *et al.* (1994). Whist results of comparative analysis have been used to support inferences, greater weight has been given to relating the frequency and dominance of key FCT defining species with those species recorded in the current survey.

Table 8: Floristic Community Types Inferred to Occur within the Proposed Ocean Reef Marina Survey Area
(WAPC, 2000b; DPaW 2013d).
SCC = State Conservation Code (Appendix A1); FCC = Federal Conservation Code (Appendix A1).

SCP	Description	SCC	FCC
24	Northern Spearwood shrublands and woodlands.	P3	-
29a	Coastal shrublands on shallow sands, southern Swan Coastal Plain.	P3	-
29b	*Acacia* shrublands on taller dunes, southern Swan Coastal Plain.	P3	-

Heathland sites within SCP 24 are typically characterised by taxa such as *Banksia sessilis, Calothamnus quadrifidus*, and *Schoenus grandiflorus.* Sites generally occur on deeper soils on the Cottesloe unit of the Spearwood system (Gibson *et al*. 1994; DPaW 2013f). Aspects of this community are inferred to be represented in the current survey area by vegetation community S2. The S2 community was a unique community within the survey area and predominately comprised dense tall stands of *B. sessilis* and number of other species consistent with that of SCP 24.

Table 9: Area Coverage (ha) of Floristic Community Types within the Survey Area, Percentage of Survey Area, Extent Mapped Outside and Inside the Application Area and Percentage Impact

SCP	Total Mapped Area (ha)	Percentage of Survey Area	Extent Mapped Outside Application Area (ha)	Extent Mapped Inside Application Area (ha)	Percentage Impact
24	2.77	4.68	1.49	1.28	46.13
29a	17.76	30.02	5.90	11.87	66.81
29b	24.87	42.02	17.27	7.59	30.54
n/a	13.78	23.28	1.15	12.63	91.66
Total	**59.18**	**100.00**	**25.81**	**33.37**	**56.39**

SCP 29a is characterised by heaths with no single dominant species. Important shrubs include; *Acanthocarpus preissii, Spyridium globulosum, Rhagodia baccata* and *Olearia axillaris* and important herbs include; *Crassula colorata, Senecio pinnatifolius* and *Austrostipa flavescens.* Generally found on shallow soils over limestone by the coast (Gibson *et al*. 1994; DPaW 2013f). Aspects of this community are inferred to be represented in the survey area by vegetation communities S1 and H1. Both communities predominately occur on shallow sands associated with limestone and comprise analogous dominant species to that of SCP29a. The H1 community comprises a number of admixtures associated

with changing species dominance and as such it is likely that aspects of S13 Northern *Olearia axillaris* – *Scaevola crassifolia* shrublands and S14 *Spinifex longifolius* grasslands and low shrublands occur within the broadly inferred SCP 29a community. Subjectively, however, areas of S13 and S14 are very small and non-contiguous making delineating and mapping their occurrence impractical.

SCP 29b is characterised by either *Acacia* shrublands or mixed heaths on larger dunes along the coast. This community has no consistent dominate species but important species include; *Acacia rostellifera, Acacia lasiocarpa*, *Melaleuca systena, Rhagodia baccata, Lepidosperma angustatum* and *Trachymene pilosa* (Gibson *et al*. 1994; DPaW 2013f). Aspects of this community are inferred to be represented in the survey area by vegetation communities S3, S4, S5, H2, H3 and H4. These communities occur on tall consolidated dunes and swales in central and eastern sections of the survey area. Admixtures were a common occurrence within associated communities, particularly S3 – S5. As a result, it is likely that aspects of S11 Northern *Acacia rostellifera* – *Melaleuca systena* occur within the broadly inferred SCP 29b community. Similarly to SCP 29a, delineating and mapping the occurrence of this possible admixture within SCP29b would be impractical.

379000mE 379500mE 380000mE

6486500mN 6486000mN 6485500mN 6485000mN

LEGEND

Floristic Community Type	Description	State Conservation Code (SCC)	Federal Conservation Code (FCC)
SCP 24	Northern Spearwood shrublands and woodlands.	P3	N/A
SCP 29a	Coastal shrublands on shallow sands, southern Swan Coastal Plain.	P3	N/A
SCP 29b	Acacia shrublands on taller dunes, southern Swan Coastal Plain.	P3	N/A

Resolute Way

Ocean Reef Road

Hodges Drive

Swanson Way

Application Area

SCP 24

SCP 29a

SCP 29b

Notes:
Application area boundary - Taylor Burrell Barnett (29/10/2013)
This figure to be read in conjunction with Mattiske Consulting Pty Ltd report numbered STR1301/41/13

Client: City of Joondalup

0 80m
Scale 1:5,000
MGA94 (Zone 50)
CAD Ref: g2155_f06.dgn
Date: Dec 2013 | Rev: B | A3

Mattiske Consulting Pty Ltd
28 Central Road, Kalamunda WA 6076 ~ Tel: 9257 1625 ~ Fax: 9257 1640
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Ocean Reef Marina

Floristic Community Types

Decmber 2013

Figure: **6**

5.2.8 Introduced (Exotic) Plant Species

A total of 49 introduced (exotic) taxa were recorded within the proposed Ocean Reef Marina survey area (Appendix C). Of these, none are Declared Pests (s22) within the City of Joondalup pursuant to the *BAM Act* according to the Department of Agriculture and Food (2013). One species; **Moraea flaccida* is a Declared Pest (s22; C3 Management) in many adjacent Local Government Area. **Moraea flaccida* is a cormous, perennial herb growing to 0.75 m, producing orange/yellow flowers from September to November. It is known to occur in many areas, including seasonally wet areas, creeklines, hilltops, pastures and disturbed land in sand, sandy loam, clay and gravel (DPaW 2013h).

Introduced species accounted for approximately 36% (Appendix C) of taxa recorded within the survey area. Many sites within the survey area were dominated by introduced species. The high incidence and sustained persistence of introduced species within the survey area can be attributed to the fragmented and disturbed landscape, numerous unauthorised tracks and clearings and illegal dumping of refuse.

5.2.9 Statistical Analysis

Similarity Profile Analysis (SIMPROF) identified eleven significantly associated groups of quadrats (Pi = 5.074; p = <0.001). Generally for the purposes of vegetation mapping, i.e. extrapolating quadrat data to generalise vegetation communities over broad areas, an inclusive rather than exclusive approach is adopted for outliers or minor branching's. With such distinctive communities, however, *a-priori* groupings of quadrats generated by SIMPROF were seen to best represent vegetative variation at this small scale. Two exceptions were the grouping of survey sites 47 and 48 as both represented foredune rehabilitation/stabilisation works, and the separation of sites 8 and 52 from the broader F1 community into the unique H3 community. The H3 community comprised a dominant *Cryptandra mutila* and *Acacia lasiocarpa* heath community which justified this separation.

Eleven significantly dissimilar vegetation communities were delineated within the survey area (Global R = 0.86; p = <0.001). One vegetation community (DS) was represented by one survey quadrat (site 26). This community comprised of a degraded dune swale dominated by exotic species. Subjective assessments of aerial photography indicated that this vegetation community was most likely restricted within the bounds of the survey area and does not appear to be an outlier solely based on sampling effort.

Vegetation of shrubland and scrublands typically comprised admixtures, to varying degrees, of species including *Acacia rostellifera*, *Banksia sessilis* var. *cygnorum, Melaleuca huegelii, Spyridium globulosum, Santalum acuminatum, Rhagodia baccata* subsp. *dioica, Templetonia retusa, Hibbertia cuneiformis* and *Melaleuca cardiophylla* (S1 – S5). Subtle differences in the structure and dominance of species, particularly in the aforementioned, clearly differentiated each shrub/scrubland community.

Vegetation of heathlands typically comprised vegetation associated with coastal shallow sands over limestone (H1) and those of tall consolidated dunes (H2 – H4). Characteristic species of coastal heaths included *Acacia cyclops*, *Acacia rostellifera* (wind stunted), *Olearia axillaris*, *Scaevola crassifolia*, *Threlkeldia diffusa*, *Senecio pinnatifolius*, *Frankenia paucifolia* and *Lepidosperma gladiatum*. Characteristic species of tall consolidated dunes included *Melaleuca systena*, *Acanthocarpus preissii*, *Leucopogon insularis*, *Acacia lasiocarpa* and *Lomandra maritima*.

A summary of the eleven PRIMER groupings, species by vegetation community, is detailed in Appendix E. A photographic record of vegetation communities delineated within the survey area is detailed in Appendix F. A dendrogram of the 65 survey sites with assigned vegetation communities is depicted in Appendix G.

5.2.10 Vegetation

Eleven plant communities were defined and mapped within the proposed Ocean Reef Marina survey area (Figure 7). Descriptions of each vegetation community, based on the Structural Forms of Australian Vegetation (Beard 1990) were summarised below:

Shrublands and scrublands:

S1: Mid closed scrubland of *Acacia rostellifera* and *Melaleuca huegelii* with occasional emergent *Banksia sessilis* var. *cygnorum* over *Spyridium globulosum*, *Rhagodia baccata* subsp. *dioica* and *Hibbertia cuneiformis* over *Acanthocarpus preissii*, *Clematis linearifolia*, *Hardenbergia comptoniana* and mixed exotics on deep grey sands of primary and secondary dunes.

S2: Tall shrubland of *Banksia sessilis* var. *cygnorum*, *Spyridium globulosum*, *Santalum acuminatum* and *Acacia saligna* with occasional emergent *Eucalyptus todtiana* over *Rhagodia baccata* subsp. *dioica*, *Alyogyne huegelii* and *Trymalium odoratissimum* over *Conostylis bracteata* (P3), *Desmocladus asper*, *Lepidosperma pubisquameum* and mixed exotics on deep grey or brown sands of secondary dune swales.

S3: Tall shrubland of *Spyridium globulosum*, *Acacia rostellifera*, *Banksia sessilis* var. *cygnorum* and *Santalum acuminatum* over *Phyllanthus calycinus*, *Hibbertia hypericoides* and *Melaleuca systena* over *Clematis linearifolia*, *Austrostipa flavescens*, *Desmocladus flexuosus* and mixed exotics on light grey or brown sands of secondary dune swales.

S4: Mid to tall scrubland of *Acacia rostellifera*, *Spyridium globulosum*, *Templetonia retusa*, *Melaleuca huegelii* and *Melaleuca cardiophylla* over *Leucopogon parvifolius*, *Thomasia cognata*, *Acanthocarpus preissii*, *Phyllanthus calycinus* and mixed exotics on grey sands of secondary dunes with frequent limestone outcropping.

