

Appendix 1
Subdivision approval (WAPC 155520)



Your Ref :

Taylor Burrell Barnett
Po Box 7130
Cloisters Square
PERTH WA 6850

Approval Subject To Condition(s) Freehold (Green Title) Subdivision

Application No : 155520

Planning and Development Act 2005

Applicant	:	Taylor Burrell Barnett Po Box 7130 Cloisters Square PERTH WA 6850
Owner	:	Capricorn Investment Group Pty Ltd 164 Williams Road PRAHRAN VIC 3181 Yanchep Sun City Pty Ltd Level 4, 225 St Georges Terrace PERTH WA 6000
Application Receipt	:	1 August 2017

Lot Number	:	9048
Diagram / Plan	:	P405421, P407765
Location	:	-
C/T Volume/Folio	:	2887/498, 2890/669
Street Address	:	Lot 9046 Campground Road , Yanchep
Local Government	:	City of Wanneroo

The Western Australian Planning Commission has considered the application referred to and is prepared to endorse a deposited plan in accordance with the plan date-stamped **01 August 2017** once the condition(s) set out have been fulfilled.

This decision is valid for **four years** from the date of this advice, which includes the lodgement of the deposited plan within this period.

The deposited plan for this approval and all required written advice confirming that the requirement(s) outlined in the condition(s) have been fulfilled must be submitted by **19 December 2021** or this approval no longer will remain valid.

Reconsideration - 28 days

Under section 151(1) of the *Planning and Development Act 2005*, the applicant/owner may, within 28 days from the date of this decision, make a written request to the WAPC to reconsider any condition(s) imposed in its decision. One of the matters to which the WAPC will have regard in reconsideration of its decision is whether there is compelling evidence by way of additional information or justification from the applicant/owner to warrant a reconsideration of the decision. A request for reconsideration is to be submitted to the WAPC on a Form 3A with appropriate fees. An application for reconsideration may be submitted to the WAPC prior to submission of an application for review. Form 3A and a schedule of fees are available on the WAPC website: <http://www.planning.wa.gov.au>

Right to apply for a review - 28 days

Should the applicant/owner be aggrieved by this decision, there is a right to apply for a review under Part 14 section 251 of the *Planning and Development Act 2005*. The application for review must be submitted in accordance with part 2 of the *State Administrative Tribunal Rules 2004* and should be lodged within 28 days of the date of this decision to: the State Administrative Tribunal, Level 6, State Administrative Tribunal Building, 565 Hay Street, PERTH, WA 6000. It is recommended that you contact the tribunal for further details: telephone 9219 3111 or go to its website: <http://www.sat.justice.wa.gov.au>

Deposited plan

The deposited plan is to be submitted to the Western Australian Land Information Authority (Landgate) for certification. Once certified, Landgate will forward it to the WAPC. In addition, the applicant/owner is responsible for submission of a Form 1C with appropriate fees to the WAPC requesting endorsement of the deposited plan. A copy of the deposited plan with confirmation of submission to Landgate is to be submitted with all required written advice confirming compliance with any condition(s) from the nominated agency/authority or local government. Form 1C and a schedule of fees are available on the WAPC website: <http://www.planning.wa.gov.au>

Condition(s)

The WAPC is prepared to endorse a deposited plan in accordance with the plan submitted once the condition(s) set out have been fulfilled.

The condition(s) of this approval are to be fulfilled to the satisfaction of the WAPC.

The condition(s) must be fulfilled before submission of a copy of the deposited plan for endorsement.

The agency/authority or local government noted in brackets at the end of the condition(s) identify the body responsible for providing written advice confirming that the WAPC's requirement(s) outlined in the condition(s) have been fulfilled. The written advice of the agency/authority or local government is to be obtained by the applicant/owner. When



the written advice of each identified agency/authority or local government has been obtained, it should be submitted to the WAPC with a Form 1C and appropriate fees and a copy of the deposited plan.

If there is no agency/authority or local government noted in brackets at the end of the condition(s), a written request for confirmation that the requirement(s) outlined in the condition(s) have been fulfilled should be submitted to the WAPC, prior to lodgement of the deposited plan for endorsement.

Prior to the commencement of any subdivision works or the implementation of any condition(s) in any other way, the applicant/owner is to liaise with the nominated agency/authority or local government on the requirement(s) it considers necessary to fulfil the condition(s).

The applicant/owner is to make reasonable enquiry to the nominated agency/authority or local government to obtain confirmation that the requirement(s) of the condition(s) have been fulfilled. This may include the provision of supplementary information. In the event that the nominated agency/authority or local government will not provide its written confirmation following reasonable enquiry, the applicant/owner then may approach the WAPC for confirmation that the condition(s) have been fulfilled.

In approaching the WAPC, the applicant/owner is to provide all necessary information, including proof of reasonable enquiry to the nominated agency/authority or local government.

The condition(s) of this approval, with accompanying advice, are:

CONDITIONS:

1. The plan of subdivision being modified;
 - a) to include additional foreshore reserve to accommodate the values, functions and uses prescribed by State Planning Policy 2.6 *Coastal Planning* as shown on the plan dated 20 November 2017 (attached); and
 - b) to include all land reserved Parks and Recreation under the Metropolitan Region Scheme within the foreshore reserve.

(Western Australian Planning Commission)
2. The landowner/applicant contributing towards development infrastructure provisions pursuant to the City of Wanneroo District Planning Scheme No. 2 (Local Government)
3. Engineering drawings and specifications are to be submitted, approved, and works undertaken in accordance with the approved engineering drawings, specifications and approved plan of subdivision, for grading and/or stabilisation of the site to ensure that:

- a) lots can accommodate their intended use; and
 - b) finished ground levels at the boundaries of the lot(s) the subject of this approval match or otherwise coordinate with the existing and/or proposed finished ground levels of the land abutting.
(Local Government)
4. Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water and Environment Regulation, having regard to the 2007 Drainage and Water Management Plan prepared for the area. (Local Government)
 5. Engineering drawings and specifications are to be submitted and approved, and works undertaken in accordance with the approved engineering drawings and specifications and approved plan of subdivision, for the filling and/or draining of the land, including ensuring that stormwater is contained on-site, or appropriately treated and connected to the local drainage system. Engineering drawings and specifications are to be in accordance with the approved urban water management plan, to the satisfaction of the Western Australian Planning Commission. (Local Government)
 6. The implementation of the Flora and Fauna Management plan for the area in accordance with the Capricorn Coastal Village Agreed Local Structure Plan No. 44. (Local Government)
 7. Measures being taken to ensure the identification and protection of any vegetation on the site worthy of retention that is not impacted by subdivisional works, prior to commencement of subdivisional works. (Local Government).
 8. Local Development Plan(s) being prepared and approved for the mixed use site shown on the plan dated 20 November 2017 (attached) that address the following:
 - a) Frontage and interface with the adjacent road network, public open space and Coastal Foreshore Reserve;
 - b) Adaptability to non-residential use over time by providing suitable access, parking, street interface, site layout, external building design, internal building design and facilities.
 - c) Public accessibility and view corridors to the Coastal Foreshore Reserve. (Local Government)
 9. The landowner/applicant shall make arrangements to ensure that prospective purchasers of lots subject of a Local Development Plan are advised in writing that Local Development Plan provisions apply (Local Government).
 10. Information is to be provided to demonstrate that the measures contained in the Bushfire Management Plan by Strategen Environmental dated July 2017 have been implemented during subdivisional works. (Local Government)

11. A Notification, pursuant to Section 165 of the *Planning and Development Act 2005* is to be placed on the certificate(s) of title of the proposed lot(s) with a Bushfire Attack Level (BAL) rating of 12.5 or above, advising of the existence of a hazard or other factor.

Notice of this notification is to be included on the diagram or plan of survey (deposited plan).

The notification is to state as follows:

'This land is within a bushfire prone area as designated by an Order made by the Fire and Emergency Services Commissioner and may be subject to a Bushfire Management Plan. Additional planning and building requirements may apply to development on this land' (Western Australian Planning Commission)

12. A foreshore reserve in accordance with the plan dated 20 November 2017 (attached); as established by survey, being shown on the diagram or plan of survey (deposited plan) as a reserve for foreshore management and vested in the Crown under Section 152 of the *Planning and Development Act 2005*, such land to be ceded free of cost and without any payment of compensation by the Crown. (Western Australian Planning Commission)
13. Prior to the commencement of subdivision works a foreshore management plan for the coastal foreshore reserve is to be prepared and approved to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan (Local Government)
14. The proposed reserve(s) shown on the approved plan of subdivision as public open space being shown on the diagram or plan of survey (deposited plan) as reserves for recreation and vested in the Crown under Section 152 of the *Planning and Development Act 2005*, such land to be ceded free of cost and without any payment of compensation by the Crown. (Local Government)
15. Arrangements being made for the proposed public open space to be developed by the landowner/applicant to a minimum standard and maintained for two summers through the implementation of an approved landscape plan providing for the development and maintenance of the proposed public open space in accordance with the requirements of Liveable Neighbourhoods and to the specifications of the local government. (Local Government)
16. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, to ensure that those lots not fronting an existing road are provided with frontage to a constructed road(s) connected by a constructed road(s) to the local road system and such road(s) are constructed and drained at the landowner/applicant's cost.

As an alternative, and subject to the agreement of the Local Government the Western Australian Planning Commission (WAPC) is prepared to accept the landowner/applicant paying to the local government the cost of such road works as estimated by the local government and the local government providing formal assurance to the WAPC confirming that the works will be completed within a reasonable period as agreed by the WAPC. (Local Government)

17. Engineering drawings and specifications are to be submitted and approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications to ensure that:
 - a) roads that have been designed to connect with existing or proposed roads abutting the subject land are coordinated so the road reserve location and width connect seamlessly and/or
 - b) temporary turning areas are provided to those subdivisional roads that are subject to future extension and/or
 - c) embayment parking is provided within the/abutting the proposed public open space and mixed use zone lots.to the satisfaction of the Western Australian Planning Commission. (Local Government)
18. Engineering drawings and specifications are to be submitted, approved, and subdivisional works undertaken in accordance with the approved plan of subdivision, engineering drawings and specifications, for the provision of shared paths through and connecting to the application area in accordance with the plan dated 20 November 2017 (attached). The approved shared paths are to be constructed by the landowner/applicant. (Local Government)
19. Arrangements being made with the Water Corporation so that provision of a suitable water supply service will be available to the lots shown on the approved plan of subdivision. (Water Corporation)
20. Arrangements being made with the Water Corporation so that provision of a sewerage service will be available to the lots shown on the approved plan of subdivision. (Water Corporation)
21. Arrangements being made to the satisfaction of the Western Australian Planning Commission and to the specification of Western Power for the provision of an underground electricity supply to the lot(s) shown on the approved plan of subdivision. (Western Power).
22. The transfer of land as a Crown reserve free of cost to Western Power for the provision of electricity supply infrastructure. (Western Power)

ADVICE:

1. With regard to Condition 1, the applicant is advised to obtain a certificate under Clause 42 of the Metropolitan Region Scheme to determine the precise boundary of the Parks and Recreation reservation.

2. With regard to Condition 7, these measures are to include a tree survey on the site and an accompanying arborists report to support tree specimens to be retained or removed.
3. In regard to Conditions 19 and 20, the landowner/applicant shall make arrangements with the Water Corporation for the provision of the necessary services. On receipt of a request from the landowner/applicant, a Land Development Agreement under Section 83 of the *Water Services Act 2012* will be prepared by the Water Corporation to document the specific requirements for the proposed subdivision.
4. In regard to Condition 21, Western Power provides only one underground point of electricity supply per freehold lot.
5. The Department of Fire and Emergency Services(DFES) advises that historical research has revealed that during the past 100 years, former elements of the Australian Defence Forces may have conducted training and/or operational activities within or close to the area of the proposed subdivision. It is possible that as a result of these activities, the subject area may contain unexploded ordnance (UXO). While it is considered that the possible risk from UXO on the land subject to this approval is minimal, an absolute guarantee that the area is free from UXO cannot be given. Should, during subdivisional works, or at any other time, a form or suspected form of UXO be located, DFES has advised that the following process should be initiated:
 - a) do not disturb the site of the known or suspected UXO;
 - b) without disturbing the immediate vicinity, clearly mark the site of the UXO;
 - c) notify Police of the circumstances/situation as quickly as possible; and
 - d) maintain a presence near the site until advised to the contrary by a member of the WA Police Service or Defence Forces.

Further advice on this issue may be obtained by contacting the Unexploded Ordnance Unit, Department of Fire and Emergency Services.



Kerrine Blenkinsop
Secretary
Western Australian Planning Commission

19 December 2017

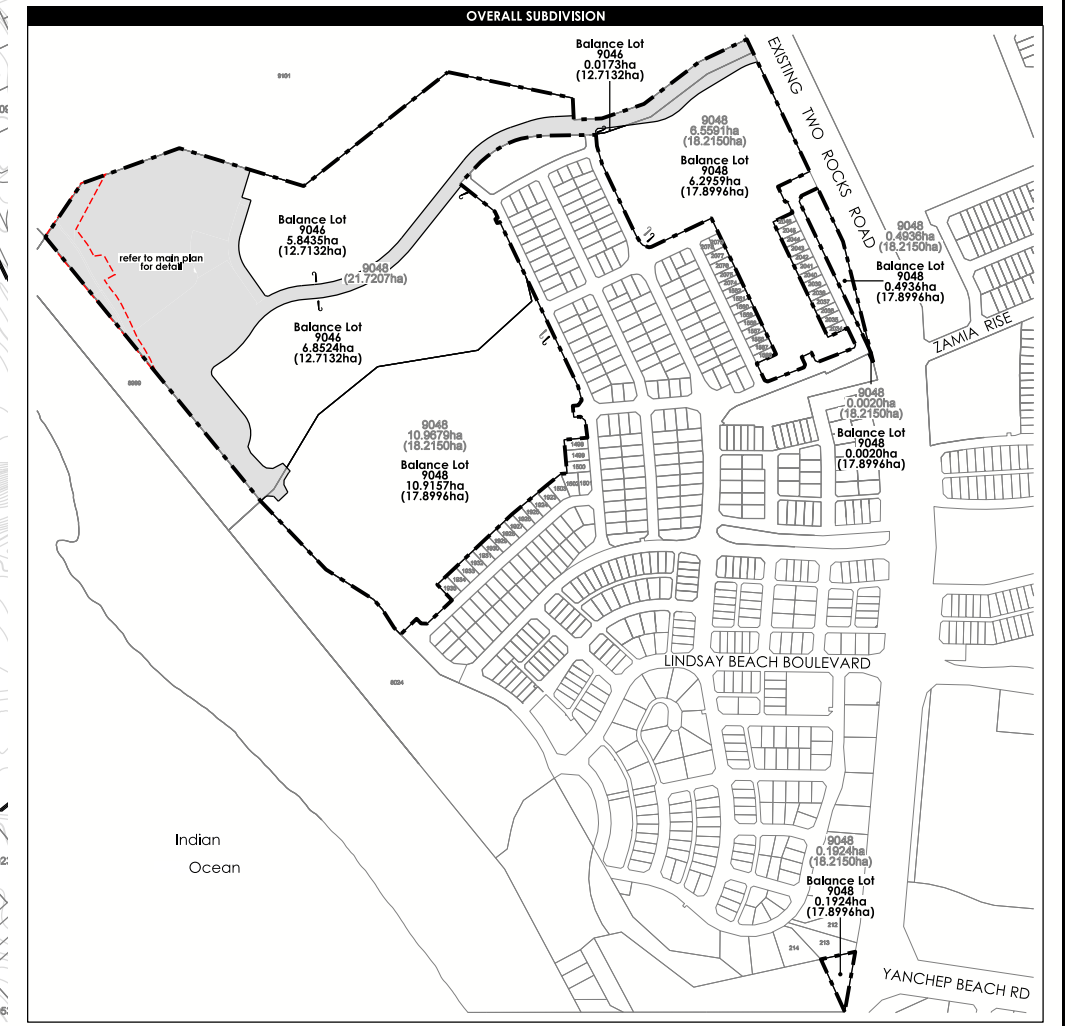
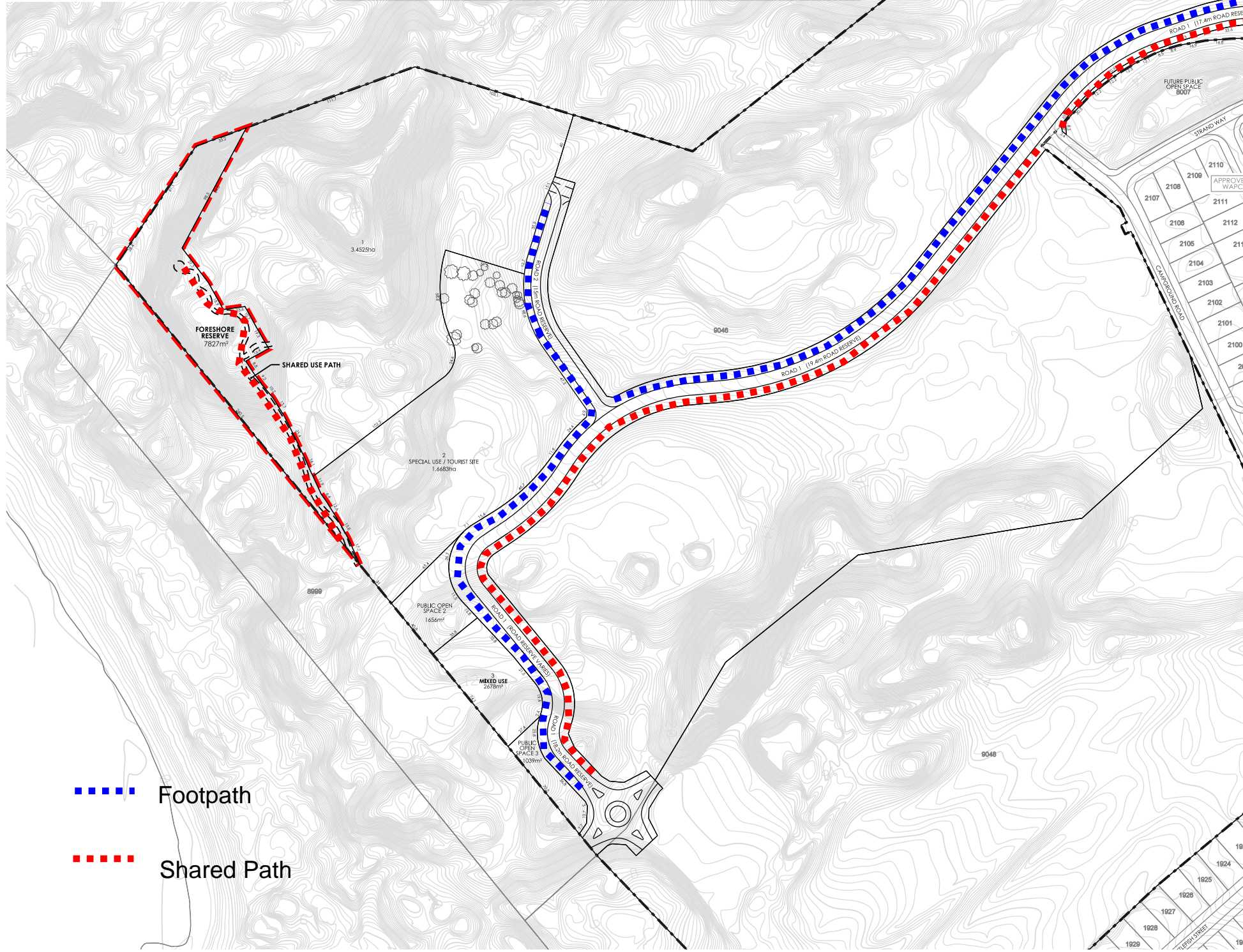
Enquiries : Jas Lapinski (Ph 6551 9563)

LEGEND	
	TOTAL APPLICATION AREA (39.9357ha)
	SURVEYED TREES IN THE VICINITY OF THE PROPOSED SUBDIVISION WORKS CONSIDERED FOR POSSIBLE RETENTION

LOT SUMMARY				
LOT YIELD		LOT AREA		
Size	No. Lots	% Total Lots	Average Size	% of Total Area
2000m ² - 2999m ²	1	33.33%	2678m ²	4.97%
1ha - 2ha	1	33.33%	1.6683ha	30.96%
2ha - 5ha	1	33.33%	3.4525ha	64.07%
Number of Lots	3			
Minimum Lot Size 2678m ²			Average Lot Size 17962m ²	
Maximum Lot Size 34525m ²			Total Lot Area 53886m ²	
Balance Lots	2			
Total Number of Lots	5			

DEPARTMENT OF PLANNING, LANDS AND HERITAGE

DATE **20-Nov-2017** FILE **155520**



Footpath

Shared Path

Plan of Subdivision
 LOTS 9046 & 9048 TWO ROCKS ROAD, YANCHEP
 A CAPRICORN VILLAGE JOINT VENTURE PROJECT

plan: 14/024/117M
 date: 17/11/2017
 projection: PCG94

designed: ME
 checked: RC
 drawn: MH

scale: 1:750@A1 | 1:1500@A3
 0 30 60m

Taylor Burrell Barnett Town Planning & Design
 Level 7, 150 St Georges Terrace, Perth WA 6000
 p: (08) 9226 4276 f: (08) 9322 7879 e: admin@tbbplanning.com.au

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Appendix 2
Karst Risk Assessment

Acumen Development Solutions
18 Lyall Street
SOUTH PERTH WA 6151

Attention: Preston O'Keefe

**KARST RISK DESK STUDY
CAPRICORN FORESHORE
YANCHEP**

Dear Preston,

1. INTRODUCTION

This letter presents the outcomes of Galt Geotechnics (Galt) desk study on karst risk for the foreshore along the Capricorn Yanchep project (the "site"). The location of the site relative to the surrounding area is shown on the attached Figure 1, Site and Location Plan.

The study was authorised by you on behalf of Capricorn Village Joint Village in a signed Client Authorisation form dated 9 November 2016.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Based on the supplied information, the length of the foreshore for the study is about 1,200 m, and is up to about 250 m wide at some locations (from shoreline to crest of sand dunes).

We understand that the site is to remain as a foreshore and will remain relatively undeveloped, except for minor parks and streetscapes at the crest of the sand dunes adjacent to the residential subdivision, and three beach access routes.

We understand that the park within the foreshore development is to include minor development, namely: changerooms, toilet facilities, pathways, play equipment, retaining walls up to about 1 m high, trees, shade structures, park furniture and associated amenities.

The proposed development overlaid on a recent aerial photograph of the site is presented as Figure 2, Proposed Development.

The desk study assumes that no significantly loaded structures such as residential dwellings or multi-storey buildings are to be constructed within the site.

3. PROJECT OBJECTIVES

The objectives of the desk study were to:

- ✦ conduct a karst risk desk study along the foreshore of the Capricorn Yanchep project (area nominated on provided plans), in line with City of Wanneroo planning requirements, including a map showing areas of karst risk; and
- ✦ provide advice on further geotechnical investigation/s (if required) to support a Karst Risk Management Plan.

Note: The desk study does not include an intrusive geotechnical study of the subsurface conditions at the site for assessment of karstic features (voids, dolines and loose sand zones etc.). Such an intrusive investigation (not related specifically to karst risk) is normally required prior to development.

4. SITE WALKOVER

A site walkover was conducted by a geotechnical engineer from Galt on 11 November 2016 and included taking photographs.

There are a number of access pathways from the adjacent residential developments /access roads to the shoreline.

At the time of the site walkover, the foreshore comprised undulating sand dunes, particularly along the eastern portion of the foreshore parallel to the shoreline (with significant elevation changes up to about 10 m). The western portion of the foreshore parallel with the shoreline was lower lying with less significant changes in elevation.

The sand dunes were generally covered with low lying vegetation including grasses and shrubs. The surface generally comprised sandy material with limestone gravels. No areas of significant exposed limestone or limestone outcrops were observed during the site walkover.

Erosion of the shoreline was noted during the site visit, particularly at the southern end of the foreshore site.

Photographs of the site are presented in Attachment A, Site Photographs.

No intrusive/ground-breaking investigation was conducted.

5. EXPECTED SUBSURFACE CONDITIONS

We have previously been involved in both geotechnical investigation and extensively in earthworks and earthworks verification in a number of stages as part of the Capricorn development in Yanchep.

Based on our experience within the Capricorn development, the subsurface conditions can generally be summarised as comprising:

- ✦ SAND, generally fine to coarse grained of variable thickness; overlying
- ✦ LIMESTONE.

We are not aware of any karstic features (voids, dolines or significant deep loose sand zones) being encountered during the earthworks adjacent to the foreshore site (also completed as part of the Capricorn development).

6. KARST TERRAIN

6.1 General

Karst is a distinctive topography that develops as a result of the dissolution of soluble bedrock. A Karst Terrain is defined as one with underground drainage and the distinctive landforms associated with this such as caves, closed depressions, sinkholes and occasionally dry valleys. Engineering issues include open voids, potential collapse and subsiding soil cover, which can provide uneven support to overlying structures and infrastructure.

Limestone and other carbonate rich materials are soluble in water and can be almost entirely removed during the weathering process leaving varying amounts of insoluble residues. The effect of this on the ground surface is the development of a distinctive assemblage of landforms which in turn can create a range of management issues. In most cases, the formation of Karst involves what is known as “the carbon dioxide cascade”. As rain falls through the atmosphere, it gathers CO₂, which dissolves in the droplets. Once the rain enters the ground it percolates through the soil and collects more CO₂ to form a weak solution of carbonic acid. Water flow is naturally concentrated in discontinuities in the rock, and due to prolonged exposure, carbonates begin to dissolve. This process can be accelerated by the presence of adjacent low pH soils. Small discontinuities can be enlarged by chemical dissolution caused by slow moving groundwater as fracture walls are removed in solution. Over time, the initial small discontinuities are enlarged into wide fissures and sometimes into open caves that are capable of carrying all natural drainage underground.

6.2 City of Wanneroo Requirements

The City of Wanneroo (CoW) has prepared a document entitled “Local Planning Policy 4.13: Caves and Karstic Features” to deal with development of areas within the CoW that have been identified as containing caves or other karstic features. The CoW uses a level of risk approach and Figure 1 of CoW’s document shows the extent of areas that are low, medium and high risk of containing caves and Karstic features. Based on the risk category associated with the location of a site the document imposes various conditions on development of the site. A copy of this Policy is included in Attachment B, City of Wanneroo Local Planning Policy 4.13.

The City of Wanneroo Karstic Features Risk Zones map (Local Planning Policy 4.13: Caves and Karstic Features) shows the site to be in a “low karst risk” area. This is presented in Figure 3, Karst Risk Map.

7. SITE HISTORY

Historical aerial photographs show that the site has remained relatively unchanged since at least 1963. Minor erosion and accretion of the shoreline is noted however, no development of the site appears to have occurred in this time. Historical aerial photographs are shown on Figures 4A-4D.

8. GEOTECHNICAL DESK STUDY (FIGURE 5)

8.1 Geology

The Yanchep sheet of the 1:50,000 scale Environmental Geology series map indicates that the area is underlain by calcareous sand described as “white, fine to medium grained, sub-rounded quartz and shell debris, or eolian origin”.

8.2 Groundwater

The Perth Groundwater Atlas (1997) shows the historical maximum groundwater level to be close to sea level at around RL 0 m AHD to RL 1 m AHD.

9. ENVIRONMENTAL DESK STUDY (FIGURE 6)

9.1 Acid Sulfate Soils

The Department of Environment Regulation (DER) acid sulfate soils risk (ASS) mapping indicates that the site is in an area identified as having no known risk of ASS occurrence within 3 m of the ground surface.

9.2 Environmentally Sensitive Areas

The Department of Parks and Wildlife (DPaW) mapping shows that the entire site is located within an Environmentally Sensitive Area (ESA). As such, any clearing of native vegetation will require a clearing permit issued by DPaW.