S5: Tall closed shrubland of *Acacia cochlearis*, *Acacia cyclops*, *Acacia rostellifera*, *Allocasuarina lehmanniana* subsp. *lehmanniana*, *Melaleuca huegelii* and *Templetonia retusa* over *Melaleuca systena*, *Scaevola crassifolia* and mixed exotics on grey sands of secondary dune swales with frequent limestone outcropping.

Heath:

H1: Low open scrubland to heath of *Acacia cyclops*, *Acacia rostellifera*, *Spyridium globulosum* and *Templetonia retusa* over *Scaevola crassifolia*, *Olearia axillaris*, *Myoporum insulare* and *Rhagodia baccata* subsp. *dioica* over *Acanthocarpus preissii*, *Threlkeldia diffusa*, *Senecio pinnatifolius* and *Frankenia pauciflora* over *Lepidosperma gladiatum*, *Spinifex longifolius*, *Sporobolus virginicus* and mixed exotics on white sands or light grey sands of fore- and primary dunes with frequent limestone outcropping.

H2: Open heath of *Melaleuca systena*, *Acanthocarpus preissii*, *Leucopogon insularis* and *Acacia lasiocarpa* var. *lasiocarpa* with emergent *Acacia rostellifera* and *Santalum acuminatum* over *Lomandra maritima*, *Conostylis bracteata* (P3), *Poa drummondii* and mixed exotics on grey sands of secondary dune slopes.

H3: Closed heath of *Acacia lasiocarpa* var. *lasiocarpa*, *Cryptandra mutila*, *Leucopogon insularis* and *Melaleuca systena* over *Comesperma confertum*, *Gompholobium tomentosum* and *Opercularia vaginata* over *Lepidosperma pubisquameum*, *Dianella revoluta* var. *divaricata* and mixed exotics on light grey sands of secondary dune slopes.

H4: Low open scrub to heath of *Acacia rostellifera*, *Spyridium globulosum* and *Acacia saligna* over *Melaleuca systena*, *Acanthocarpus preissii*, *Olearia axillaris*, *Phyllanthus calycinus* and mixed exotics on white to light grey sands of primary and secondary dune crests.

Other:

DS: Degraded dune swale.

FR: Foredune rehabilitation.

Miscellaneous

BS: Bare sand

CL: Cleared

379000mE 379500mE 380000mE

6486500mN 6486000mN 6485500mN 6485000mN

LEGEND

Shrublands and scrublands

S1: Mid closed scrubland of *Acacia rostellifera* and *Melaleuca huegelii* with occasional emergent *Banksia sessilis* var. *cygnorum* over *Spyridium globulosum*, *Rhagodia baccata* subsp. *dioica* and *Hibbertia cuneiformis* over *Acanthocarpus preissii*, *Clematis linearifolia*, *Hardenbergia comptoniana* and mixed exotics on deep grey sands of primary and secondary dunes.

S2: Tall shrubland of *Banksia sessilis* var. *cygnorum*, *Spyridium globulosum*, *Santalum acuminatum* and *Acacia saligna* with occasional emergent *Eucalyptus todtiana* over *Rhagodia baccata* subsp. *dioica*, *Alyogyne huegelii* and *Trymalium odoratissimum* over *Conostylis bracteata* (P3), *Desmocladus asper*, *Lepidosperma pubisquameum* and mixed exotics on deep grey or brown sands of secondary dune swales.

S3: Tall shrubland of *Spyridium globulosum*, *Acacia rostellifera*, *Banksia sessilis* var. *cygnorum* and *Santalum acuminatum* over *Phyllanthus calycinus*, *Hibbertia hypericoides* and *Melaleuca systena* over *Clematis linearifolia*, *Austrostipa flavescens*, *Desmocladus flexuosus* and mixed exotics on light grey or brown sands of secondary dune swales.

S4: Mid to tall scrubland of *Acacia rostellifera*, *Spyridium globulosum*, *Templetonia retusa*, *Melaleuca huegelii* and *Melaleuca cardiophylla* over *Leucopogon parvifolius*, *Thomasia cognata*, *Acanthocarpus preissii*, *Phyllanthus calycinus* and mixed exotics on grey sands of secondary dunes with frequent limestone outcropping.

S5: Tall closed shrubland of *Acacia cochlearis*, *Acacia cyclops*, *Acacia rostellifera*, *Allocasuarina lehmanniana* subsp. *lehmanniana*, *Melaleuca huegelii* and *Templetonia retusa* over *Melaleuca systena*, *Scaevola crassifolia* and mixed exotics on grey sands of secondary dune swales with frequent limestone outcropping.

Heath

H1: Low open scrubland to heath of *Acacia cyclops*, *Acacia rostellifera*, *Spyridium globulosum* and *Templetonia retusa* over *Scaevola crassifolia*, *Olearia axillaris*, *Myoporum insulare* and *Rhagodia baccata* subsp. *dioica* over *Acanthocarpus preissii*, *Threlkeldia diffusa*, *Senecio pinnatifolius* and *Frankenia pauciflora* over *Lepidosperma gladiatum*, *Spinifex longifolius*, *Sporobolus virginicus* and mixed exotics on white sands or light grey sands of fore- and primary dunes with frequent limestone outcropping.

H2: Open heath of *Melaleuca systena*, *Acanthocarpus preissii*, *Leucopogon insularis* and *Acacia lasiocarpa* var. *lasiocarpa* with emergent *Acacia rostellifera* and *Santalum acuminatum* over *Lomandra maritima*, *Conostylis bracteata* (P3), *Poa drummondii* and mixed exotics on grey sands of secondary dune slopes.

H3: Closed heath of *Acacia lasiocarpa* var. *lasiocarpa*, *Cryptandra mutila*, *Leucopogon insularis* and *Melaleuca systena* over *Comesperma confertum*, *Gompholobium tomentosum* and *Opercularia vaginata* over *Lepidosperma pubisquameum*, *Dianella revoluta* var. *divaricata* and mixed exotics on light grey sands of secondary dune slopes.

H4: Low open scrub to heath of *Acacia rostellifera*, *Spyridium globulosum* and *Acacia saligna* over *Melaleuca systena*, *Acanthocarpus preissii*, *Olearia axillaris*, *Phyllanthus calycinus* and mixed exotics on white to light grey sands of primary and secondary dune crests.

Other

DS: Degraded dune swale.

FR: Foredune rehabilitation.

BSL: Bare sand / Limestone

CL: Clearing

GOR *Grevillea* sp. Ocean Reef (D. Pike Joon 4) (P1)

Cb *Conostylis bracteata* (P3)

Resolute Way

Ocean Reef Road

Hodges Drive

Swanson Way

Application Area

Notes:
Application area boundary - Taylor Burrell Barnett (29/10/2013)
This figure to be read in conjunction with Mattiske Consulting Pty Ltd report numbered STR1301/41/13

Client: City of Joondalup

0 80m
Scale 1:5,000
MGA94 (Zone 50)
CAD Ref: g2155_f06.dgn
Date: Dec 2013 | Rev: B | A3

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Ocean Reef Marina

Vegetation Communities

Decmber 2013

Figure: 7

5.2.11 Area Coverage of each Delineated Vegetation Community

The total area mapped and percentage cover for each delineated vegetation community (Figure 7) is shown in Table 10. Shrubland/scrubland and heath communities accounted for approximately 45% (26.87 ha) and 31% (18.3 ha) of the total mapped area, respectively. Vegetation communities showed a clear coastal mosaic, with occurrence primarily determined by dune type and position. The H1 community was mapped across the largest area, and comprised a characteristic coastal heath community. No one species showed cleared dominance within this community and admixtures were common. Cleared areas accounted for just over 17% of the total mapped area.

Approximately 55.4% of the total mapped area occurs within the application area. Excluding DS, FR, CL and BSL, percentage impact figures range from 0% (H3) to 88.5% (H4).

Table 10: Area Coverage (ha) of each Vegetation Community Type within the Survey Area

Vegetation Community	Total Mapped Area (ha)	Percentage of Survey Area	Extent Mapped Outside Application Area (ha)	Extent Mapped Inside Application Area (ha)	Percentage Impact
S1	6.12	10.34	2.60	3.52	57.49
S2	2.77	4.68	1.49	1.28	46.13
S3	7.48	12.64	5.21	2.28	30.43
S4	6.78	11.46	5.33	1.45	21.39
S5	3.72	6.28	1.87	1.85	49.77
H1	11.41	19.29	3.30	8.12	71.12
H2	4.16	7.03	3.45	0.71	17.17
H3	1.25	2.12	1.25	0.00	0.00
H4	1.47	2.48	0.17	1.30	88.55
DS	0.23	0.39	0.00	0.23	100.00
FR	0.36	0.61	0.00	0.36	100.00
CL	10.21	17.26	0.93	9.28	90.88
BSL	3.21	5.42	0.22	2.99	93.23
Total	**59.18**	**100**	**25.81**	**33.37**	**56.39**

5.2.12 Regional and Local Extent of Vegetation

The shoreline boundary of Pre-European and System 6 vegetation mapping extents do not match the shoreline boundary of the actual survey area; as determined by aerial photography supplied by Landgate (Image date: January, 2013). As a result, Pre-European and System 6 mapping and resultant impact figures as they stand do not provide an accurate quantitative representation of the actual area covered by relevant associations within the survey area (both outside and inside the application area; see Figures 3 and 4).

The homogenous nature of Pre-European and System 6 vegetation within the survey area has led to the mapping extents of the Guilderton_1007 vegetation association and the Quindalup Complex_55 unit being extended to the 'actual' shoreline. Though Pre-European and System 6 vegetation association figures now reflect the actual size survey area (both inside and outside application area), use of these figures should be treated with a degree of caution given the ad-hoc nature of the extrapolation.

The Proposed Ocean Reef Marina Development survey area comprises two broad Pre-European vegetation associations, namely Guilderton_1007 and to a lesser extent Guilderton_129 (Table 11 and 12). As a result of the proposal, the representation of Guilderton_129 and Guilderton_1007 across the Swan Coastal Plain Bioregion is expected to be reduced by 0.0% and 0.18%, respectively (Table 11)

Table 11: Extent of Pre-European Vegetation Associations across the Swan Coastal Plain IBRA Region and Percentage Impact Figures Associated with the Proposed Ocean Reef Marina Development

	Vegetation Association	
	Guilderton_129	**Guilderton_1007**
Total Pre-1750 Extent (ha)	9074.45	25375.49
Total Current Extent (ha)	8718.40	18129.90
Total Current Extent within DPaW Estate (ha)	133.20	1342.53
Total Extent within Survey Area (ha)	0.39	58.79
Extent Outside Application Area (ha)	0.39	25.42
Extent Inside Application Area (ha)	0.00	33.37
% Impact	0.00	0.18

Within the City of Joondalup the remaining extent of Pre-European vegetation associations is low (Table 12). In addition, vegetation associations within the local area are not represented in secure tenure. Secure tenure being defined as National Parks, Nature Reserves, Conservation Parks and 5(g) Reserves (DPaW, 2013i; EPA, 2006). As a result of the proposal, the representation of the Guilderton_129 and Guilderton_1007 vegetation associations within the City of Joondalup is expected to be reduced by 0.0% and 17.75%, respectively (Table 12).