9.3 Geomorphic Wetlands

The DPaW mapping shows that no geomorphic wetland sites are located within 500 m of the site.

9.4 Contamination

The DER database shows that the site is not a registered contaminated site.

9.5 Aboriginal Heritage Site

The Department of Indigenous Affairs (DIA) heritage database indicates that part of the site is located in an area mapped as an Aboriginal Heritage site. The heritage site is identified as 'Yanchep Beach – mythological' and extends across the southern portion of the study area.

10. KARST RISK ASSESSMENT

The City of Wanneroo Karstic Features Risk Zones map (Local Planning Policy 4.13: Caves and Karstic Features) shows the site to be in a "low karst risk" area. Based on the proposed foreshore development comprising a public open space (POS) including changerooms, toilet facilities, pathways, play equipment, retaining walls, trees, shade structures, park furniture and associated amenities, etc, we do not consider that any further requirements specifically related to karst risk are required. Specifically, we do not consider that a Karstic Features Management Plan is needed for the proposed development (subject to City of Wanneroo and Local Structure Plan requirements).

Nonetheless, a geotechnical study will be required across the development area where structures (such as changerooms, toilet facilities etc) are to be located, to certify that the land is capable of development. This is not specifically related to karst or karst risk, but is intended as a normal pre-development geotechnical study to assess ground conditions.

Based on the proposed development, we recommend the geotechnical study comprise the following as a minimum:

- cone penetration tests (CPTs) across the site, particularly concentrated at the areas of proposed structures (i.e. changerooms, toilet facilities, associated amenities etc).

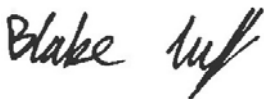
Regardless of the low karst risk of the site, if any unexpected conditions (including indications of potential karst) are encountered during further studies or earthworks, they should be referred to a geotechnical engineer for provision of further advice.

11. CLOSURE

We draw your attention to Attachment C of this letter, "Understanding your Report". The information provided within is intended to inform you as to what your realistic expectations of this report should be. This information is provided not to reduce the level of responsibility accepted by Galt, but to ensure that all parties who rely on this report are aware of the responsibilities each assumes in so doing.

We trust that the information provided satisfies your present requirements and meets with your approval. Should you have any queries please do not hesitate to contact this office.

GALT GEOTECHNICS PTY LTD



Blake Luff CPEng

Geotechnical Engineer

Attachments: Figure 1 – Site and Location Plan
 Figure 2 – Proposed Development
 Figure 3 – Karst Risk Map
 Figures 4A-4D – Historical Aerial Imagery
 Figure 5 – Indicative Geotechnical Aspects
 Figure 6 – Indicative Environmental Aspects
 Attachment A – Site Photographs
 Attachment B – City of Wanneroo Local Planning Policy 4.13
 Attachment C – Understanding your Report

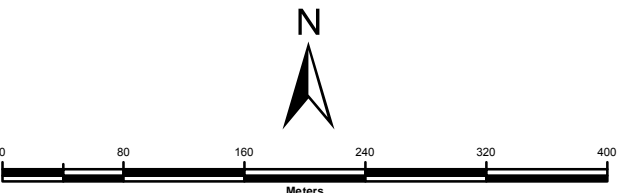
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Mary Lindsay lot excluded from FMP – managed by the City of Wanneroo



Legend
 Site Boundary



SCALE	1:5,000	(A3)
DRAWN	PIR	
DATE DRAWN	22/11/2016	
CHECKED	BL	
DATE CHECKED	22/11/2016	
PROJECTION	GDA 1994 MGA Zone 50	



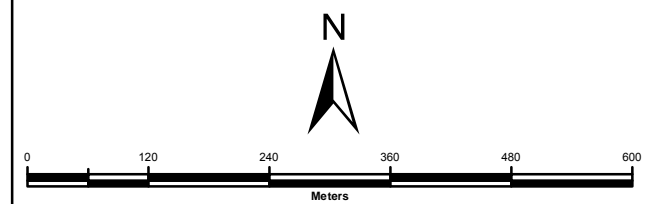
Galt Geotechnics Pty Ltd
 ACN : 138 490 865
 Tel : +61 (0)8 6272-0200
 Address : Unit 4, 15 Walters Drive
 Osborne Park WA 6017

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CLIENT	ACUMEN DEVELOPMENT SOLUTIONS		
PROJECT	KARST RISK DESK STUDY		
LOCATION	CAPRICORN FORESHORE, YANCHEP		
TITLE	SITE & LOCATION PLAN		
Job No	J1601249	Fig No	FIGURE 1
Rev	A		



Legend
 Site Boundary



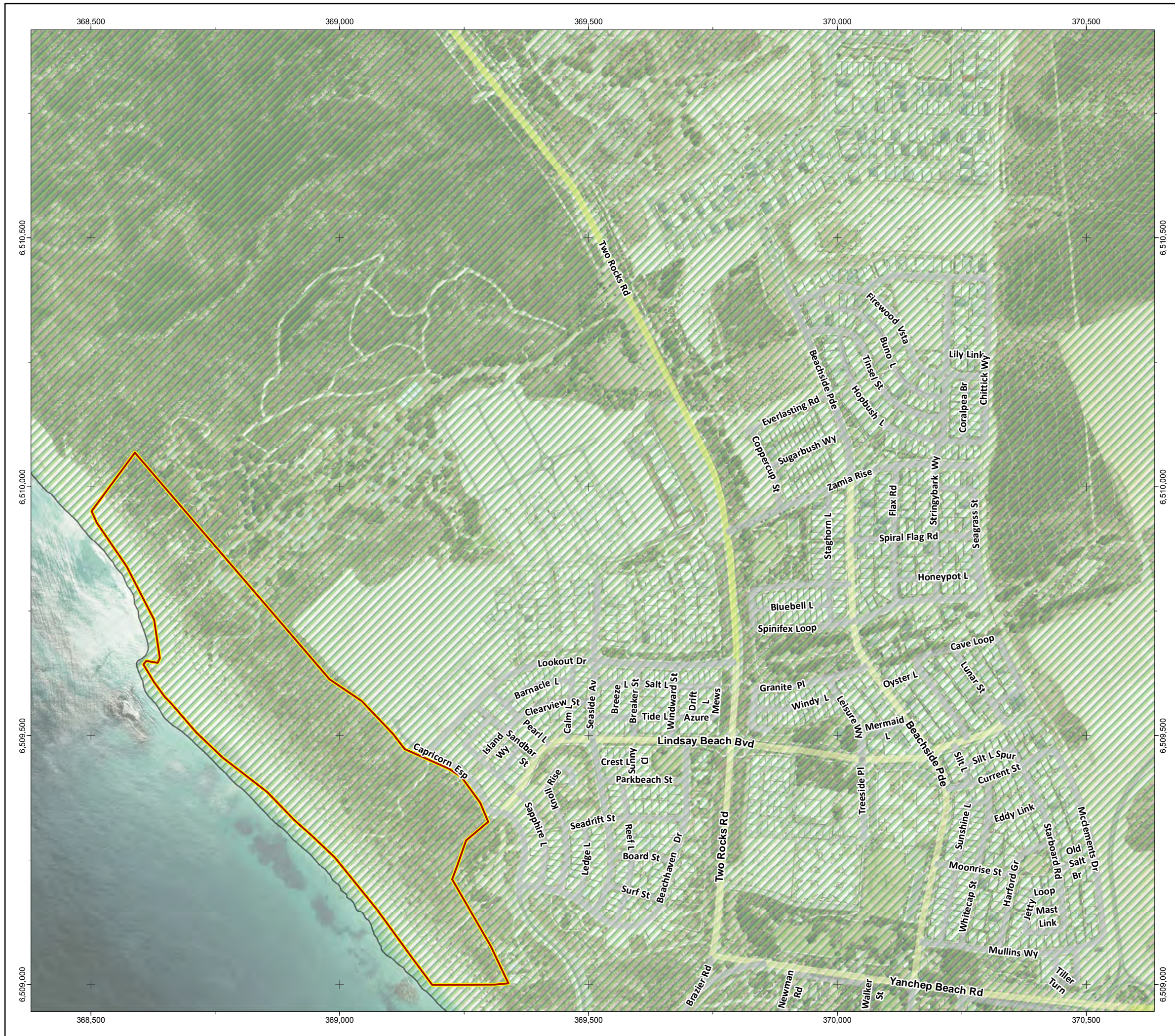
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	DRAWN	PIR	
	DATE DRAWN	22/11/2016	
	CHECKED	BL	
	DATE CHECKED	22/11/2016	
PROJECTION	GDA 1994 MGA Zone 50		



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CLIENT	ACUMEN DEVELOPMENT SOLUTIONS		
PROJECT	KARST RISK DESK STUDY		
LOCATION	CAPRICORN FORESHORE, YANCHEP		
TITLE	PROPOSED DEVELOPMENT		
Job No	J1601249	Fig No	FIGURE 2
		Rev	A

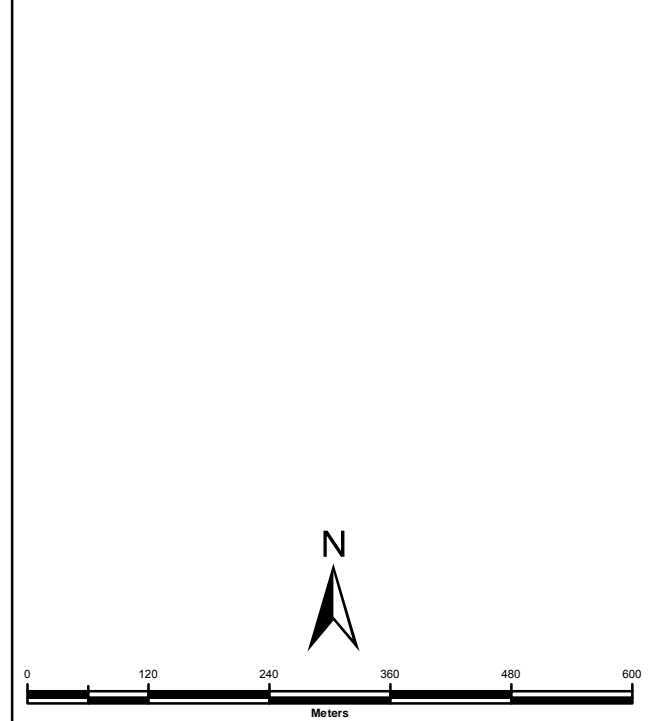


Legend

Site Boundary

Karst Risk (from City of Wanneroo [+/-200m])

Low



<p>SITE LOCATION</p>	<p>SCALE 1:7,500 (A3)</p> <p>DRAWN PIR</p> <p>DATE DRAWN 22/11/2016</p> <p>CHECKED BL</p> <p>DATE CHECKED 22/11/2016</p> <p>PROJECTION GDA 1994 MGA Zone 50</p>
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 Osborne Park WA 6017

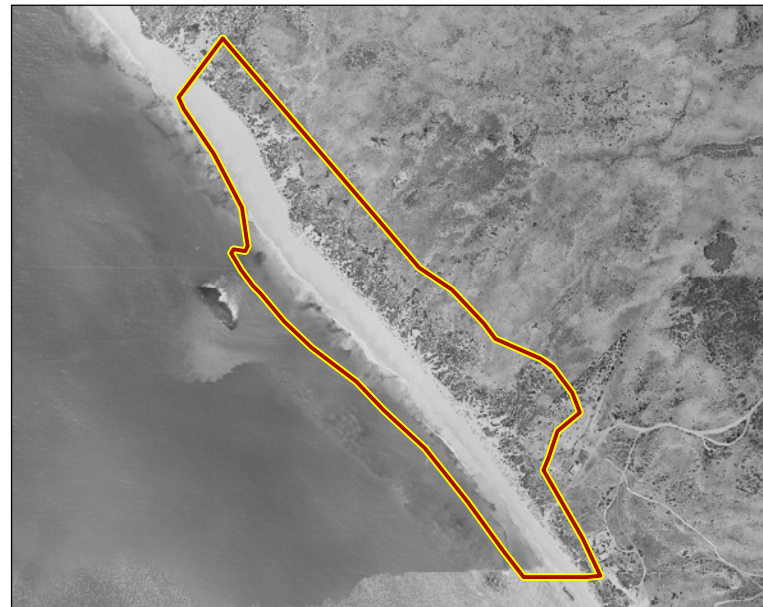
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CLIENT	ACUMEN DEVELOPMENT SOLUTIONS		
PROJECT	KARST RISK DESK STUDY		
LOCATION	CAPRICORN FORESHORE, YANCHEP		
TITLE	KARST RISK		
Job No	J1601249	Fig No	FIGURE 3
		Rev	A