Table 12: Extent of Pre-European Vegetation Associations within the City of Joondalup and Percentage Impact Figures Associated with the Proposed Ocean Reef Marina Development

	Vegetation Association	
	Guilderton_129	**Guilderton_1007**
Total Pre-1750 Extent (ha)	156.12	2648.70
Total Current Extent (ha)	28.82	187.95
Total Current Extent within DPaW Estate (ha)	0.00	0.00
Total Extent within Survey Area (ha)	0.39	58.79
Extent Outside Application Area (ha)	0.39	25.42
Extent Inside Application Area (ha)	0.00	33.37
% Impact	0.00	17.75

The Proposed Ocean Reef Marina Development survey area comprises vegetation associations across two broad vegetation complexes within the Swan Coastal Plain Bioregion (System 6/part System 1 area; Heddle *et al.*, 1980; Mattiske and Havel, 1998; EPA, 2006): the Quindalup Complex and to a lesser extent the Cottesloe Complex (central & south) (Table 13 and 14). As a result of the proposal, the representation of the Cottesloe (central & south) and Quindalup Complexes across the Swan Coastal Plain Bioregion is expected to be reduced by 0.0% and 0.1%, respectively (Table 13).

Table 13: Extent of System 6 Vegetation Complexes across the Swan Coastal Plain IBRA Region and Percentage Impact Figures Associated with the Proposed Ocean Reef Marina Development

	Vegetation Complex	
	Cottesloe Complex (Central & South)	**Quindalup Complex**
Total Pre-1750 Extent (ha)	45031.04	50718.93
Total Current Extent (ha)	15817.74	32906.10
Total % Remaining from Pre-1750 Extent	35.13	64.88
Total Current Extent within DPaW Estate (ha)	5877.46	4790.49
Total Extent within Survey Area (ha)	0.05	59.12
Extent Outside Application Area (ha)	0.05	25.76
Extent Inside Application Area (ha)	0.00	33.37
% Impact	0.00	0.10

Within the City of Joondalup the remaining extent of vegetation complexes is low (Table 14). In addition, vegetation complexes within the local area are poorly or not represented in secure tenure. As a result of the proposal, the representation of the Cottesloe (central & south) and Quindalup Complexes within the City of Joondalup is expected to be reduced by 0.0% and 10.89%, respectively (Table 14).

Table 14: Extent of System 6 Vegetation Complexes within the City of Joondalup and Percentage Impact Figures Associated with the Proposed Ocean Reef Marina Development

	Vegetation Complex	
	Cottesloe Complex (Central & South)	**Quindalup Complex**
Total Pre-1750 Extent (ha)	3973.01	2442.94
Current Extent in LGA (ha)	344.79	306.58
% Remaining from Pre-1750 Extent in LGA	8.68	12.55
Current Extent within DPaW Estate in LGA (ha)	4.96	0.00
Total Extent within Survey Area (ha)	0.05	59.12
Extent Outside Application Area (ha)	0.05	25.76
Extent Inside Application Area (ha)	0.00	33.37
% Impact	0.00	10.89

5.2.13 Vegetation Condition

Vegetation condition across the survey area ranged from completely degraded (cleared) in commercial and recreational areas to excellent in central/eastern shrubland and heath communities (Figure 8). Widespread and sustained weed invasions have resulted in high weed densities, and in many instance a replacement of the native ground layer. Vegetation in close proximity to cleared areas and unauthorised trails/tracks obviously contained higher weed densities.

Over 45% of the survey was mapped in good to very good condition. Such areas showed clear vegetative impacts associated with high weed densities; however, vegetation structure in the mid and upper stratums remained largely intact (Table 15).

Table 15: Area Coverage (ha) of each Vegetation Condition Rating within the Survey Area

Vegetation Condition	Total Mapped Area (ha)	Percentage of Survey Area
Excellent	9.93	16.79
Very Good to Excellent	1.85	3.13
Very Good	12.99	21.94
Good	13.76	23.24
Degraded to Good	4.30	7.27
Degraded	3.03	5.11
Bare Sand/Limestone	3.01	5.08
Cleared	10.32	17.43
Total	**59.18**	**100**

379000mE 379500mE 380000mE

6486500mN 6486000mN 6485500mN 6485000mN

LEGEND

- P: Pristine condition
- EX: Excellent condition
- VG-EX: Very Good to Excellent condition
- VG: Very Good condition
- G: Good condition
- D-G: Degrades to Good condition
- D: Degraded condition
- CD: Completely Degraded condition
- BSL: Bare sand / Limestone
- CL: Clearing

Condition reating scale from Bush Forever (Government of Western Australia 2000 based on Keighery 1994)

Resolute Way

Ocean Reef Road

Hodges Drive

Swanson Way

Application Area

Notes:
Application area boundary - Taylor Burrell Barnett (29/10/2013)
This figure to be read in conjunction with Mattiske Consulting Pty Ltd report numbered STR1301/41/13

Client: City of Joondalup

0 80m
Scale 1:5,000
MGA94 (Zone 50)
CAD Ref: g2155_f07.dgn
Date: Dec 2013 | Rev: B | A3

Mattiske Consulting Pty Ltd
28 Central Road, Kalamunda WA 6076 ~ Tel: 9257 1625 ~ Fax: 9257 1640
Author: E M Mattiske | MCPL Ref: STR1301
Drawn: CAD Resources ~ www.cadresources.com.au
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Ocean Reef Marina

Vegetation Condition

Decmber 2013

Figure: **8**

6. DISCUSSION

Mattiske Consulting Pty Ltd was commissioned in September 2013 by Strategen to undertake a Level 2 flora and vegetation survey of the Proposed Ocean Reef Marina survey area. The survey area covers 59.18 hectares, of which, 33.37 hectares (56%) was mapped inside the application (impact) area. Vegetation largely comprised structurally intact coastal vegetation in a narrow strip between residential developments and the ocean. Transitions between vegetation communities, though occasionally abrupt as a result of topographic and/or soil profile changes, were generally discontinuous with margins resembling admixtures of two or more vegetation communities. Typically, shallow soils near the coast comprised a mixed dominance low scrub/heath with common species including *Acacia cyclops*, *Acacia rostellifera*, *Scaevola crassifolia*, *Rhagodia baccata, Olearia axillaris*, *Acanthocarpus preissii*, *Senecio pinnatifolius*, *Frankenia pauciflora*, *Threlkeldia diffusa* and *Myoporum insulare*. Tall consolidated central and eastern dunes typically comprised low mixed heaths dominated by *Melaleuca systena* and *Acacia lasiocarpa* on mid to upper slopes and mid to tall shrub/scrublands dominated by *Acacia rostellifera*, *Melaleuca huegelii*, *Spyridium globulosum* and *Banksia sessilis* on lower slopes and deep swales.

A total of 137 vascular plant taxa which are representative of 105 plant genera and 43 plant families were recorded within the survey area. The majority of the taxa recorded were representative of the Poaceae (20 taxa), Fabaceae (14 taxa), Asteraceae (12 taxa) and Myrtaceae (6 taxa) families.

No Declared Threatened Flora were recorded within the survey area. Two Priority Flora species were recorded within the survey area, namely *Grevillea* sp. Ocean Reef (P1) and *Conostylis bracteata* (P3). A large population (>60 individuals) of *Grevillea* sp. Ocean Reef (P1) were recorded within an approximate 50 x 50 m area in the central consolidated dunes. This is the only known population of *Grevillea* sp. Ocean Reef (P1) in the database of the West Australian Herbarium. The current application boundary near Hodges Drive traverses through the eastern-most population of this species (Figure 7). It is therefore strongly recommended that the application area boundary in this area be revised. Not only to avoid direct impacts, but also to provide an adequate buffer around this population to avoid potential impacts. *Conostylis bracteata* (P3) was relatively common amongst the central and eastern consolidated dunes, being recorded in over 20% of the sites surveyed.

One other species of particular interest collected within the survey area was *Tetraria* sp. (JC031, 16/10/2013), possible new taxon (M. Hislop, Pers. Comm., 5/12/2013). Western Australian Herbarium sedge specialist Russell Barrett has noted that until formal detailed evaluation and identification of this species is undertaken, it is recommended that this species be treated as potentially a currently unrecognised taxon. This species was recorded at one site (008) within the H3 community. Mapped areas of the H3 community occur outside the application area.

No Threatened Ecological Communities were inferred to occur within the survey area. Three Priority Ecological Communities were inferred to occur within the survey area, these being; SCP 24 Northern Spearwood shrublands and woodlands (FCT 24; Gibson *et al*. 1994: SCC – P3); SCP 29a Coastal shrublands on shallow sands, southern Swan Coastal Plain (FCT 29a; Gibson *et al*. 1994: SCC – P3) and; SCP 29b Acacia shrublands on taller dunes, southern Swan Coastal Plain (FCT 29b; Gibson *et al*. 1994: SCC – P3).

Floristic aspects of SCP 24 Northern Spearwood shrublands and woodlands (P3) were inferred to occur in areas mapped as S2. These areas generally comprise tall dense shrublands of *Banksia sessilis, Acacia saligna*, *Spyridium globulosum*, *Santalum acuminatum* and *Alyogyne huegelii* with occasional emergent *Eucalyptus todtiana*. DPaW records confirm the occurrence of SCP 24 approximately 6 km to the north of the survey area in the Burns Beach Bushland, approximately 5.5 km north-east in the Neerabup National Park and approximately 6 km south-east in the Whitfords Avenue Bushland. Approximately 1.3 hectares (46%) of this inferred community was mapped inside the current application area.

Floristic aspects of SCP 29a Coastal shrublands on shallow sands, southern Swan Coastal Plain (P3) were inferred to occur in areas mapped as S1 and H1. These areas generally comprise mixed dominant scrub/heaths on shallow soils over limestone formed along the coastal strip. Characteristic species of these areas included *A. cyclops*, *A. rostellifera*, *Scaevola crassifolia*, *Rhagodia baccata, Olearia axillaris*, *Acanthocarpus preissii*, *Senecio pinnatifolius*, *Lepidosperma gladiatum*, *Frankenia pauciflora*, *Threlkeldia diffusa, Spinifex longifolius,* and *Myoporum insulare*. With this coastal mosaic it is duly recognised that admixtures of S13 Northern *Olearia axillaris* – Scaevola crassifolia shrublands and S14 *Spinifex longifolius* grasslands and shrublands may occur within the broad areas mapped as SCP 29a. At this scale, physical mapping of such small, non-contiguous admixtures was impractical. Information provided by WAPC

(2000b) and NAMS (2009) support the occurrence of SCP 29a within the survey area. Approximately 11.9 hectares (67%) of this inferred community was mapped inside the current application area.