Imagery Not Available

MAP 1 - 1953

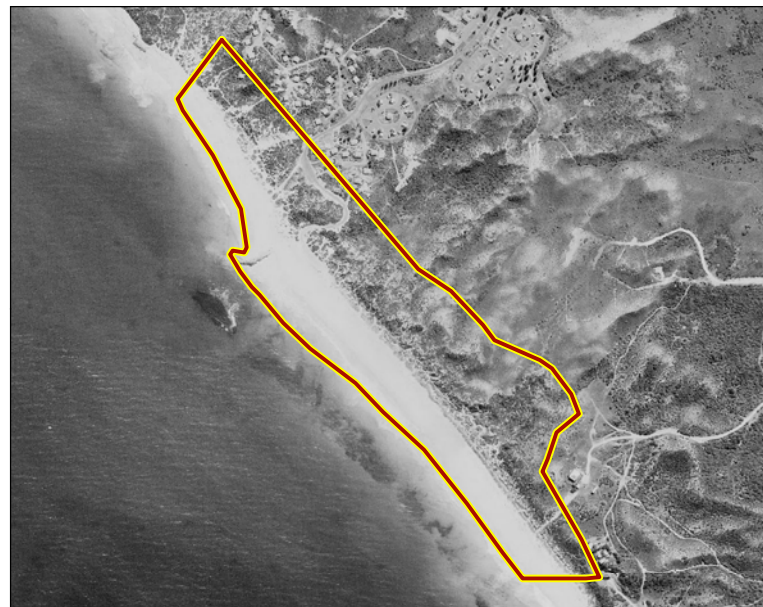


MAP 2 - 1965



Imagery Not Available

MAP 3 - 1974



MAP 4 - 1979



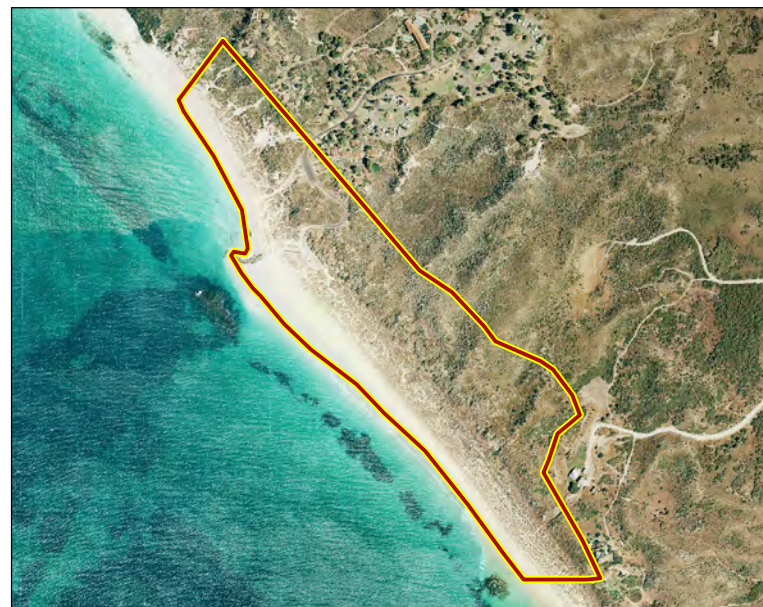
MAP 5 - 1981



MAP 6 - 1983



MAP 7 - 1985



MAP 8 - 1995

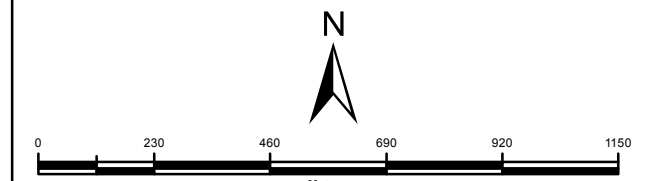


MAP 9 - 2000



Legend

 Site Boundary



SCALE	1:15,000	(A3)
DRAWN	PIR	
DATE DRAWN	22/11/2016	
CHECKED	BL	
DATE CHECKED	22/11/2016	
PROJECTION	GDA 1994 MGA Zone 50	



Galt Geotechnics Pty Ltd
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 Tel : +61 (0)8 6272-0200
 Address : Unit 4, 15 Walters Drive
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PROJECT	KARST RISK DESK STUDY		
LOCATION	CAPRICORN FORESHORE, YANCHEP		
TITLE	HISTORICAL AERIAL IMAGERY (1953 - 2000)		
Job No	J1601249	Fig No	FIGURE 4A
Rev	A		



MAP 10 - 2001



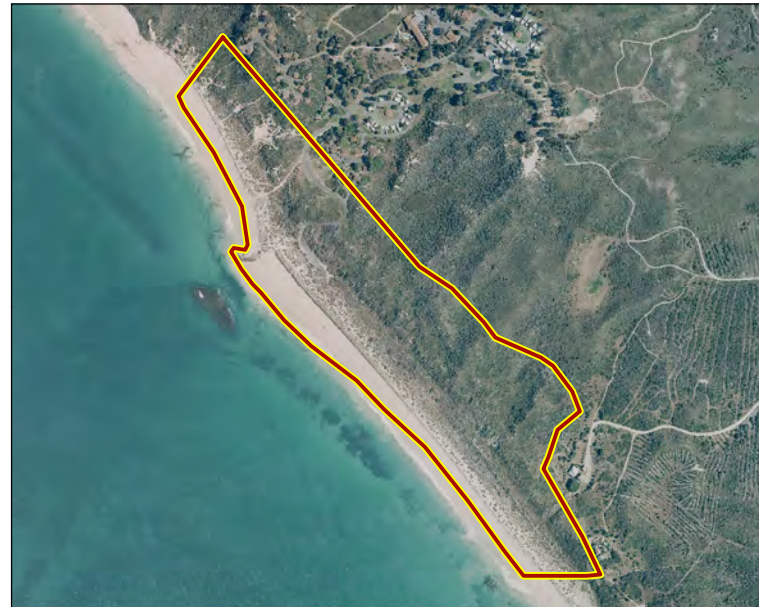
MAP 11 - 2002



MAP 12 - 2003



MAP 13 - 2004



MAP 14 - 2005



MAP 15 - 2006



MAP 16 - 2007



MAP 17 - 2008

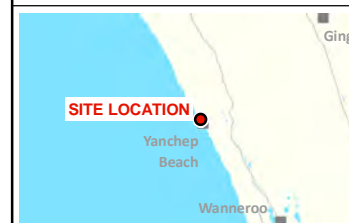
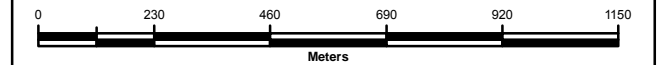


MAP 18 - 2009



Legend

Site



SCALE	1:15,000	(A3)
DRAWN	PIR	
DATE DRAWN	22/11/2016	
CHECKED	BL	
DATE CHECKED	22/11/2016	
PROJECTION	GDA 1994 MGA Zone 50	



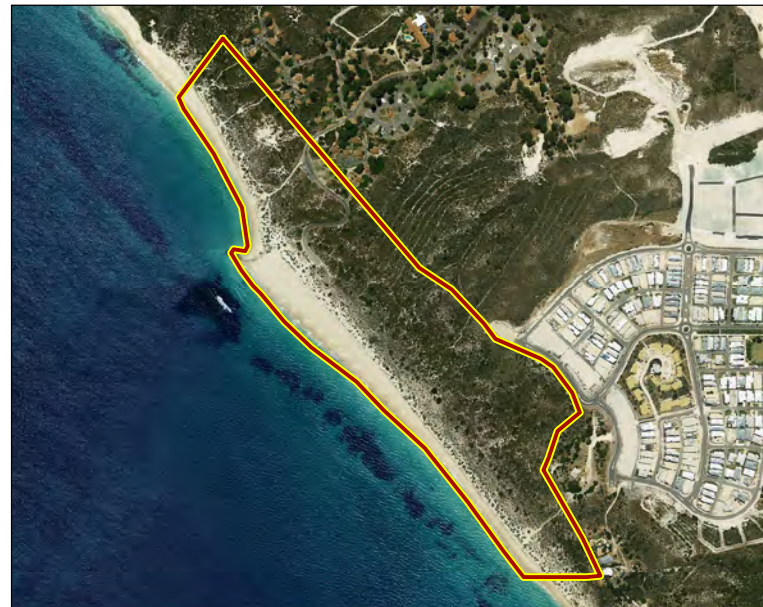
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CLIENT	ACUMEN DEVELOPMENT SOLUTIONS		
PROJECT	KARST RISK DESK STUDY		
LOCATION	CAPRICORN FORESHORE, YANCHEP		
TITLE	HISTORICAL AERIAL IMAGERY (2001 - 2009)		
Job No	J1601249	Fig No	FIGURE 4B
Rev	A		



MAP 19 - 2010



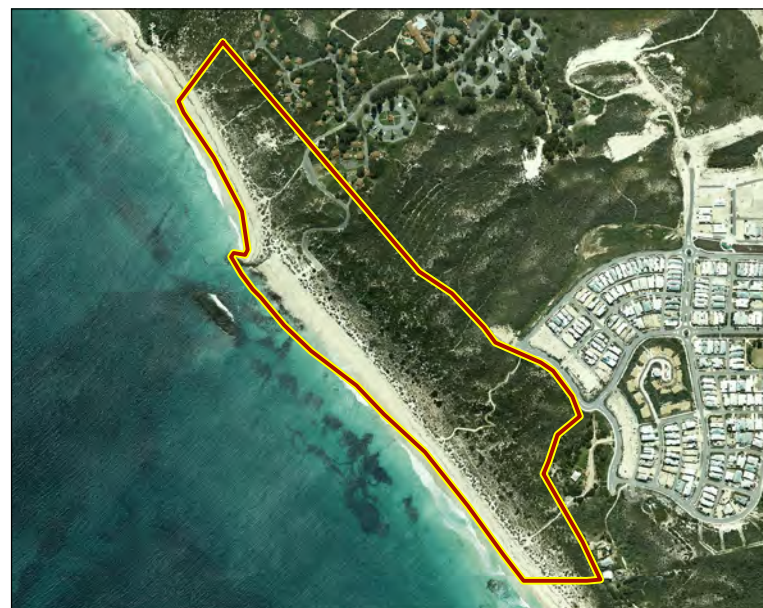
MAP 20 - 2011(March)



MAP 21 - 2011(August)



MAP 22 - 2012(February)



MAP 23 - 2012(September)



MAP 24 - 2013(January)



MAP 25 - 2013(September)



MAP 26 - 2014(February)

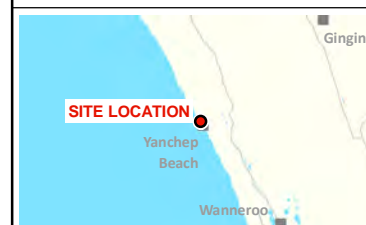
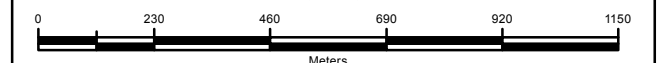


MAP 27 - 2014(August)




Legend

 Site Boundary



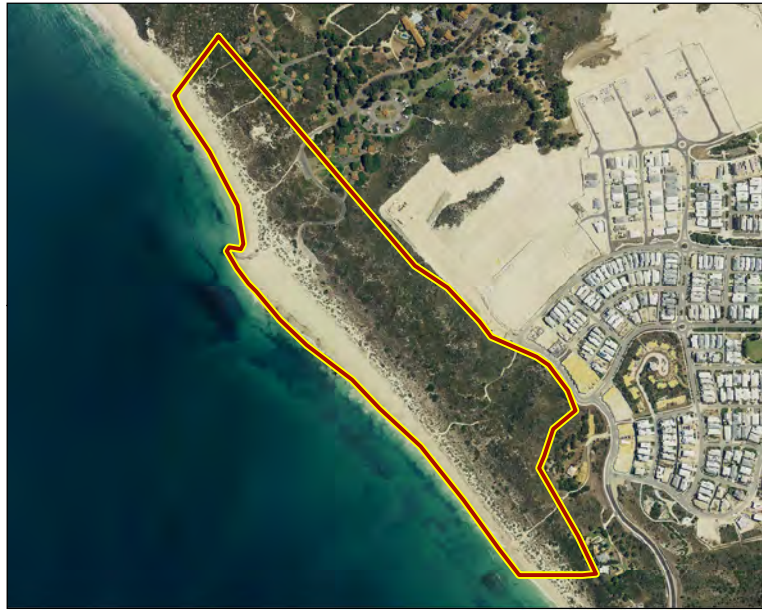
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DRAWN	PIR	
DATE DRAWN	22/11/2016	
CHECKED	BL	
DATE CHECKED	22/11/2016	
PROJECTION	GDA 1994 MGA Zone 50	



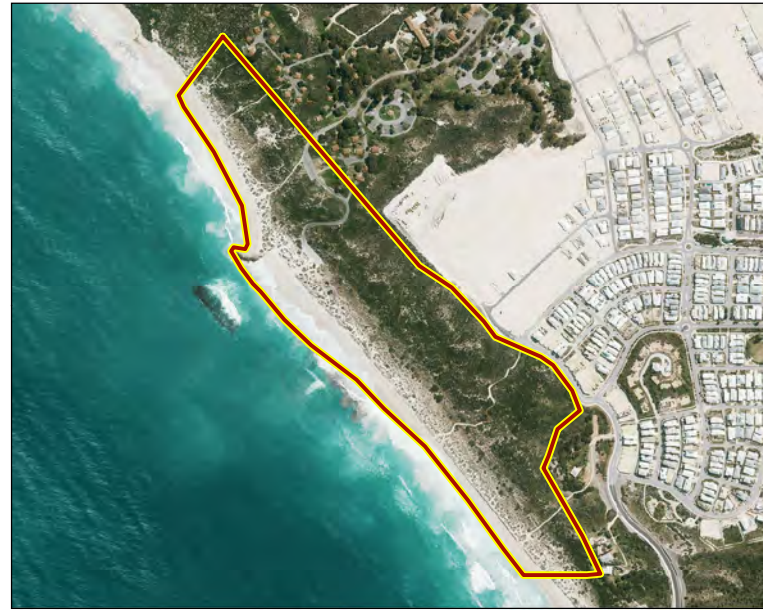
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CLIENT	ACUMEN DEVELOPMENT SOLUTIONS		
PROJECT	KARST RISK DESK STUDY		
LOCATION	CAPRICORN FORESHORE, YANCHEP		
TITLE	HISTORICAL AERIAL IMAGERY (2010 - 2014(AUGUST))		
Job No	J1601249	Fig No	FIGURE 4C
Rev			A



MAP 28 - 2015(February)



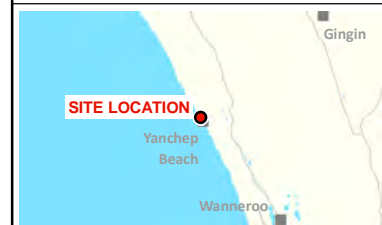
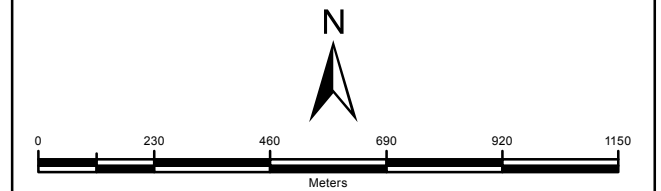
MAP 29 - 2015(September)