Floristic aspects of SCP 29b Acacia shrublands on taller dunes, southern Swan Coastal Plain were inferred to occur in areas mapped as S3-S5 and H2-H4. These areas occurred on large consolidated dunes and generally comprised low mixed heaths on mid to upper slopes and tall shrub/scrublands on lower slopes and swales. Common species of these areas included *Acacia rostellifera*, *Melaleuca systena*, *Rhagodia baccata*, *Spyridium globulosum*, *Lomandra maritima*, *Leucopogon insularis*, *Leucopogon parvifolius*, *Hibbertia cuneiformis*, *Templetonia retusa*, *Acacia lasiocarpa, Phyllanthus calycinus* and *Melaleuca cardiophylla*. It is recognised that admixtures of S11 Northern *Acacia rostellifera – Melaleuca systena* may occur within the broad areas mapped as SCP 29b. Similarly to SCP 29a, physical mapping of such small, non-contiguous admixtures was impractical. Information provided in WAPC (2000b) support the occurrence of SCP 29b within the survey area. Additional DPaW records confirm the occurrence of SCP 29b approximately 5 km north in the Burns Beach Bushland area. Approximately 12.6 hectares (31%) of this inferred community was mapped inside the application area.

Eleven vegetation communities were delineated and mapped within the survey area. Vegetation communities formed a mosaic of shrub/scrub and heath communities with occurrences linked to dune type and position. Vegetation community boundaries were often discontinuous, with boundaries resembling admixtures of two or more communities. The mosaic nature of coastal heath/scrub made delineation of subtle transition zones and admixtures difficult and as such broad community descriptions rather than a proliferation of discrete vegetation units was seen as preferable. Percentage impact figures for shrub and heath communities were high. This result, however, would be expected given the size of the total mapped area relative to the application (impact) area (Figure 1).

Two Pre-European vegetation associations occurred within the survey area, namely Guilderton_129 and Guilderton_1007. Mapped areas of Guilderton_129 vegetation associations occurred outside the application area. With respect to the current proposal, representation of Guilderton_1007 vegetation associations would be reduced by 0.18% across the Swan Coastal Plain IBRA Region and 17.75% within the City of Joondalup. Currently, representation of relevant Pre-European vegetation associations vested in DPaW estate within the City of Joondalup is nil.

Two System 6 vegetation complexes occurred within the survey area, namely the Cottesloe Complex (central & south) and the Quindalup Complex. Mapped areas of the Cottesloe Complex (central & south) occurred outside the application area. With respect to the proposal, current representation of the Quindalup Complex would be reduced by 0.1% across the Swan Coastal Plain IBRA Region and 10.89% within the City of Joondalup. Currently, representation of relevant System 6 vegetation complexes vested in DPaW estate within the City of Joondalup is nil to negligible. In reference to the Local Government Biodiversity Planning Guidelines Criteria 1b – Local Representation, under 10% of the Pre-European extent remains for the Cottesloe Complex (central & south) and 12.5% remains for the Quindalup Complex (Del Marco *et al.*, 2004; DPaW, 2013i). With respect to current application area local representation of the Cottesloe Complex (central & south) would not be further reduced, however, local representation of the Quindalup Complex would be reduced to 11.2%.

Vegetation condition across the survey area ranged from completely degraded (cleared) in commercial and recreational areas to excellent in central/eastern shrubland and heath communities (Figure 8). Widespread and sustained weed invasions have resulted in high weed densities, and in many instance a replacement of the native ground layer. The high incidence of introduced taxa (36% of all taxa recorded) within the survey area was likely due to fragmentation, unauthorized clearing and dumping of refuse and proximity to residential areas. Fragmentation of vegetation within the survey area as a result of the proposed developed will invariably increase the likelihood of further weed invasions i.e. increased edge effects. The development and ongoing implementation of weed management procedures would be necessary to mitigate potential impacts associated with the proposal, particularly across the central and eastern consolidated dunes.

The majority of taxa recorded within the Proposed Ocean Reef Marina survey area are widespread throughout the region. Vegetation communities present in the survey area are generally of a high botanical value for conservation. This is due to factors including the restricted distribution of these community types, extent of clearing in the region and poor representation of these communities in conservation reserves.

7. CONCLUSION

For the purposes of a Level 2 Flora and Vegetation survey, adequate data has been collected to define and assess the presence, extent and significance of vegetation communities within the survey area. In the event further work is required to complement information provided in the current report such works should include: A targeted T&P survey in areas of interest (i.e. areas where known records of Priority species occur) and; additional mapping of Bush Forever Site 325 to provide accurate, quantitative data regarding offsets for the current application area.

8. ACKNOWLEDGEMENTS

The author would like to thank Elizabeth Congear and Julia Morgan from Strategen for their support with this project.

9. LIST OF PERSONNEL

The following Mattiske Consulting Pty Ltd personnel were involved in this project:

Name	Position	Project Involvement	Flora Collection Permit
Dr E.M. Mattiske	Managing Director & Principal Ecologist	Planning, Management & Reporting	n/a
Mr J. Cargill	Senior Ecologist	Planning, fieldwork, data interpretation, mapping and report preparation	SL010383
Mr A. Barrett	Botanist	Fieldwork and report preparation	SL010381
Mr C. Blackburn	Experienced Botanist	Fieldwork	SL010380
Mrs B. Koch	Senior Taxonomist	Plant identification	n/a
Mr B. Ellery	Taxonomist	Plant identification	n/a
Ms J. Ellery	Taxonomist	Plant identification	n/a
Ms K. Tippur	Taxonomist	Plant identification	n/a

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APPENDIX A1: DEFINITION OF THREATENED AND PRIORITY FLORA SPECIES (Department of Parks and Wildlife 2013a)

Conservation Code	Category
T	**Threatened Flora (Declared Rare Flora – Extant)** "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 (Schedule 1 under the *Wildlife Conservation Act 1950*). Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria: • **CR:** Critically Endangered – considered to be facing an extremely high risk of extinction in the wild • **EN:** Endangered – considered to be facing a very high risk of extinction in the wild • **VU:** Vulnerable – considered to be facing a high risk of extinction in the wild."
P1	**Priority One – Poorly Known Species** "Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes."
P2	**Priority Two – Poorly Known Species** "Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes."
P3	**Priority Three – Poorly Known Species** "Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them."
P4	**Priority Four – Rare Threatened and other species in need of monitoring** "a. Rare - Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. b. Near Threatened - Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy."
P5	**Priority Five – Conservation Dependent Species** "Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years."

APPENDIX A2: DEFINITION OF THREATENED FLORA SPECIES (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*)

Category Code	Category
Ex	**Extinct** Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or 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.
CE	**Critically Endangered** Taxa which 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.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which 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.

APPENDIX A3: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Department of Parks and Wildlife 2013d)

Category Code	Category
PTD	**Presumed Totally Destroyed** An ecological community will be listed as Presumed Totally Destroyed if there are no recent records of the community being extant and either of the following applies: (i) records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or; (ii) all occurrences recorded within the last 50 years have since been destroyed.
CE	**Critically Endangered** An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the immediate future.
E	**Endangered** An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. The ecological community must meet any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the short term future.
V	**Vulnerable** An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one of the following criteria: (i) The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; (ii) The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; (iii) The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

APPENDIX A4: DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Department of Sustainability, Environment, Water, Population and Communities 2013b)

Three categories exist for listing threatened ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

Listing Category	Explanation of Category
Critically endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

APPENDIX A5: DEFINITION OF PRIORITY ECOLOGICAL COMMUNITIES (Department of Parks and Wildlife 2013d)

Category Code	Category
P1	**Poorly-known ecological communities** Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist.
P2	**Poorly-known ecological communities** Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, un-allocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.
P3	**Poorly known ecological communities** (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.
P5	**Conservation Dependent ecological communities** Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX A6: CATEGORIES AND CONTROL OF DECLARED (PLANT) PESTS IN WESTERN AUSTRALIA (Department of Agriculture and Food 2013) (*Biosecurity and Agriculture Management Regulations 2013*)

Control Category	Control Measures
C1 (Exclusion) '(a) Category 1 (C1) — Exclusion: if in the opinion of the Minister introduction of the declared pest into an area or part of an area for which it is declared should be prevented' Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.	In relation to a category 1 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C2 (Eradication) '(b) Category 2 (C2) — Eradication: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is feasible' Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.	In relation to a category 2 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to destroy, prevent or eradicate the declared pest.
C3 (Management) '(c) Category 3 (C3) — Management: if in the opinion of the Minister eradication of the declared pest from an area or part of an area for which it is declared is not feasible but that it is necessary to — (i) alleviate the harmful impact of the declared pest in the area; or (ii) reduce the number or distribution of the declared pest in the area; or (iii) prevent or contain the spread of the declared pest in the area.' Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.	In relation to a category 3 declared pest, the owner or occupier of land in an area for which an organism is a declared pest or a person who is conducting an activity on the land must take such of the control measures specified in subregulation (1) as are reasonable and necessary to — (a) alleviate the harmful impact of the declared pest in the area for which it is declared; or (b) reduce the number or distribution of the declared pest in the area for which it is declared; or (c) prevent or contain the spread of the declared pest in the area for which it is declared.

APPENDIX A7: DEFINITION OF VEGETATION CONDITION SCALE (Keighery, 1994)

Condition Rating	Description
Pristine (1)	Pristine or nearly so, no obvious sign 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 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, 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 very 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.