MAP 30 - 2016(February)



 Site



SCALE	1:15,000	(A3)
DRAWN	PIR	
DATE DRAWN	22/11/2016	
CHECKED	BL	
DATE CHECKED	22/11/2016	
PROJECTION	GDA 1994 MGA Zone 50	



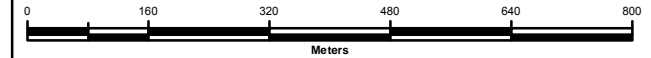
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CLIENT	ACUMEN DEVELOPMENT SOLUTIONS		
PROJECT	KARST RISK DESK STUDY		
LOCATION	CAPRICORN FORESHORE, YANCHEP		
TITLE	HISTORICAL AERIAL IMAGERY (2015(FEBRUARY) - ONWARDS)		
Job No	J1601249	Fig No	FIGURE 4D
		Rev	A



Legend
 Site Boundary



SCALE	1:10,000	(A3)
DRAWN	PIR	
DATE DRAWN	22/11/2016	
CHECKED	BL	
DATE CHECKED	22/11/2016	
PROJECTION	GDA 1994 MGA Zone 50	

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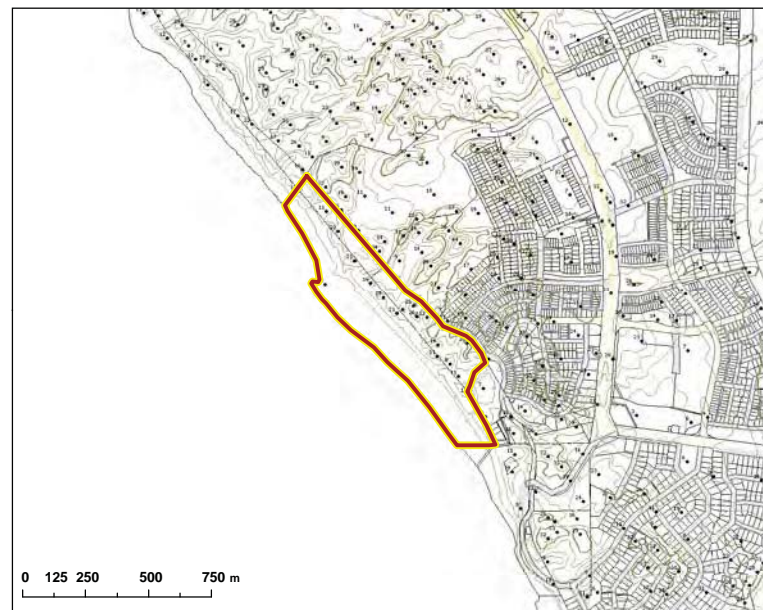
YANCHEP:20344 CODE, NARRATIVE

- LS1 ; LIMESTONE - light yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian
- LS4 ; LIMESTONE - pale yellowish brown weakly cemented, friable, medium-grained, sub-rounded, quartz and shell debris, of eolian
- S1 ; CALCAREOUS SAND - white, fine to medium-grained, sub-rounded quartz and shell debris, of eolian origin
- S2 ; CALCAREOUS SAND - white, fine to medium-grained, sub-rounded quartz and shell debris, of eolian origin
- S7 ; SAND - pale and olive yellow, medium to coarse-grained, sub-angular quartz with a trace of feldspar, moderately sorted, of residual

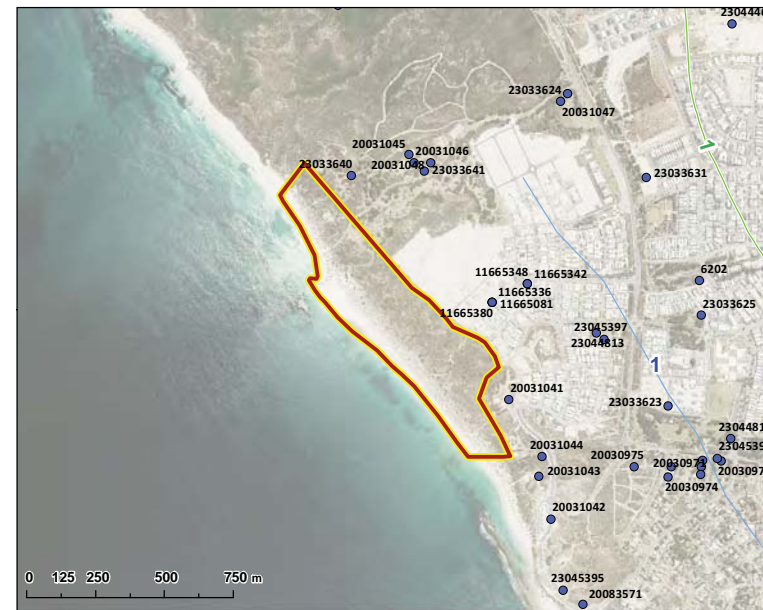
CLIENT	ACUMEN DEVELOPMENT SOLUTIONS		
PROJECT	KARST RISK DESK STUDY		
LOCATION	CAPRICORN FORESHORE, YANCHEP		
TITLE	INDICATIVE GEOTECHNICAL ASPECTS		
Job No	J1601249	Fig No	FIGURE 5
		Rev	A



MAP 1 - AERIAL



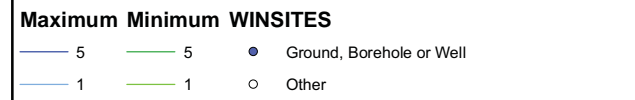
MAP 2 - CONTOURS



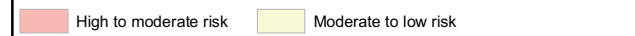
MAP 3 - GROUNDWATER CONTOURS AND WINSITES



MAP 3 - GROUNDWATER CONTOURS AND WINSITES



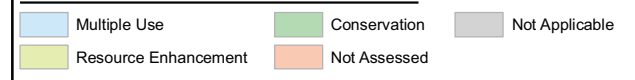
MAP 4 - ACID SULFATE SOIL RISK



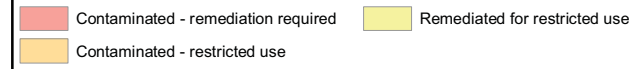
MAP 5 - ENVIRONMENTALLY SENSITIVE AREAS



MAP 6 - GEOMORPHIC WETLANDS



MAP 7 - CONTAMINATED SITES

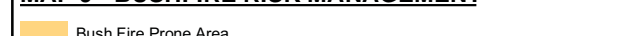


Contaminated sites information is taken from the publicly available Department of Environment Regulation (DER) Contaminated Sites Database. Only sites classified as 'Contaminated - remediation required', 'Contaminated - restricted use' and 'Remediated - restricted use' are shown. Sites with other classifications under the Contaminated Sites Act 2003 are identified through a basic or detailed summary of records search request through DER.

MAP 8 - HERITAGE SITES



MAP 9 - BUSHFIRE RISK MANAGEMENT



MAP 4 - ACID SULFATE SOIL RISK



MAP 5 - ENVIRONMENTALLY SENSITIVE AREAS



MAP 6 - GEOMORPHIC WETLANDS



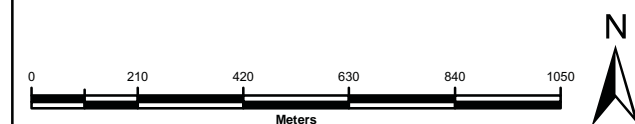
MAP 7 - CONTAMINATED SITES



MAP 8 - HERITAGE SITES



MAP 9 - BUSHFIRE RISK AREAS



	SCALE	1:15,000	(A3)
	DRAWN	PIR	
	DATE DRAWN	22/11/2016	
	CHECKED	BL	
	DATE CHECKED	22/11/2016	
PROJECTION	GDA 1994 MGA Zone 50		

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CLIENT	ACUMEN DEVELOPMENT SOLUTIONS		
PROJECT	KARST RISK DESK STUDY		
LOCATION	CAPRICORN FORESHORE, YANCHEP		
TITLE	INDICATIVE ENVIRONMENTAL ASPECTS		
Job No	J1601249	Fig No	FIGURE 6
Rev	A		



ATTACHMENT A

Site Photographs



Photograph 1: Looking south across the foreshore dunes from Capricorn Esplanade



Photograph 2: Looking north across the foreshore dunes from Capricorn Esplanade



Photograph 3: Looking south across the foreshore dunes near the centre of the site



Photograph 4: Looking west towards the ocean near the centre of the site



Photograph 5: Looking south across the foreshore dunes near the centre of the site



Photograph 6: Looking south along the coastline near the centre of the site



Photograph 7: Looking north along the coastline near the centre of the site



Photograph 8: Typical vegetation present on the sand dunes



Photograph 9: Looking west towards the ocean near the southern part of the site



Photograph 10: Erosion at the southern part of the foreshore site



Photograph 11: Erosion at the southern part of the foreshore site



Photograph 12: Looking south along the coastline near the northern part of the site



Photograph 13: Looking north along the coastline near the northern part of the site



Photograph 14: Looking west towards the ocean near the northern part of the site



ATTACHMENT B

City of Wanneroo Local Planning Policy 4.13

AUTHORISATION	Adopted 5 April 2016
REVIEW	Biennial. Next scheduled review 2018

Part 1

POLICY OPERATION

Policy Development

This Policy has been prepared under Part 2, Division 2 of the deemed provisions of the City of Wanneroo District Planning Scheme No. 2.

Application and Purpose

This Policy applies to all planning proposals that affect or are affected by Caves or Karstic features.

The purpose of this Policy is to outline the City's information requirements required for the investigation and management of caves and karstic features to assist in design, assessment, and determination of:

- Structure Plans;
- Subdivision applications; and
- Development applications.

Subject to compliance with all other scheme and policy requirements, planning proposals shall not be deemed complete until such time as all relevant information in Column C of **Table 1** of this Policy has been provided to the City.

Objective

The objectives of this Policy are to:

1. Conserve caves and significant karstic features for their geological, cultural and environmental values; and
2. Minimise risks to people and property in karst hazard areas.

Structure

The Policy contains two parts:

- Part 1: Policy Operation, which includes the policy context and objectives.
- Part 2: Policy Provisions, which includes minimum standard requirements for the assessment and management of all planning proposals in relation to caves and karstic features.

Part 2

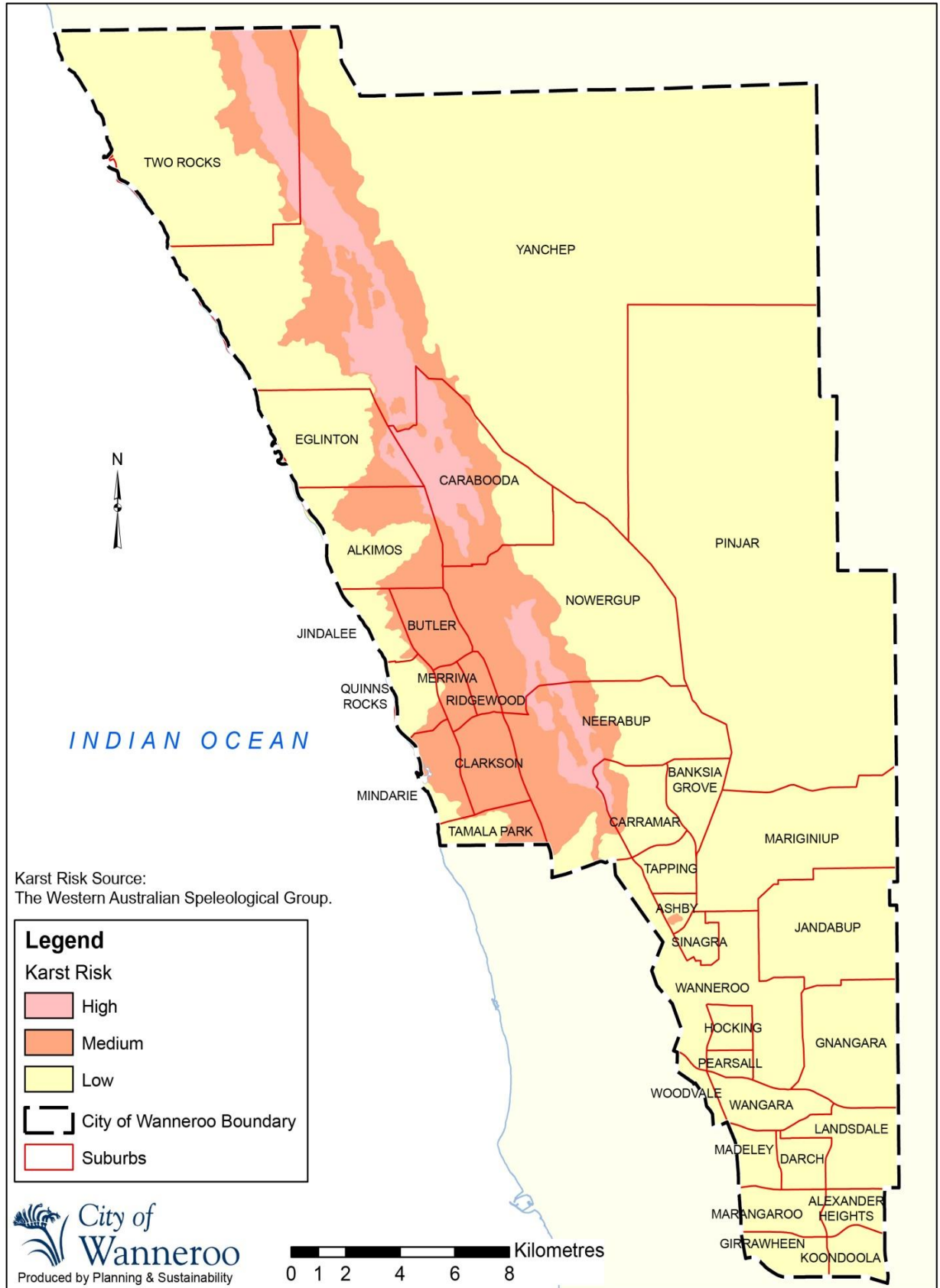
POLICY PROVISIONS

- 2.1 Karst Risk levels shown in Column A of **Table 1** are defined by the Risk Zone dataset as developed by the Western Australian Speleological Group (WASG) as illustrated in **Figure 1** of this Policy.
- 2.2 Column B of **Table 1** identifies the various planning stages of a particular proposal.
- 2.3 Column C of **Table 1** sets out the minimum requirements for planning information pertaining to karstic features and is dependant on both Karst Risk Level (Column A) and the applicable planning stage of a given planning proposal (Column B). The minimum standard requirements for supporting information as outlined in Column C are further detailed in **Schedule 1** of this Policy.
- 2.4 Column D of **Table 1** sets out the relevant conditions / provisions to be applied to a planning proposal. 'Conditions' relate to Subdivision and Development Applications only, and are derived from the specific planning information required in Column C. Similarly, 'provisions' relate to Local Structure Plans only, and are also derived from the specific planning information required in Column C.
- 2.5 Where there are two or more different karst risk levels across a subject site, the highest risk level will apply.
- 2.6 Where a property is located within 400 metres of a higher karst risk level, the higher risk level will be used when determining the requirements for karst assessment.
- 2.7 The City may, at its discretion, waive the requirements for a 'Geotechnical Report' where the following criteria have been met to the satisfaction of the City:
- The nature of the proposed development is such that karstic features will pose no impact on the development; or
 - Information provided at prior planning stages is sufficient in determining whether the subject land is capable of the proposed development.

Table 1: Karst Assessment and Management Requirements for Planning Proposals

COLUMN A Karst Risk Level	COLUMN B Planning Stage	COLUMN C Planning Information	COLUMN D Conditions / Provisions
Low	Local Structure Plan	A "Desktop Karst Survey" shall be prepared and included in Part 3 of the Local Structure Plan. The outcome and recommendations of the Survey will determine whether a "Geotechnical Report" and/ or "Karstic Features Management Plan" is required as a condition of Subdivision.	Where a "Desktop Karst Survey" provided with a Local Structure Plan identifies further investigations or management measures to be undertaken, a provision shall be added to Part 1 of the Local Structure Plan that requires a "Karstic Features Management Plan" to be prepared and implemented as a condition of subdivision.
	Subdivision	The requirement for a "Geotechnical Report" shall be recommended by the City as a condition of Subdivision only where: <ul style="list-style-type: none"> • no prior karst assessment has been conducted at Local Structure Plan stage; or • where the "Desktop Karst Survey" undertaken at structure planning stage requires one to be prepared. 	The City will recommend the following model condition where a "Geotechnical Report" is deemed to be required be prepared as a condition of subdivision: <i>'Prior to the commencement of subdivisional works, the landowner/applicant is to provide a pre-works geotechnical report certifying that the land is physically capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development; and In the event that remediation works are required, the landowner/applicant is to provide a post-works geotechnical report certifying that all subdivisional works have been carried out in accordance with the pre-works geotechnical report. (Local Government)'</i>
		The requirement for a "Karstic Features Management Plan" shall be recommended by the City as a condition of Subdivision where a provision has been included in Part 1 of the Local Structure Plan requiring one to be prepared.	The City will recommend the following model subdivision condition where a 'Karstic Features Management Plan' is deemed to be required as a result of karst investigations at the Structure Plan and Subdivision stages: <i>Prior to the commencement of subdivisional works a Karstic Features Management Plan for [INSERT SITE ADDRESS] is to be prepared and approved to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan. (Department of Water) OR (Local Government) OR (Department of Environment and Conservation) [DELETE AS APPLICABLE]</i>
Development Application	A "Geotechnical Report" shall be prepared only where prior planning stages specifically request further karst investigation.	In instances where a "Geotechnical Report" was required, the following condition will be included in the approval of the Development Application to implement the recommendations of the Geotechnical Report: <i>'In development of the subject site, the proponent shall adhere to the recommendations as outlined by [AUTHOR OF GEOTECHNICAL REPORT] in the Technical Memorandum of [DATE OF GEOTECHNICAL REPORT].'</i>	
Medium	Local Structure Plan	A "Desktop Karst Survey" shall be prepared and included in Part 3 of the Local Structure Plan. The outcome and recommendations of the Survey will determine whether a "Geotechnical Report" and/ or "Karstic Features Management Plan" is required at Subdivision.	Where a "Desktop Karst Survey" provided with a Local Structure Plan identifies further investigations or management measures to be undertaken, a provision shall be added to Part 1 of the Local Structure Plan that requires a "Karstic Features Management Plan" to be prepared and implemented as a condition of subdivision.
	Subdivision	The requirement for a "Geotechnical Report" shall be recommended by the City as a condition of Subdivision only where: <ul style="list-style-type: none"> • structure planning has not been undertaken; • a "Desktop Karst Survey" has not been prepared at Local Structure Plan stage; • the "Desktop Karst Survey" undertaken at structure planning stage requires one to be prepared; or • high risk karstic features have been identified in the "Desktop Karst Survey". 	The City will recommend the following model condition where a "Geotechnical Report" is deemed to be required be prepared as a condition of subdivision: <i>'Prior to the commencement of subdivisional works, the landowner/applicant is to provide a pre-works geotechnical report certifying that the land is physically capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development; and In the event that remediation works are required, the landowner/applicant is to provide a post-works geotechnical report certifying that all subdivisional works have been carried out in accordance with the pre-works geotechnical report. (Local Government)'</i>
		The requirement for a "Karstic Features Management Plan" shall be recommended by the City as a condition of Subdivision where a provision has been included in Part 1 of the Local Structure Plan requiring one to be prepared.	The City will recommend the following model subdivision condition where a 'Karstic Features Management Plan' is deemed to be required as a result of karst investigations at the Structure Plan and Subdivision stages: <i>Prior to the commencement of subdivisional works a Karstic Features Management Plan for [INSERT SITE ADDRESS] is to be prepared and approved to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan. (Department of Water) OR (Local Government) OR (Department of Environment and Conservation) [DELETE AS APPLICABLE]</i>
Development Application	A "Geotechnical Report" shall be prepared where: <ul style="list-style-type: none"> • prior planning stages specifically request further karst investigation; or • in the opinion of the City, the proposed development in conjunction with the associated karst risk poses a threat to people, property, or the environment. 	In instances where a "Geotechnical Report" was required, the following condition will be included in the approval of the Development Application to implement the recommendations of the Geotechnical Report: <i>'In development of the subject site, the proponent shall adhere to the recommendations as outlined by [AUTHOR OF GEOTECHNICAL REPORT] in the Technical Memorandum of [DATE OF GEOTECHNICAL REPORT].'</i>	
High	Local Structure Plan	A "Desktop Karst Survey" shall be prepared and included in Part 3 of the Local Structure Plan. The outcome and recommendations of the Survey will determine whether a "Geotechnical Report" and/ or "Karstic Features Management Plan" is required at Subdivision.	Where a "Desktop Karst Survey" provided with a Local Structure Plan identifies further investigations or management measures to be undertaken, a provision shall be added to Part 1 of the Local Structure Plan that requires a "Karstic Features Management Plan" to be prepared and implemented as a condition of subdivision.
	Subdivision	A "Geotechnical Report" shall be recommended as a condition of Subdivision by the City in all instances unless investigations carried out in previous planning stages specifically state that this is not required.	The City will recommend the following model condition where a "Geotechnical Report" is deemed to be required be prepared as a condition of subdivision: <i>'Prior to the commencement of subdivisional works, the landowner/applicant is to provide a pre-works geotechnical report certifying that the land is physically capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development; and In the event that remediation works are required, the landowner/applicant is to provide a post-works geotechnical report certifying that all subdivisional works have been carried out in accordance with the pre-works geotechnical report. (Local Government)'</i>
		The requirement for a "Karstic Features Management Plan" shall be recommended by the City as a condition of Subdivision where a provision has been included in Part 1 of the Local Structure Plan requiring one to be prepared.	The City will recommend the following model subdivision condition where a 'Karstic Features Management Plan' is deemed to be required as a result of karst investigations at the Structure Plan and Subdivision stages: <i>Prior to the commencement of subdivisional works a Karstic Features Management Plan for [INSERT SITE ADDRESS] is to be prepared and approved to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan. (Department of Water) OR (Local Government) OR (Department of Environment and Conservation) [DELETE AS APPLICABLE]</i>
Development Application	A "Geotechnical Report" shall be provided in all instances unless investigations carried out in previous planning stages specifically state that this is not required.	In instances where a "Geotechnical Report" was required, the following condition will be included in the approval of the Development Application to implement the recommendations of the Geotechnical Report: <i>'In development of the subject site, the proponent shall adhere to the recommendations as outlined by [AUTHOR OF GEOTECHNICAL REPORT] in the Technical Memorandum of [DATE OF GEOTECHNICAL REPORT].'</i>	

Figure 1: Karstic Features Risk Zones in the City of Wanneroo



Schedule 1

MINIMUM STANDARD REQUIREMENTS FOR SUPPORTING INFORMATION

3.1 Desktop Karst Survey – This assessment is a geological study undertaken to determine the risks related to karst landforms. Initial investigations of a ‘Desktop Karst Survey’ may recommend that on ground geotechnical investigations be undertaken where necessary. The survey is to be prepared to the satisfaction of the City by a certified Geotechnical Engineer or similarly qualified karst expert and is to include the following:

- Analysis of existing site specific field data where it is available, and other existing resources and literature on karst in the specified area including the City’s ‘Karstic Features Risk Zones’ found in Figure 1;
- Consideration of significant karst features and subterranean fauna of conservation significance in accordance with the *Environmental Protection Act 1986* and related guidelines;
- Associated mapping showing the extent and severity of karst risk;
- Information pertaining to the capacity for the subject land to support a proposed development;
- Confirmation of the actual karst risk when taking into account existing literature outlined in the above point. Where there is uncertainty as to the on ground karst risk, a field investigation (including drilling/ radar where necessary) will need to be undertaken;
- Recommendations for the management of the site in response to karstic features; and
- Where initial desktop and field investigations indicate the presence of karst, the survey shall include comprehensive geomorphic analysis, exploration drilling and geophysical studies that will result in recommendations for investigations and management measures to be undertaken at future planning stages.

3.2 Geotechnical Report – To be prepared to the satisfaction of the City by a certified Geotechnical Engineer or similarly qualified karst expert and to include the following:

- Detailed site investigation including drilling for proposals located within areas of medium or higher karst risk;

- Consideration of significant karst features and subterranean fauna of conservation significance in accordance with the *Environmental Protection Act 1986* and related guidelines;
- Anticipated site classification in accordance with 'AS2870: Residential Slabs and Footings' and requirements to improve the classification, in so far as this is relevant to the proposed development;
- Information pertaining to the capacity for the subject land to support a proposed development; and
- Recommendations for the management of the site in response to karstic features.

3.3 Karstic Features Management Plan - To be prepared for the entire development area to the satisfaction of the City by a certified Geotechnical Engineer or similarly qualified karst expert and to include the following:

- Detailed site investigation including Ground Penetrating Radar for proposals located within areas of high karst risk;
- Consideration of significant karst features and subterranean fauna of conservation significance in accordance with the *Environmental Protection Act 1986* and related guidelines;
- Information pertaining to how the proposed development may affect or be affected by nearby karst features on adjacent or nearby land parcels, and detail on how impacts to off-site karst formations will be mitigated where necessary;
- Detail on the management of significant karstic features identified or to be retained and protected within POS. It must be adequately demonstrated as to how the protection of life, property and significant karstic features is to occur in response to the proposed development; and
- Recommendations provided in karst investigations undertaken in prior planning stages shall be addressed to the satisfaction of the City.



ATTACHMENT C

Understanding Your Report

UNDERSTANDING YOUR REPORT

GALT FORM PMP11 Rev2

1. EXPECTATIONS OF THE REPORT

This document has been prepared to clarify what is and is not provided in your report. It is intended to inform you of what your realistic expectations of this report should be and how to manage your risks associated with the conditions on site.

Geotechnical engineering and environmental science are less exact than other engineering and scientific disciplines. We include this information to help you understand where our responsibilities begin and end. You should read and understand this information. Please contact us if you do not understand the report or this explanation. We have extensive experience in a wide variety of projects and we can help you to manage your risk.

2. THIS REPORT RELATES TO PROJECT-SPECIFIC CONDITIONS

This report was developed for a unique set of project-specific conditions to meet the needs of the nominated client. It took into account the following:

- ✦ the project objectives as we understood them and as described in this report;
- ✦ the specific site mentioned in this report; and
- ✦ the current and proposed development at the site.

It should not be used for any purpose other than that indicated in the report. You should not rely on this report if any of the following conditions apply:

- ✦ the report was not written for you;
- ✦ the report was not written for the site specific to your development;
- ✦ the report was not written for your project (including a development at the correct site but other than that listed in the report); or
- ✦ the report was written before significant changes occurred at the site (such as a development or a change in ground conditions).

You should always inform us of changes in the proposed project (including minor changes) and request an assessment of their impact.

Where we are not informed of developments relevant to your report, we cannot be held responsible or liable for problems that may arise as a consequence.

Where design is to be carried out by others using information provided by us, we recommend that we be involved in the design process by being engaged for consultation with other members of the project team. Furthermore, we recommend that we be able to review work produced by other members of the project team that relies on information provided in our report.

3. SOIL LOGS

Our reports often include logs of intrusive and non-intrusive investigation techniques. These logs are based on our interpretation of field data and laboratory results. The logs should only be read in conjunction with the report they were issued with and should not be re-drawn for inclusion in other documents not prepared by us.

4. THIRD PARTY RELIANCE

We have prepared this report for use by the client. This report must be regarded as confidential to the client and the client's professional advisors. We do not accept any responsibility for contents of this document from any party other than the nominated client. We take no responsibility for any damages suffered by a third party because of any decisions or actions they may make based on this report. Any reliance or decisions made by a third party based on this report are the responsibility of the third party and not of us.