APPENDIX A8: DEFINITION OF STRUCTURAL FORMS OF AUSTRALIAN VEGETATION (Beard 1990)

Structural Forms of Australian Vegetation			
Growth Form of Tallest Stratum	**Foliage Cover of Tallest Stratum**		
	30 – 70%	**10 – 30%**	**less than 10%**
Tall Trees [greater than 30 m]	Tall Forest	Tall Woodland	Open Tall Forest
Medium Trees [10 – 30 m]	Forest	Woodland	Open Woodland
Low Trees [less than 10 m]	Low Forest	Low Woodland	Open Low Woodland
Tall Shrubs [greater than 2 m]	Thicket	Scrub	Open Scrub
Low Shrubs [less than 2 m]	Heath	Low Shrubland	Open Low Shrubland
Grassland [less than 1 m]	Closed Bunch Grassland	Open Bunch Grassland	Hummock Grassland

APPENDIX B: GPS LOCATION OF SITES WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

SURVEY SITE	(GDA 94 _50J)	
	EASTING	NORTHING
1	379342	6486347
2	379370	6486336
3	379410	6486310
4	379448	6486344
5	379346	6486309
6	379400	6466254
7	379471	6486262
8	379895	6485328
9	379382	6486197
10	379501	6486201
11	379379	6486158
12	379557	6486162
13	379434	6486121
14	379487	6486134
15	379561	6486103
16	379587	6486076
17	379613	6486012
18	379554	6486005
19	379426	6485981
20	379488	6485979
21	379414	6485941
22	379482	6485900
23	379573	6485894
24	379639	6485917
25	379885	6485697
26	379488	6485877
27	379428	6485848
28	379492	6485821
29	379656	6485826
30	379759	6485823
31	379809	6485799
32	379797	6485689
33	379667	6485743
34	379581	6485721
35	379511	6485675
36	379738	6485737
37	379809	6485248
38	379707	6485630
39	379673	6485572
40	379836	6485554
41	379985	6485464
42	379885	6485514
43	379715	6485516
44	379658	6485500

APPENDIX B: GPS LOCATION OF SITES WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

SURVEY SITE	(GDA 94 _50J)	
	EASTING	NORTHING
45	379616	6485472
46	379554	6485448
47	379535	6485424
48	379511	6485413
49	379723	6485418
50	379736	6485363
51	379835	6485350
52	379939	6485296
53	379792	6485268
54	379886	6485246
55	379310	6486393
56	379946	6485155
57	379842	6485144
58	379697	6485065
59	379791	6485021
60	379858	6485035
61	379999	6485020
62	379680	6484981
63	379702	6484992
64	379348	6486401
65	379393	6486402

APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

FAMILY	SPECIES
Poaceae	* *Aira caryophyllea* *Austrostipa flavescens* * *Avena barbata* * *Avena fatua* * *Brachypodium distachyon* * *Briza maxima* * *Briza minor* * *Bromus diandrus* * *Catapodium rigidum* * *Ehrharta calycina* * *Ehrharta longiflora* * *Lagurus ovatus* * *Lolium perenne* * *Lolium rigidum* *Poa drummondiana* *Poa porphyroclados* *Rytidosperma occidentale* *Spinifex x alterniflorus* *Spinifex longifolius* *Sporobolus virginicus*
Cyperaceae	*Carex thecata* *Cassytha glabella* *Ficinia nodosa* *Lepidosperma calcicola* *Lepidosperma gladiatum* *Tetraria* sp. (JC031, 16/10/2013), possible new taxon (M. Hislop, Pers. Comm., 5/12/2013)
Restionaceae	*Desmocladus asper* *Desmocladus flexuosus*
Asparagaceae	*Acanthocarpus preissii* *Lomandra maritima* *Thysanotus manglesianus*
Asphodelaceae	* *Trachyandra divaricata*
Hemerocallidaceae	*Dianella revoluta* var. *divaricata* *Tricoryne elatior*
Haemodoraceae	*Anigozanthos* sp. P3 *Conostylis bracteata* *Conostylis* sp.
Iridaceae	* *Moraea flaccida* *Patersonia occidentalis* * *Romulea ?flava* * *Romulea rosea* * Iridaceae sp.
Casuarinaceae	*Allocasuarina lehmanniana* subsp. *Lehmanniana*
Urticaceae	*Parietaria debilis*

APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

FAMILY	SPECIES
Proteaceae	*Banksia sessilis* var. *cygnorum*
	Banksia sp.
	P1 *Grevillea* sp. Ocean Reef
	Lambertia multiflora
Santalaceae	*Exocarpos sparteus*
	Santalum acuminatum
Chenopodiaceae	*Rhagodia baccata* subsp. *dioica*
	Threlkeldia diffusa
Aizoaceae	* *Carpobrotus edulis*
	* *Tetragonia decumbens*
Portulacaceae	*Calandrinia liniflora*
	Calandrinia tholiformis
Caryophyllaceae	* *Cerastium glomeratum*
	* *Silene nocturna*
Ranunculaceae	*Clematis linearifolia*
Brassicaceae	* *Brassica tournefortii*
	* *Cakile maritima*
	* *Raphanus raphanistrum*
	* *Sisymbrium ?irio*
Crassulaceae	* *Crassula glomerata*
	Crassula colorata var. *colorata*
Fabaceae	*Acacia cochlearis*
	Acacia cyclops
	Acacia lasiocarpa var. *lasiocarpa*
	Acacia rostellifera
	Acacia saligna
	Gompholobium tomentosum
	Hardenbergia comptoniana
	Kennedia prostrata
	* *Lupinus cosentinii*
	* *Medicago polymorpha*
	* *Medicago* sp.
	* *Melilotus indicus*
	Templetonia retusa
	* *Trifolium campestre*
Geraniaceae	*Erodium cygnorum*
	* *Geranium molle*
	* *Pelargonium capitatum*
Polygalaceae	*Comesperma confertum*
Euphorbiaceae	* *Euphorbia paralias*
	* *Euphorbia terracina*

APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

FAMILY	SPECIES
Phyllanthaceae	*Phyllanthus calycinus* *Poranthera microphylla*
Celastraceae	*Stackhousia monogyna*
Rhamnaceae	*Cryptandra mutila* *Spyridium globulosum* *Trymalium odoratissimum*
Malvaceae	*Alyogyne huegelii* *?Alyogyne* sp. *Thomasia cognata* *Thomasia triphylla*
Dilleniaceae	*Hibbertia cuneiformis* *Hibbertia hypericoides* *Hibbertia racemosa* *Hibbertia subvaginata*
Frankeniaceae	*Frankenia pauciflora*
Violaceae	*Hybanthus debilissimus*
Thymelaeaceae	*Pimelea ferruginea* *Pimelea suaveolens*
Myrtaceae	*Eucalyptus ?todtiana* *Melaleuca cardiophylla* *Melaleuca huegelii* *Melaleuca ?incana* *Melaleuca lanceolata* *Melaleuca systena*
Araliaceae	*Trachymene pilosa*
Ericaceae	*Acrotriche cordata* *Leucopogon insularis* *Leucopogon parviflorus*
Primulaceae	* *Lysimachia arvensis*
Gentianaceae	* *Centaurium erythraea*
Lamiaceae	*Hemiandra glabra* subsp. *Glabra* *Hemiandra* sp.
Solanaceae	* *Solanum nigrum*
Scrophulariaceae	*Eremophila glabra* *Myoporum insulare*
Orobanchaceae	* *Bartsia trixago*

APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

FAMILY	SPECIES
Rubiaceae	* *Galium murale* *Opercularia vaginata*
Goodeniaceae	*Scaevola crassifolia* *Scaevola repens* var. *repens*
Asteraceae	* *Arctotheca calendula* * *Arctotheca calendula x Arctotheca populifolia* * *Cotula coronopifolia* * *Hypochaeris glabra* * *Lactuca* sp. *Olearia axillaris* * *Reichardia tingitana* *Rhodanthe corymbosa* *Senecio pinnatifolius* * *Sonchus ?asper* * *Sonchus oleraceus* * *Urospermum picroides*

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Acacia cochlearis																																		
Acacia cyclops	x	x										x	x							x						x							x	
Acacia lasiocarpa var. *lasiocarpa*							x	x																										
Acacia rostellifera			x	x			x							x		x	x	x				x			x			x		x	x	x	x	x
Acacia saligna								x		x																								
Acanthocarpus preissii	x				x		x		x		x		x					x	x	x	x	x					x			x	x			
Acrotriche cordata																																		
* *Aira caryophyllea*																																x		
Allocasuarina lehmanniana subsp. *lehmanniana*																																		
Alyogyne huegelii			x	x																														
Anigozanthos sp.																																		
* *Arctotheca calendula*																																		
* *Arctotheca calendula x Arctotheca populifolia*																							x											
Austrostipa flavescens										x														x								x		
* *Avena barbata*																																		
* *Avena fatua*		x	x	x		x	x	x	x	x		x	x	x	x	x	x	x	x	x		x	x	x		x		x		x	x		x	
Banksia sessilis var. *cygnorum*												x				x	x							x					x				x	x
Banksia sp.							x					x																						
* *Bartsia trixago*																			x															
* *Brachypodium distachyon*																																		
* *Brassica tournefortii*							x							x																				x
* *Briza maxima*																														x				x
* *Briza minor*																																		
* *Bromus diandrus*	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x		x	x		x				x		x						x
* *Cakile maritima*																																		
Calandrinia liniflora																									x							x		
Calandrinia tholiformis																				x													x	
Carex thecata																																		
* *Carpobrotus edulis*	x	x		x		x				x			x	x				x		x	x	x	x	x		x								
Cassytha glabella	x					x			x					x						x						x			x					
* *Catapodium rigidum*																													x			x		
* *Centaurium erythraea*																																		
* *Cerastium glomeratum*																	x			x		x						x				x	x	
Clematis linearifolia			x														x					x		x	x					x	x	x	x	x
Comesperma confertum								x																							x			
Conostylis bracteata (P3)							x	x		x		x			x			x		x														
Conostylis sp.								x																									x	
* *Cotula coronopifolia*																																		
Crassula colorata var. *colorata*																							x						x					
* *Crassula glomerata*	x				x	x		x				x	x	x	x	x			x	x			x	x		x	x		x			x	x	x

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Cryptandra mutila								x																										
Desmocladus asper							x			x								x																
Desmocladus flexuosus								x												x											x	x	
Dianella revoluta var. *divaricata*																														x	x	x		
* *Ehrharta calycina*								x								x						x						x					x
* *Ehrharta longiflora*																x			x	x					x				x			x	x	x
Eremophila glabra		x							x												x												
Erodium cygnorum																																		
Eucalyptus ?todtiana												x																						
* *Euphorbia paralias*		x	x	x	x	x	x		x			x	x	x	x	x	x						x	x		x			x	x	x	x	x
* *Euphorbia terracina*																																		
Exocarpos sparteus																																		
Ficinia nodosa														x																				
Frankenia pauciflora	x	x									x								x		x						x							
* *Galium murale*																									x		x		x	x	x	x		
* *Geranium molle*									x											x												x		
Gompholobium tomentosum								x																										
Grevillea sp. Ocean Reef (P1)																																		
Hardenbergia comptoniana	x						x	x						x				x		x		x						x	x				
Hemiandra glabra subsp. *Glabra*								x																										
Hemiandra sp.										x																								
Hibbertia cuneiformis																												x						
Hibbertia hypericoides																							x	x	x								x	
Hibbertia racemosa								x																										
Hibbertia subvaginata																																		
Hybanthus debilissimus																								x										
* *Hypochaeris glabra*																							x									x		
* Iridaceae sp.																																		
Kennedia prostrata														x																				
* *Lactuca* sp.																																		
* *Lagurus ovatus*	x	x				x	x	x	x	x		x	x	x	x	x		x	x							x				x				
Lambertia multiflora																																		
Lepidosperma calcicola							x	x		x		x																			x	x		
Lepidosperma gladiatum									x				x																					
Leucopogon insularis							x	x										x																
Leucopogon parviflorus																												x	x	x	x	x	x	
* *Lolium perenne*								x																										
* *Lolium rigidum*																																		x
Lomandra maritima							x	x				x						x	x												x	x		
* *Lupinus cosentinii*												x																						

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
* *Lysimachia arvensis*		x		x		x	x	x	x				x	x		x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x
* *Medicago polymorpha*	x													x		x										x								
Medicago sp.																																		
Melaleuca ?incana																																		
Melaleuca cardiophylla																																		
Melaleuca huegelii																												x	x					x
Melaleuca lanceolata														x																			
Melaleuca systena								x																x							x	x	
* *Melilotus indicus*						x								x													x		x				
* *Moraea flaccida*																x	x						x	x									
Myoporum insulare	x								x												x												
Olearia axillaris	x				x	x	x	x		x	x		x	x				x	x	x	x												
Opercularia vaginata								x																										
Parietaria debilis																						x												
Patersonia occidentalis																																	x	
* *Pelargonium capitatum*	x	x		x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x								
Phyllanthus calycinus								x									x							x						x	x		x	
Pimelea ferruginea																																x		
Pimelea suaveolens																																		
Poa drummondiana																																x		
Poa porphyroclados																														x				
Poranthera microphylla																															x			
* *Raphanus raphanistrum*																																		
* *Reichardia tingitana*																																		
Rhagodia baccata subsp. *dioica*		x	x	x						x		x			x				x	x		x	x	x	x			x	x			x	x
Rhodanthe corymbosa																													x					
* *Romulea ?flava*								x																										
* *Romulea rosea*																					x											x		
Rytidosperma occidentale																																x		
Santalum acuminatum							x					x			x	x	x							x									
Scaevola crassifolia	x	x			x	x			x		x		x	x					x		x						x						
Scaevola repens var. *repens*								x																										
Senecio pinnatifolius	x	x							x					x					x		x												
* *Silene nocturna*								x																									x	
* *Sisymbrium ?irio*																															x			
* *Solanum nigrum*				x								x																						
* *Sonchus ?asper*																																		
* *Sonchus oleraceus*	x	x	x	x	x	x			x		x	x	x	x	x	x	x			x	x			x	x	x	x	x	x	x	x	x	x	x
Spinifex longifolius	x	x			x						x										x													
Spinifex x alterniflorus																																		

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Sporobolus virginicus																					x													
Spyridium globulosum			x				x					x				x	x			x		x		x	x			x	x	x	x	x	x	
Stackhousia monogyna								x																										
Templetonia retusa																											x							
* *Tetragonia decumbens*	x	x	x		x	x	x		x		x		x	x							x						x							
Tetraria sp. (JC031, 16/10/2013), possible new taxon (M. Hislop, Pers. Comm., 5/12/2013)								x																										
Thomasia cognata																																		
Thomasia triphylla																																		
Threlkeldia diffusa		x		x	x	x			x										x	x	x						x	x						
Thysanotus manglesianus																												x						
* *Trachyandra divaricata*	x	x			x	x	x		x	x	x			x	x			x	x	x	x		x			x	x							
Trachymene pilosa																						x			x			x		x	x	x		
Tricoryne elatior																															x	x		
* *Trifolium campestre*																																		
Trymalium odoratissimum				x																														
* *Urospermum picroides*																																x		

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

Species	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
Acacia cochlearis																						x	x								
Acacia cyclops			x								x	x										x	x	x		x					
Acacia lasiocarpa var. *lasiocarpa*																		x								x	x				
Acacia rostellifera		x		x	x	x	x	x	x	x	x				x	x	x	x		x		x	x							x
Acacia saligna				x						x									x					x		x					
Acanthocarpus preissii	x	x		x	x	x	x		x	x	x					x	x				x			x	x	x	x	x	x	x	x
Acrotriche cordata																													x			
* *Aira caryophyllea*																																
Allocasuarina lehmanniana subsp. *lehmanniana*																						x	x								
Alyogyne huegelii																																
Anigozanthos sp.				x																												
* *Arctotheca calendula*			x							x	x	x																x	x			
* *Arctotheca calendula x Arctotheca populifolia*																																
Austrostipa flavescens								x								x		x						x							
* *Avena barbata*		x														x		x								x					
* *Avena fatua*	x		x	x	x	x	x	x		x									x	x				x						x		
Banksia sessilis var. *cygnorum*																				x											x
Banksia sp.																																
* *Bartsia trixago*				x																												
* *Brachypodium distachyon*																x																
* *Brassica tournefortii*	x	x					x									x		x									x				x
* *Briza maxima*		x			x					x						x														x		
* *Briza minor*															x			x														
* *Bromus diandrus*	x	x		x	x	x			x	x	x				x				x					x	x	x	x	x	x	x	x	x
* *Cakile maritima*	x													x																		
Calandrinia liniflora																																
Calandrinia tholiformis																																
Carex thecata															x																	
* *Carpobrotus edulis*	x																				x											
Cassytha glabella	x																								x		x			x		
* *Catapodium rigidum*															x																	
* *Centaurium erythraea*																								x								
* *Cerastium glomeratum*					x				x	x	x																					
Clematis linearifolia	x	x	x		x	x	x		x	x	x	x			x	x	x			x		x			x					x	x	
Comesperma confertum																		x														
Conostylis bracteata (P3)		x		x			x	x																	x		x					x
Conostylis sp.				x	x					x	x						x												x			
* *Cotula coronopifolia*							x																									
Crassula colorata var. *colorata*																																
* *Crassula glomerata*	x			x	x	x	x		x	x	x	x				x		x	x	x				x	x	x	x	x	x	x	x	x

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

Species	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
Cryptandra mutila		x																x													
Desmocladus asper																															
Desmocladus flexuosus		x		x			x	x	x						x	x		x							x						
Dianella revoluta var. *divaricata*		x				x									x	x		x		x							x				x
* *Ehrharta calycina*				x																				x					x		
* *Ehrharta longiflora*		x		x					x						x										x	x	x		x	x	x
Eremophila glabra																													x	x	
Erodium cygnorum															x																
Eucalyptus ?todtiana																															
* *Euphorbia paralias*	x		x	x	x	x	x	x		x	x	x							x	x		x		x							
* *Euphorbia terracina*		x														x		x							x	x	x				x
Exocarpos sparteus																x															
Ficinia nodosa																												x			
Frankenia pauciflora																					x							x			
* *Galium murale*			x												x	x			x	x							x				x
* *Geranium molle*																															
Gompholobium tomentosum		x																x													
Grevillea sp. Ocean Reef (P1)																															
Hardenbergia comptoniana	x						x		x		x				x			x		x				x	x	x	x		x	x	x
Hemiandra glabra subsp. *Glabra*																															
Hemiandra sp.																															
Hibbertia cuneiformis																	x														
Hibbertia hypericoides								x																							
Hibbertia racemosa																															
Hibbertia subvaginata																										x					
Hybanthus debilissimus																															
* *Hypochaeris glabra*			x					x																							
* Iridaceae sp.							x													x											
Kennedia prostrata			x																					x							
* *Lactuca* sp.			x				x	x												x											
* *Lagurus ovatus*	x	x		x	x		x		x	x	x				x	x	x	x	x	x				x	x	x	x	x	x	x	
Lambertia multiflora																										x					
Lepidosperma calcicola		x		x	x					x					x			x							x					
Lepidosperma gladiatum	x																												x		
Leucopogon insularis		x										x			x			x						x	x	x	x			
Leucopogon parviflorus							x								x	x									x						
* *Lolium perenne*																									x						
* *Lolium rigidum*													x														x				
Lomandra maritima		x																							x	x	x				
* *Lupinus cosentinii*																															

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

Species	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
* *Lysimachia arvensis*	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x		x				x	x	x	x	x	x	x	x
* *Medicago polymorpha*			x								x	x									x			x				x	x		
Medicago sp.																x															
Melaleuca ?incana																			x												
Melaleuca cardiophylla				x					x			x			x				x							x		x	x	
Melaleuca huegelii									x	x					x					x		x	x		x						x
Melaleuca lanceolata																															
Melaleuca systena		x		x	x					x							x	x				x	x		x		x			
* *Melilotus indicus*															x						x			x					x	x	
* *Moraea flaccida*																															
Myoporum insulare	x											x																x	x		
Olearia axillaris				x							x						x			x	x			x	x			x	x		
Opercularia vaginata																		x							x		x				
Parietaria debilis																															
Patersonia occidentalis																															
* *Pelargonium capitatum*	x	x									x									x	x			x				x	x		
Phyllanthus calycinus		x		x	x		x	x		x						x		x						x							
Pimelea ferruginea																		x						x							
Pimelea suaveolens																										x					
Poa drummondiana		x													x	x		x							x	x	x				x
Poa porphyroclados																															
Poranthera microphylla																															
* *Raphanus raphanistrum*										x																					
* *Reichardia tingitana*																								x						x	
Rhagodia baccata subsp. *dioica*		x	x			x			x		x						x		x						x	x	x			x	x
Rhodanthe corymbosa															x																
* *Romulea ?flava*																		x						x							
* *Romulea rosea*		x																							x						
Rytidosperma occidentale																															
Santalum acuminatum	x	x																													
Scaevola crassifolia	x		x								x	x									x	x	x	x				x	x		
Scaevola repens var. *repens*																															
Senecio pinnatifolius	x																				x							x	x	x	
* *Silene nocturna*		x																													
* *Sisymbrium ?irio*																															
* *Solanum nigrum*																						x									
* *Sonchus ?asper*																			x												
* *Sonchus oleraceus*	x	x	x	x	x	x	x		x	x	x	x			x		x		x	x	x			x	x	x	x	x		x	x
Spinifex longifolius														x																	
Spinifex x alterniflorus													x																		

APPENDIX D: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA 2013

Note: * denotes introduced species and P1-P5 denote Priority Flora Species (DPAW 2013c).