5. CHANGE IN SUBSURFACE CONDITIONS

The recommendations in this report are based on the ground conditions that existed at the time when the study was undertaken. Changes in ground conditions can occur in numerous ways including anthropogenic events (such as construction or contaminating activities on or adjacent to the site) or natural events (such as floods, groundwater fluctuations or earthquakes). We should be consulted prior to use of this report so that we can comment on its reliability. It is important to note that where ground conditions have changed, additional sampling, testing or analysis may be required to fully assess the changed conditions.

6. SUBSURFACE CONDITIONS DURING CONSTRUCTION

Practical constraints mean that we cannot know every minute detail about the subsurface conditions at a particular site. We use professional judgement to form an opinion about the subsurface conditions at the site. Some variation to our evaluated conditions is likely and significant variation is possible. Accordingly, our report should not be considered as final as it is developed from professional judgement and opinion.

The most effective means of dealing with unanticipated ground conditions is to engage us for construction support. We can only finalise our recommendations by observing actual subsurface conditions encountered during construction. We cannot accept liability for a report's recommendations if we cannot observe construction.

7. ENVIRONMENTAL AND GEOTECHNICAL ISSUES

Unless specifically mentioned otherwise in our report, environmental considerations are not addressed in geotechnical reports. Similarly, geotechnical issues are not addressed in environmental reports. The investigation techniques used for geotechnical investigations can differ from those used for environmental investigations. It is the client's responsibility to satisfy themselves that geotechnical and environmental considerations have been taken into account for the site.

O:\Administration\Standard Forms and Documents\PMP11-Rev2 Understanding your Report.docx

Appendix 3
Level 2 flora and vegetation survey and
supplementary survey



intelligent outcomes | respected experience

Capricorn foreshore reserve

Detailed flora and vegetation survey

Prepared for
Acumen Development Solutions
by Strategen

January 18

Capricorn foreshore reserve

Detailed flora and vegetation survey

Strategen is a trading name of
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Level 1, 50 Subiaco Square Road Subiaco WA 6008
ACN: 056 190 419

January 18

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consultants Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

Client: Acumen Development Solutions

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	A	Client review	C Courtauld / D Panickar / D Newsome	Electronic	22 Dec 2016
Final Report	B	Issue to CoW / DoP	C Courtauld / T Bowra	Electronic	31 July 2017
Final Report	C	Issue to DWER	A Dalton / T sleigh	Electronic	21 Dec 2017

Filename: ADS16585_01 R001 Rev 0 - 12 January 2018

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Appendix 2 Desktop assessment results (DBCA 2017-, DEE 2015b)
Appendix 3 Photographic record of site and vegetation types
Appendix 4 Vascular plant taxa recorded from quadrats within the survey area
Appendix 5 Supplementary flora and vegetation survey

1. Introduction

This report presents the findings of a detailed flora and vegetation survey undertaken to support the proposed development of the Capricorn foreshore reserve that forms part of the Coastal Village and Coastal Node, Yanchep (the survey area; Figure 1).

This flora and vegetation assessment will support the Foreshore Management Plan for the proposed foreshore development. The survey area will be created as a 'Parks and Recreation' reserve and vested to the Crown as agreed by Capricorn Village Joint Venture (CVJV) and the Western Australian Planning Commission (WAPC). Upon the transfer of the foreshore to the Crown, the foreshore will be vested to the City of Wanneroo (CoW). The flora survey was undertaken in November 2016, with an additional portion of the Capricorn foreshore reserve (Figure 1) surveyed in November 2017. This report presents the findings from the November 2016 and November 2017 surveys.

1.1 Background

Capricorn Village Joint Venture (CVJV) is proposing to develop the Capricorn Coastal Village and Coastal Node, located in Yanchep, Western Australia, approximately 51 km north-northwest of the Perth Central Business District (CBD). The Capricorn Coastal Village and Coastal Node (the Project), incorporates Part Lot 312 and Lots 2, 303 and 304, Two Rocks Road, Yanchep, in the City of Wanneroo (CoW, Figure 1).

The foreshore reserve provides a link between the Indian Ocean and urban development and as such provides opportunity for both conservation and development purposes. The proposed foreshore development will require clearing of native vegetation and as such, a flora and vegetation survey was deemed necessary to determine the environmental values of the proposed clearing area. The survey area was designed based on the draft concept plan, focussing on areas of proposed disturbance and a buffer area (Figure 1).

1.2 Scope

The scope of this flora and vegetation survey was to undertake a desktop assessment and field assessment within the survey area consistent with the requirements of *Guidance Statement 51 Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia* and *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) and meeting the definition of a detailed survey as described by the guidance.

The objectives were to:

- conduct a desktop survey for Threatened and Priority flora which have been identified as being present in or around the survey area during historic surveys
- collect and identify the vascular plant species present within the survey area
- search areas of suitable habitat for Threatened and/or Priority flora
- define and map the native vegetation communities present within the survey area
- map vegetation condition within the survey area
- map the densities of weeds in the survey
- provide recommendations on the local and regional significance of the vegetation communities
- prepare a report summarising the findings.

A supplementary survey was undertaken within the southern portion of the foreshore reserve in October 2017 (Appendix 5), which included detailed quadrat analysis. This field survey was conducted according to standards set out in *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

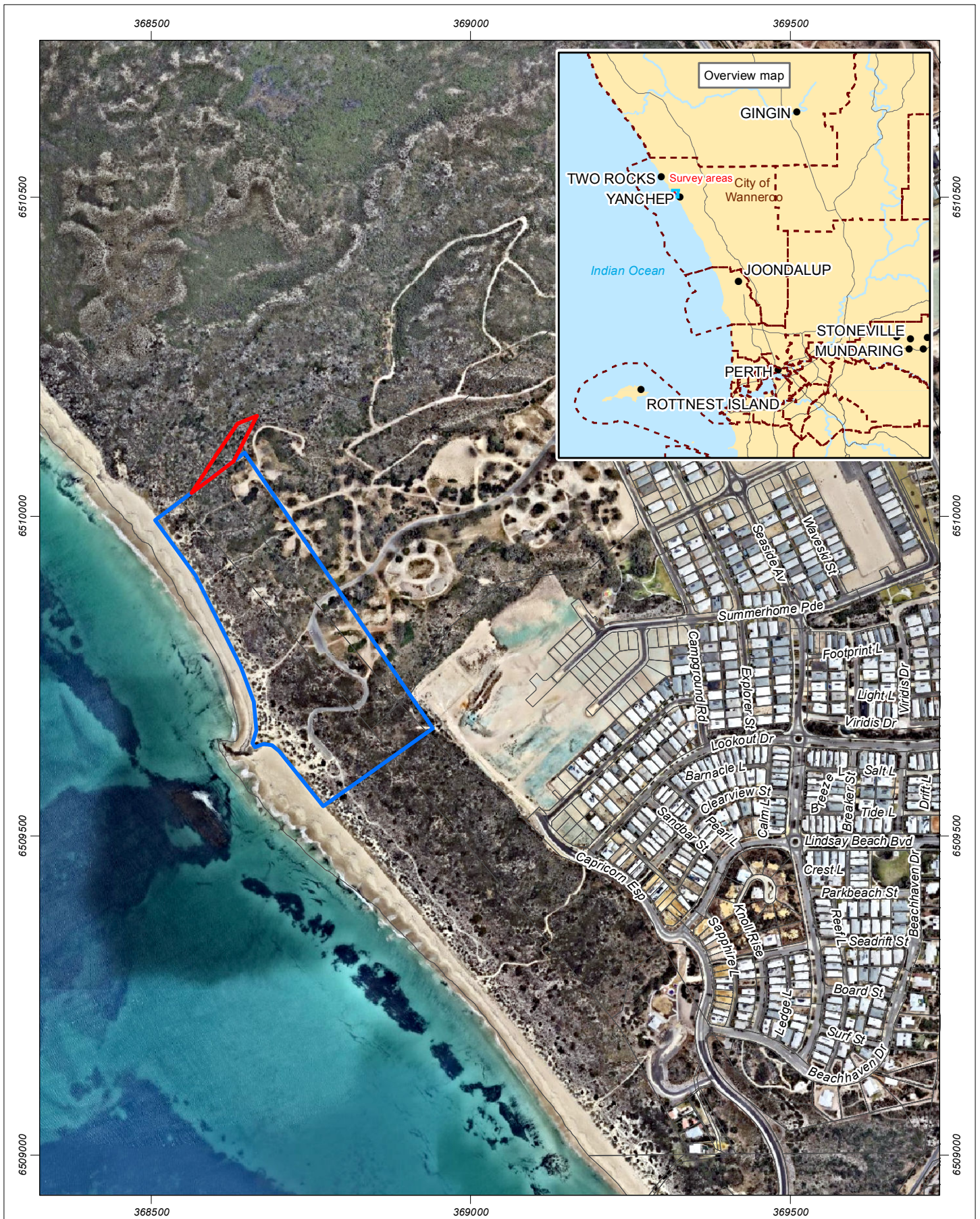


Figure 1: The survey area

Scale 1:8,000 at A4



Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 21/12/2017
 Author: JCrute
 Source: Aerial image: Nearmap, flown 12/2017. Existing cadastre, Landgate 2017.

Legend

- November 2017 survey area
- November 2016 survey area
- Existing cadastre



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2. Context

2.1 Legislative context

This biological survey has been conducted with reference to the following Australian and Western Australian legislation and guidance:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Australian Government
- *Wildlife Conservation Act 1950* (WC Act) – State
- *Environmental Protection Act 1986* (EP Act) – State
- *Biosecurity and Agriculture Management Act 2007* (BAM Act) – State
- *Guidance Statement 51 Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia* and *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

2.1.1 Conservation significant flora and ecological communities

Conservation significant flora and ecological communities are determined at a state and federal legislative level. Threatened species are listed under the EPBC Act at the Australian Government level and under the WC Act at the State level (Appendix 1). Priority species are listed by the Department of Biodiversity, Conservation and Attractions (DBCA [formerly Department of Parks and Wildlife]) and include species of 'significant conservation value' (Appendix 1).

Threatened Ecological Communities (TECs) are listed under both the EPBC Act and EP Act (Appendix 1). Priority Ecological Communities (PECs) are listed by DBCA and include species of significant conservation value (Appendix 1).

2.1.2 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are protected under the EP Act, and include the following:

- World Heritage areas
- areas included on the National Estate Register
- defined wetlands and associated buffers
- vegetation within 50 m of a listed Threatened species
- TECs.

2.1.3 Protection of native vegetation

Native vegetation is defined under the EP Act as “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”.

This definition of native vegetation does not include vegetation that was intentionally sown, planted or propagated unless either of the following applies:

- (a) the vegetation was sown, planted or propagated as required under the EP Act or another written law
- (b) the vegetation is declared to be native under Regulation 4 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Regulation 4 prescribes the kinds of intentionally planted indigenous vegetation that are “native vegetation” and which therefore require a clearing permit or exemption to clear and includes:

- (a) planting that was funded (fully or partly)
 - i. by a person who was not the owner of the land
 - ii. for the purpose of biodiversity conservation or land conservation

- (b) intentionally planted vegetation that has one of the following:
- i. a conservation covenant or agreement to reserve under section 30B of the *Soil and Land Conservation Act 1945*
 - ii. a covenant to conserve under section 21A of the *National Trust of Australia (WA) Act 1964*
 - iii. restrictive covenant to conserve under section 129B of the *Transfer of Land Act 1983*
 - iv. some other form of binding or undertaking to establish and maintain, or maintain, the vegetation.

Native vegetation can only be cleared with a clearing permit, unless for some circumstances where exemptions apply pursuant to the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (the Regulations). Clearing permits issued pursuant to the Regulations may be issued as area permits or purpose permits. Exemptions for clearing under Regulation 5 of the Regulations do not apply within ESAs.

2.1.4 Introduced species

The BAM Act provides for management and control of listed organisms, including introduced flora species (weeds). Species listed as declared pests under the BAM Act are classified under three categories:

- C1 Exclusion: Pests assigned under this category are not established in Western Australia, and control measures are to be taken to prevent them entering and establishing in the State
- C2 Eradication: Pests assigned under this category are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility
- C3 Management: Pests assigned under this category 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 that is currently free of that pest.

Under the BAM Act, land managers are required to manage populations of declared pests as outlined under the relevant category.

2.2 Environmental setting

2.2.1 Soils and topography

The survey area is located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). The Swan Coastal Plain comprises five major geomorphologic 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 & McArthur 1980; Gibson *et al.* 1994). Each major system is composed of further subdivisions in the form of detailed geomorphologic units (Churchward & McArthur 1980; Semeniuk 1990; Gibson *et al.* 1994). Beard (1990) describes the Swan Coastal Plain as a low-lying coastal plain, often swampy, with sandhills also containing dissected country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly sandy, yellow soils.

2.2.2 Climate

The Yanchep locality experiences a Mediterranean climate characterised by mild, wet winters and warm to hot, dry summers. The nearest Bureau of Meteorology (BoM) weather station at Gingin Aero (Station No. 009178) provides average monthly climate statistics for the Yanchep locality (Figure 2). Average annual rainfall recorded at Gingin Aero since 1996 is 620.2 mm (BoM 2017). Rainfall may occur at any time of year; however, most occurs in winter in association with cold fronts from the southwest. Highest temperatures occur between December and February, with average monthly maximums ranging from 30.6°C in December to 33.3°C in February (BoM 2017). Lowest temperatures occur between June and September, with average monthly minimums ranging from 6.2°C in July to 7.4°C in September (BoM 2017).