Species	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
Sporobolus virginicus																					x							x			
Spyridium globulosum	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x		x	x				x	x	x	x		x		x
Stackhousia monogyna																		x									x				
Templetonia retusa									x						x	x		x				x	x	x	x				x	x	
* *Tetragonia decumbens*	x												x			x		x			x							x			
Tetraria sp. (waiting on WAH)																															
Thomasia cognata							x		x																						
Thomasia triphylla															x															x	x
Threlkeldia diffusa	x										x	x									x			x	x			x	x	x	
Thysanotus manglesianus																															
* *Trachyandra divaricata*	x										x		x					x			x			x				x			
Trachymene pilosa						x		x	x									x									x				x
Tricoryne elatior																															
* *Trifolium campestre*																		x													
Trymalium odoratissimum																															
* *Urospermum picroides*															x																

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA, 2013

Note: * denotes introduced species; P1 - P5 denotes Priority Flora Species (DPaW 2013b)

	Veg community										
Species	**H1**	**H2**	**H3**	**H4**	**S1**	**S2**	**S3**	**S4**	**S5**	**FR**	**DS**
Acacia cochlearis									x		
Acacia cyclops	x	x			x	x	x		x		x
Acacia lasiocarpa var. lasiocarpa		x	x								
Acacia rostellifera	x	x	x	x	x	x	x	x	x		
Acacia saligna	x	x	x	x		x					
Acanthocarpus preissii	x	x		x	x			x			
Acrotriche cordata	x										
* *Aira caryophyllea*								x			
Allocasuarina lehmanniana subsp. *lehmanniana*									x		
Alyogyne huegelii					x	x					
Anigozanthos sp.				x							
* *Arctotheca calendula*	x			x	x						
* *Arctotheca calendula x Arctotheca populifolia*						x					
Austrostipa flavescens		x	x			x	x	x			
* *Avena barbata*		x	x					x			
* *Avena fatua*	x	x	x	x	x	x	x	x			x
Banksia sessilis var. *cygnorum*					x	x	x				
Banksia sp.		x				x					
* *Bartsia trixago*	x			x							
* *Brachypodium distachyon*								x			
* *Brassica tournefortii*	x	x	x		x			x			
* *Briza maxima*	x	x		x	x			x			
* *Briza minor*			x					x			
* *Bromus diandrus*	x	x	x	x	x	x	x	x			x
* *Cakile maritima*	x									x	
Calandrinia liniflora					x			x			
Calandrinia tholiformis	x						x				
Carex thecata								x			
* *Carpobrotus edulis*	x	x			x	x	x				x
Cassytha glabella	x	x				x					x
* *Catapodium rigidum*						x		x			
* *Centaurium erythraea*	x										
* *Cerastium glomeratum*	x			x	x		x				
Clematis linearifolia	x	x		x	x		x	x	x		
Comesperma confertum			x					x			
Conostylis bracteata (P3)	x	x	x	x	x	x	x	x			
Conostylis sp.	x		x	x	x		x				
* *Cotula coronopifolia*								x			
Crassula colorata var. *colorata*						x					
* *Crassula glomerata*	x	x	x	x	x	x	x	x			x
Cryptandra mutila		x	x								
Desmocladus asper		x				x					

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA, 2013

Note: * denotes introduced species; P1 - P5 denotes Priority Flora Species (DPaW 2013b)

	Veg community										
Species	**H1**	**H2**	**H3**	**H4**	**S1**	**S2**	**S3**	**S4**	**S5**	**FR**	**DS**
Desmocladus flexuosus	x	x	x	x			x	x			
Dianella revoluta var. *divaricata*		x	x		x			x			
* *Ehrharta calycina*	x		x	x	x		x				
* *Ehrharta longiflora*	x	x		x	x	x	x	x			
Eremophila glabra	x										
Erodium cygnorum								x			
Eucalyptus ?todtiana						x					
* *Euphorbia paralias*	x	x		x	x	x	x	x	x		x
* *Euphorbia terracina*		x	x		x			x			
Exocarpos sparteus								x			
Ficinia nodosa	x										
Frankenia pauciflora	x										
* *Galium murale*	x	x			x	x		x			
* *Geranium molle*	x						x				
Gompholobium tomentosum		x	x								
Hardenbergia comptoniana	x	x	x		x	x		x			
Hemiandra glabra subsp. *Glabra*			x								
Hemiandra sp.						x					
Hibbertia cuneiformis					x						
Hibbertia hypericoides					x	x	x				
Hibbertia racemosa			x								
Hibbertia subvaginata		x									
Hybanthus debilissimus							x				
* *Hypochaeris glabra*	x					x	x	x			
* Iridaceae sp.					x			x			
Kennedia prostrata	x										
* *Lactuca* sp.	x				x		x	x			
* *Lagurus ovatus*	x	x	x	x	x	x	x	x			x
Lambertia multiflora		x									
Lepidosperma calcicola		x	x	x		x		x			
Lepidosperma gladiatum	x										
Leucopogon insularis	x	x	x					x			
Leucopogon parviflorus		x			x	x	x	x			
* *Lolium perenne*		x	x								
* *Lolium rigidum*		x			x					x	
Lomandra maritima	x	x	x			x		x			
* *Lupinus cosentinii*						x					
* *Lysimachia arvensis*	x	x	x	x	x	x	x	x			x
* *Medicago polymorpha*	x				x		x				x
Medicago sp.								x			
Melaleuca cardiophylla	x	x		x		x		x			
Melaleuca huegelii		x		x	x	x		x	x		

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA, 2013

Note: * denotes introduced species; P1 - P5 denotes Priority Flora Species (DPaW 2013b)

		Veg community										
	Species	**H1**	**H2**	**H3**	**H4**	**S1**	**S2**	**S3**	**S4**	**S5**	**FR**	**DS**
	Melaleuca ?incana						x					
	Melaleuca lanceolata	x										
	Melaleuca systena		x	x	x	x		x	x	x		
*	*Melilotus indicus*	x					x		x			
*	*Moraea flaccida*						x	x				
	Myoporum insulare	x										
	Olearia axillaris	x	x	x	x	x	x					
	Opercularia vaginata		x	x								
	Parietaria debilis					x						
	Patersonia occidentalis							x				
*	*Pelargonium capitatum*	x	x			x	x	x				x
	Phyllanthus calycinus		x	x	x			x	x			
	Pimelea ferruginea	x		x					x			
	Pimelea suaveolens		x									
	Poa drummondiana		x	x		x			x			
	Poa porphyroclados								x			
	Poranthera microphylla								x			
*	*Raphanus raphanistrum*				x							
*	*Reichardia tingitana*	x										
	Rhagodia baccata subsp. *dioica*	x	x			x	x	x				
	Rhodanthe corymbosa						x		x			
*	*Romulea ?flava*	x		x								
*	*Romulea rosea*	x	x						x			
	Rytidosperma occidentale								x			
	Santalum acuminatum	x	x				x	x				
	Scaevola crassifolia	x				x				x		
	Scaevola repens var. *repens*			x								
	Senecio pinnatifolius	x										
*	*Silene nocturna*		x	x				x				
*	*Sisymbrium ?irio*								x			
*	*Solanum nigrum*						x			x		
*	*Sonchus ?asper*						x					
*	*Sonchus oleraceus*	x	x		x	x	x	x	x			x
	Spinifex longifolius	x									x	
	Spinifex x alterniflorus										x	
	Sporobolus virginicus	x										
	Spyridium globulosum	x	x		x	x	x	x	x			
	Stackhousia monogyna		x	x								
	Templetonia retusa	x	x	x					x	x		
*	*Tetragonia decumbens*	x	x			x			x		x	
	Tetraria sp. (JC031, 16/10/2013), possible new taxon (M. Hislop, Pers. Comm., 5/12/2013)			x								

APPENDIX E: VASCULAR PLANT SPECIES BY VEGETATION COMMUNITY WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA, 2013

Note: * denotes introduced species; P1 - P5 denotes Priority Flora Species (DPaW 2013b)

		Veg community									
	Species	**H1**	**H2**	**H3**	**H4**	**S1**	**S2**	**S3**	**S4**	**S5**	**FR**	**DS**
	Thomasia cognata								x			
	Thomasia triphylla	x				x			x			
	Threlkeldia diffusa	x	x			x	x					
	Thysanotus manglesianus					x						
*	*Trachyandra divaricata*	x	x			x	x				x	x
	Trachymene pilosa		x	x		x		x	x			
	Tricoryne elatior								x			
*	*Trifolium campestre*			x								
	Trymalium odoratissimum						x					
*	*Urospermum picroides*								x			

APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE PROPOSED OCEAN REEF MARINA, 2013

Mapping Code	Vegetation Community Description	Representative Plate of Community
H1	Low open scrubland to heath of *Acacia cyclops, Acacia rostellifera, Spyridium globulosum* and *Templetonia retusa* over *Scaevola crassifolia, Olearia axillaris, Myoporum insulare* and *Rhagodia baccata* subsp. *dioica* over *Acanthocarpus preissii, Threlkeldia diffusa, Senecio pinnatifolius* and *Frankenia pauciflora* over *Lepidosperma gladiatum, Spinifex longifolius, Sporobolus virginicus* and mixed exotics. **Other Associated Species:** *Eremophila glabra, Hardenbergia comptoniana* and *Kennedia prostrata*. **Soils and Landform:** White or light grey sands of fore and primary dunes. **Outcropping:** Numerous, limestone. **Condition:** Good to Excellent. **Plate Details:** Survey Site 1 **No. of Quadrats:** 20 **Similarity Percentage:** 43.6%	
H2	Open heath of *Melaleuca systena, Acanthocarpus preissii, Leucopogon insularis* and *Acacia lasiocarpa* var. *lasiocarpa* with emergent *Acacia rostellifera* and *Santalum acuminatum* over *Lomandra maritima, Conostylis bracteata* (P3), *Poa drummondii* and mixed exotics. **Other Associated Species:** *Clematis linearifolia*, *Desmocladus asper*, *Dianella revoluta* var. *divaricata*, *Hardenbergia comptoniana* and *Olearia axillaris.* **Soils and Landform:** Grey sands of secondary dune slopes. **Outcropping:** Few, limestone. **Condition:** Good to Excellent. **Plate Details:** Survey Site 18 **No. of Quadrats:** 6 **Similarity Percentage:** 51.5%	

APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE PROPOSED OCEAN REEF MARINA, 2013

Mapping Code	Vegetation Community Description	Representative Plate of Community
H3	Closed heath of *Acacia lasiocarpa* var. *lasiocarpa, Cryptandra confertum, Leucopogon insularis* and *Melaleuca systena* over *Comesperma confertum, Gompholobium tomentosum* and *Opercularia vaginata* over *Lepidosperma pubisquameum, Dianella revoluta* var. *divaricata* and mixed exotics. **Other Associated Species:** *Desmocladus flexuosus, Hardenbergia comptoniana* and *Phyllanthus calycinus*. **Soils and Landform:** Light grey sands of secondary dune slopes. **Outcropping:** N/A **Condition:** Excellent. **Plate Details:** Survey Site 52 **No. of Quadrats:** 2 **Similarity Percentage:** 66.7%	
H4	Low open scrub to heath of *Acacia rostellifera, Spyridium globulosum* and *Acacia saligna* over *Melaleuca systena, Acanthocarpus preissii, Olearia axillaris, Phyllanthus calycinus* and mixed exotics. **Other Associated Species:** *Conostylis sp.* and *Lepidosperma ?pubisquameum.* **Soils and Landform:** White to light grey sands of primary and secondary dune crests. **Outcropping:** N/A **Condition:** Very Good to Excellent. **Plate Details:** Survey Site 39 **No. of Quadrats:** 3 **Similarity Percentage:** 77.2%	

APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE PROPOSED OCEAN REEF MARINA, 2013

Mapping Code	Vegetation Community Description	Representative Plate of Community
S1	Mid closed scrubland of *Acacia rostellifera* and *Melaleuca huegelii* with occasional emergent *Banksia sessilis* var. *cygnorum* over *Spyridium globulosum, Rhagodia baccata* subsp. *dioica* and *Hibbertia cuneiformis* over *Acanthocarpus preissii, Clematis linearifolia, Hardenbergia comptoniana* and mixed exotics. **Other Associated Species:** *Leucopogon parviflorus, Olearia axillaris, Threlkeldia diffusa, Thomasia triphylla* and *Trachymene pilosa.* **Soils and Landform:** Deep grey sands of primary and secondary dunes. **Outcropping:** Few, limestone. **Condition:** Good. **Plate Details:** Survey Site 54 **No. of Quadrats:** 10 **Similarity Percentage:** 57.7%	
S2	Tall shrubland of *Banksia sessilis* var. *cygnorum, Spyridium globulosum, Santalum acuminatum* and *Acacia saligna* with occasional emergent *Eucalyptus todtiana* over *Rhagodia baccata* subsp. *dioica, Alyogyne huegelii* and *Trymalium odoratissimum* over *Conostylis bracteata* (P3), *Desmocladus asper, Lepidosperma pubisquameum* and mixed exotics. **Other Associated Species:** *Acacia cyclops, Austrostipa flavescens, Hardenbergia comptoniana, Hibbertia hypericoides* and *Threlkeldia diffusa.* **Soils and Landform:** Deep grey or brown sands of secondary dune swales. **Outcropping:** Few, limestone. **Condition:** Degraded to Very Good. **Plate Details:** Survey Site 12 **No. of Quadrats:** 7 **Similarity Percentage:** 27.0%	

APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE PROPOSED OCEAN REEF MARINA, 2013

Mapping Code	Vegetation Community Description	Representative Plate of Community
S3	Tall shrubland of *Spyridium globulosum, Acacia rostellifera, Banksia sessilis* var. *cygnorum* and *Santalum acuminatum* over *Phyllanthus calycinus, Hibbertia hypericoides* and *Melaleuca systena* over *Clematis linearifolia, Austrostipa flavescens, Desmocladus flexuosus* and mixed exotics. **Other Associated Species:** *Acacia cyclops, Patersonia occidentalis, Rhagodia baccata* subsp. *dioica,* and *Trachymene pilosa.* **Soils and Landform:** Light grey or brown sands of secondary dune swales. **Outcropping:** Few to Moderate, limestone. **Condition:** Degraded to Very Good. **Plate Details:** Survey Site 24 **No. of Quadrats:** 5 **Similarity Percentage:** 51.5%	
S4	Mid to tall scrubland of *Acacia rostellifera, Spyridium globulosum, Templetonia retusa, Melaleuca huegelii* and *Melaleuca cardiophylla* over *Leucopogon parvifolius*, *Thomasia cognata, Acanthocarpus preissii, Phyllanthus calycinus* and mixed exotics. **Other Associated Species:** *Austrostipa flavescens, Clematis linearifolia, Desmocladus flexuosus, Dianella revoluta* var. *divaricata* and *Pimelea ferruginea*. **Soils and Landform:** Grey sands of secondary dunes. **Outcropping:** Moderate, limestone. **Condition:** Good to Very Good **.** **Plate Details:** Survey Site 50 **No. of Quadrats:** 7 **Similarity Percentage:** 55.2%	

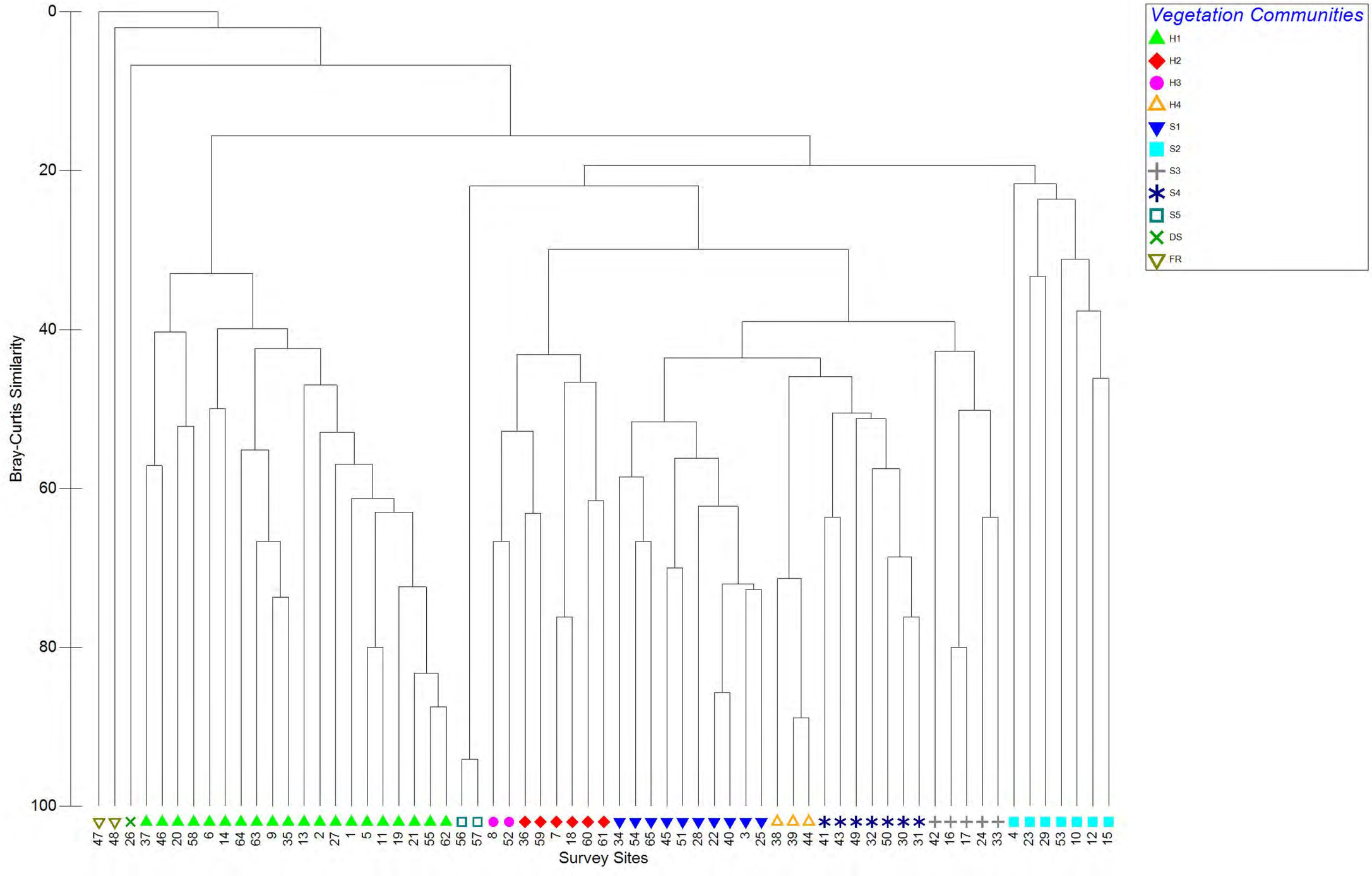
APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE PROPOSED OCEAN REEF MARINA, 2013

Mapping Code	Vegetation Community Description	Representative Plate of Community
S5	Tall closed shrubland of *Acacia cochlearis, Acacia cyclops, Acacia rostellifera, Allocasuarina lehmanniana* subsp. *lehmanniana, Melaleuca huegelii* and *Templetonia retusa* over *Melaleuca systena, Scaevola crassifolia* and mixed exotics. **Other Associated Species:** *Clematis linearifolia, *Euphorbia paralias* and **Solanum nigrum.* **Soils and Landform:** Grey sands of secondary dune swales. **Outcropping:** Moderate, limestone. **Condition:** Good to Very Good. **Plate Details:** Survey Sites 57 **No. of Quadrats:** 2 **Similarity Percentage:** 94.1%	
DS	Degraded dune swale. **Associated Species:** **Avena fatua, *Bromus diandrus, *Carpobrotus edulis, *Crassula glomerata, *Euphorbia paralias, *Lagurus ovatus, *Lysimachia arvensis, *Medicago polymorpha, *Pelargonium capitatum, *Sonchus oleraceus, *Trachyandra divaricata, Acacia cyclops* and *Cassytha glabella.* **Soils and Landform:** Deep grey sands. **Outcropping:** N/A **Condition:** Degraded. **Plate Details:** Survey Site 26 **No. of Quadrats:** 1 **Similarity Percentage:** N/A	

APPENDIX F: VEGETATION COMMUNITY DESCRIPTIONS FOR THE PROPOSED OCEAN REEF MARINA, 2013

Mapping Code	Vegetation Community Description	Representative Plate of Community
FR	Foredune rehabilitation. **Associated Species:** **Lolium rigidum, *Tetragonia decumbens, *Trachyandra divaricata, Spinifex x alterniflorus, *Cakile maritima* and *Spinifex longifolius.* **Soils and Landform:** White sands on foredunes. **Outcropping:** N/A **Condition:** Good. **Plate Details:** Survey Site 48 **No. of Quadrats:** 2 **Similarity Percentage:** N/A	

APPENDIX G: CLUSTER DENDROGRAM OF SITES SURVEYED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA



APPENDIX H: RELATIONSHIP BETWEEN SITES AND VEGETATION COMMUNITIES DEFINED WITHIN THE PROPOSED OCEAN REEF MARINA SURVEY AREA AND SELECTED VEGETATION COMMUNITIES DEFINED BY GIBSON *et al.* 1994