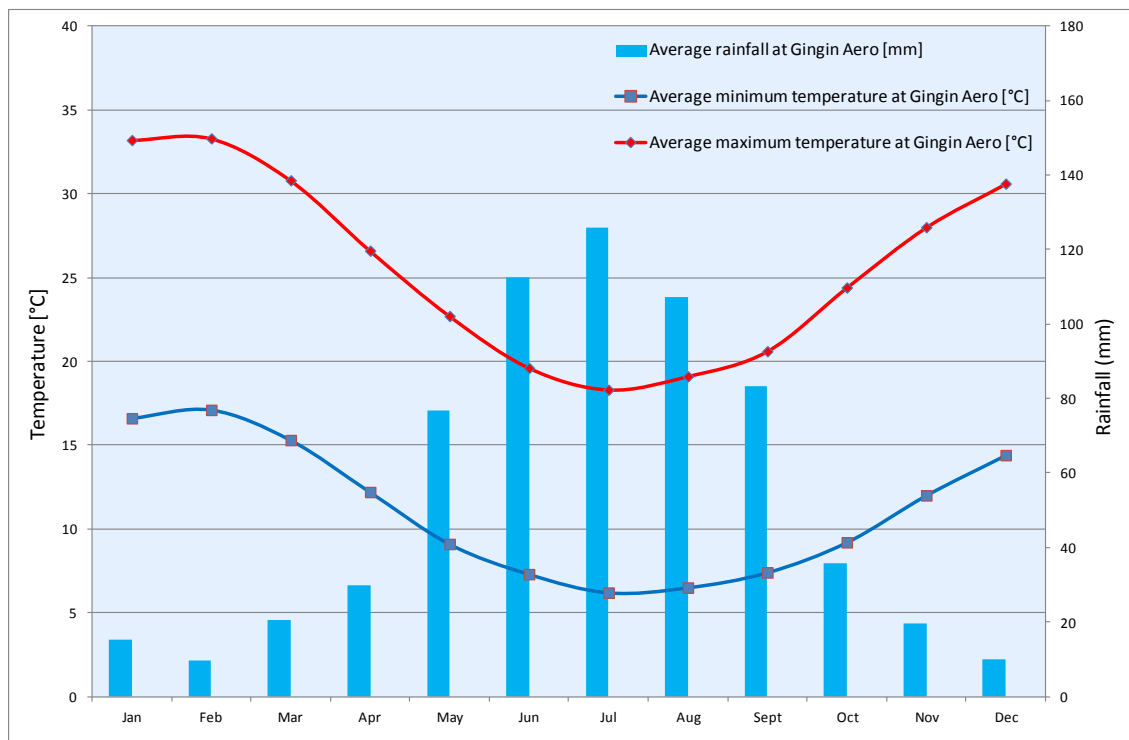


Figure 2: Mean monthly climatic data (temperature and rainfall) for Gingin Aero

2.2.3 Regional vegetation

Vegetation occurring within the region was initially mapped at a broad scale (1:1 000 000) by Beard during the 1970s. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1981) which led to the delineation of botanical districts as described in Beard (1990); the biogeographical region dataset (Interim Biogeographical Regionalisation for Australia, IBRA) for Western Australia (DEE 2015a) and System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980).

Beard (1990) Botanical Subdistrict

The survey area occurs within the Drummond Botanical Subdistrict which 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).

IBRA subregion

IBRA describes a system of 85 'biogeographic regions' (bioregions) and 403 subregions covering the entirety of the Australian continent (Thackway & Cresswell 1995). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The survey area occurs within the Swan Coastal Plain 2 IBRA subregion which is dominated by *Banksia* spp. or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca* spp.) in swampy areas (Mitchell et al. 2002).

System 6 and vegetation system association mapping

System 6 mapping refers to vegetation mapping undertaken at a Vegetation Complex scale by Heddle *et al.* (1980). This is the primary source of information used to calculate potential impacts of proposals to clear native vegetation on the Swan Coastal Plain. The survey area occurs within the Quindalup Complex (Figure 3) which is described as:

- Coastal dune complex consisting mainly of two alliances – the strand and fore dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata* – *Callitris preissii* and the closed scrub of *Acacia rostellifera*.

At a finer scale, the survey area likely¹ falls within the Guilderton 1007 vegetation system association (i.e. Mosaic: Shrublands; *Acacia lasiocarpa* and *Melaleuca acerosa* heath / Shrublands; *Acacia rostellifera* and *Acacia cyclops* thicket) as defined in Government of Western Australia (2016).

2.2.4 Wetlands

No mapped geomorphic wetlands occur within the survey area (Landgate 2016). The closest such wetland is located approximately 2 km east of the survey area (Wetland UFI: 8010; Conservation Category Wetland).

2.2.5 Bush Forever

The survey area occurs within the mapped extent of Bush Forever Site 397: *Coastal Strip from Wilbinga to Mindarie*. Bush Forever Site 397 corresponds to the existing coastal foreshore reserve between Mindarie and Wilbinga and is therefore identified in Bush Forever as a 'Site with some Existing Protection'.

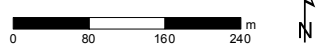
Bush Forever Site 397 comprises part of the Yanchep foreshore reserve. The foreshore reserve boundary was determined in 1996 as part of MRS Amendment 975/33 and is based on the Coastal Planning Strategy prepared for the Yanchep-Two Rocks area (Alan Tingay & Associates, 1993).

¹ The survey area falls outside of the extent mapped by Government of Western Australia (2016). This is likely attributable to a georeferencing error associated with the mapped dataset and as such, the system association within the survey area has been inferred through a comparison of vegetation descriptions and location in the landscape.



Figure 3: Regional vegetation mapping

Scale 1:8,000 at A4



Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 21/12/2017

Author: JCrute

Source: Aerial image: Nearmap, flown 12/2017. Existing cadastral, Landgate 2017.



Legend

- November 2017 survey area
- November 2016 survey area
- Existing cadastral
- Pre-European vegetation
- Guilderton 1007
- Heddlle Vegetation Comple x
- Quindalup Complex



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3. Methods

3.1 Desktop assessment

A desktop assessment was conducted using FloraBase, DBCA, and Department of the Environment and Energy (DEE) databases to identify the possible occurrence of TECs, PECs and Threatened and Priority flora potentially occurring within the survey area. Reports that document regional flora, vegetation and fauna within the surrounds of the survey area were also reviewed prior to the field assessment.

A database search request was also submitted to the Threatened Communities Branch of DBCA to identify any potential TECs or PECs within 5 km of the survey area.

3.2 Field assessment

The field survey was conducted according to standards set out in *Guidance Statement 51 Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia* and *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). The assessment of flora and vegetation within the survey area was undertaken by one ecologist from Strategen on 25 November 2016, with a subsequent survey of an additional northern section of the survey area undertaken by one ecologist on the 27 November 2017. Table 1 identifies staff involved in the field surveys, their roles and qualifications. The survey area was traversed on foot to record changes in vegetation structure and type and 16 vegetation quadrats were surveyed to identify vegetation types (Figure 1; Appendix 3).

Table 1: Personnel

Name	Role
Ms. C. Courtauld Strategen (Ecologist)	Planning, fieldwork, plant identification, data interpretation and report preparation.
Ms. A. Dalton Strategen (Botanist)	Planning, fieldwork, plant identification, data interpretation and report preparation.

Site selection for vegetation mapping was based on differences in structure and species composition of the communities present within the survey area. Vegetation mapping sites were determined from aerial photographs. The survey area was traversed on foot, allowing for opportunistic sites to be placed where a change in vegetation structure or composition was observed.

Flora and vegetation was described and sampled systematically at each quadrat and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site the following floristic and environmental parameters were noted:

- GPS location
- topography
- soil type and colour
- outcropping rocks and their type
- percentage cover and average height of each vegetation stratum.

For each vascular plant species, the average height, number of plants and percent cover were recorded.

All plant specimens collected during the field surveys were identified using appropriate reference material or through comparisons with pressed specimens housed at the Western Australian Herbarium where necessary. Nomenclature of the species recorded is in accordance with Western Australian Herbarium (1998-).

3.3 Data analysis and vegetation mapping

Due to the degraded nature and uniform distribution of vegetation within the survey area; quadrat data were grouped into a species by site matrix to delineate individual vegetation types (VTs) present within the survey area. Aerial photography interpretation and field notes taken during the survey were then used to develop VT mapping polygon boundaries over the survey area. These polygon boundaries were then digitised using Geographic Information System (GIS) software.

VT descriptions (though floristic in origin) have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003), a system of describing structural vegetation units (based on dominant taxa). This model follows nationally-agreed guidelines to describe and represent vegetation types, so that comparable and consistent data is produced nation-wide. For the purposes of this report, a VT is considered equivalent to a NVIS sub-association as described in ESCAVI (2003).

Vegetation condition was recorded at all quadrats, and also opportunistically within the survey area during the field assessment where required. Vegetation condition was described using the vegetation condition scale for the South West Botanical Province (Keighery 1994). Vegetation condition polygon boundaries were developed using this information in conjunction with aerial photography interpretation, and were digitised as for vegetation type mapping polygon boundaries.

The degraded nature of the survey area did not allow for statistically valid multivariate analyses to be undertaken to determine resemblance of sites to Floristic Community Types (FCTs) as mapped and defined by Gibson *et al.* (1994). Therefore, inferences between recorded VTs and FCT and DBCA descriptions of TECs/PECs were used to determine any potential occurrence of a conservation significant vegetation community where necessary. The Bush Forever list of FCTs per vegetation complex was also used as a guide to infer potential occurrence of conservation significant FCTs within the survey area (GoWA 2000).

3.4 Weed density mapping

Weed density in the survey area was mapped using the guidelines for mapping weed distribution in Western Australia (DEC 2011). The entire survey area was traversed and the percentage cover of individual weed species was recorded. Broad cover classes of less than 5% cover (low density), 6-75% cover (medium density) and 76-100% (high density) were used to map the density of weeds in the survey area (DEC 2011).

3.5 Survey limitations and constraints

Table 2 displays the evaluation of the flora and vegetation assessment against a range of potential limitations that may have an effect on that assessment. Based on this evaluation, the assessment has not been subject to constraints that would affect the thoroughness of the assessment and the conclusions reached.

Table 2: Flora and vegetation survey potential limitations and constraints

Potential limitation	Impact on assessment	Comment
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	Not a constraint.	The survey has been undertaken in the Drummond Botanical Subdistrict on the Swan Coastal Plain which has been well studied and documented with ample literature available (Beard 1990).
Scope (i.e. what life forms, etc., were sampled).	Not a constraint.	Due to the degraded nature and uniform distribution of vegetation within the survey area and timing of the survey (i.e. spring); most life forms are likely to have been sampled adequately during the time of the survey.
Proportion of flora/fauna collected and identified (based on sampling, timing and intensity).	Not a constraint.	The proportion of flora surveyed was adequate. The entire survey area was traversed and flora species were recorded systematically.
Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed).	Not a constraint	The information collected during the survey was sufficient to assess the vegetation that was present during the time of the survey.
Mapping reliability.	Not a constraint.	Aerial photography of a suitable scale was used to map the survey area and identify changes in vegetation. Sites were chosen from these aerials to reflect changes in community structure. Opportunistic sites were also used if differences were observed during on ground reconnaissance. Vegetation types were assigned to each site based on topography, soil type and presence/absence and percent foliage cover of vegetation.
Timing, weather, season, cycle.	Not a constraint.	Flora and vegetation surveys are normally conducted following winter rainfall in the South-West Botanical Province of Western Australia, ideally during spring (EPA 2016). The field assessment was conducted in November (i.e. spring) in fine weather conditions and therefore these factors are not deemed to be constraints.
Disturbances (fire flood, accidental human intervention, etc.).	Not a constraint.	The survey area and regional surrounds have been subject to disturbance over a significant period of time. Given the wide range of this disturbance, this is not considered to be a limitation within the survey area.
Intensity (in retrospect, was the intensity adequate).	Not a constraint.	The survey area was traversed on foot and all differences in vegetation structure were recorded appropriately.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	Not a constraint.	The available resources were adequate to complete the survey.
Access problems (i.e. ability to access survey area).	Not a constraint.	Existing tracks enabled adequate access to survey the vegetation within the survey area. Where access was not available by car, the area was easily traversed by foot.
Experience levels (e.g. degree of expertise in species identification to taxon level).	Not a constraint.	All survey personnel have the appropriate training in sampling and identifying the flora of the region.

4. Results

4.1 Desktop assessment results

A total of 176 native vascular plant taxa from 66 plant families have the potential to occur within the survey area (DBCA 2017-; DEE 2015b). The majority of taxa were from within the Asteraceae (14 taxa) and Fabaceae (14 taxa) families.

4.1.1 Threatened and Priority flora

A desktop survey for Threatened and Priority flora that may potentially occur within the survey area was undertaken using NatureMap (DBCA 2007-), the Western Australian Herbarium (Western Australian Herbarium 1998-), and the DEE Protected Matters Search Tool (DEE 2015b).

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, the taking of such flora without the written consent of the Minister is an offence. The WC Act defines “to take” flora as 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. DBCA (2016) contains the current list of Threatened flora in Western Australia.

Priority flora are considered to be species which are potentially 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. DBCA categorises Priority flora according to their conservation priority using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such species. Priority flora species are regularly reviewed and may have their priority status changed when more information on the species becomes available. Appendix 1 defines levels of Threatened and Priority flora (Western Australian Herbarium 1998).

At the national level, the EPBC Act lists Threatened species as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent. Appendix 1 defines each of these categories of Threatened species. The EPBC Act prohibits an action that has or will have a significant impact on a listed Threatened species without approval from the Australian Government Minister for the Environment. The current EPBC Act list of Threatened flora may be found on the DEE (2015c) website.

Table 3 shows the Threatened and Priority flora potentially occurring within the survey area. The desktop assessment identified one Threatened flora and three Priority flora species that have been recorded in the regional area. Of these, based on specific habitat requirements, no Threatened flora species and two Priority flora species were considered to have the potential to occur within the survey area:

- *Leucopogon maritimus* (P1)
- *Leucopogon* sp. Yanchep (P3).

Table 3: Threatened and Priority flora potentially occurring within the survey area

Species	Conservation status		Description	Potential to occur
	EPBC Act	WC Act		
<i>Eucalyptus argutifolia</i> (Wabling Hill Mallee)	Threatened – Vulnerable	Threatened	Mallee to 4 m tall with smooth bark. Flowers are white and visible March to April. Habitat for this species occurs within shallow soils over limestone, on slopes or gullies of limestone ridges and outcrops (Western Australian Herbarium 1998-).	Unlikely – Preferred soil type/habitat does not occur within the survey area.
<i>Leucopogon maritimus</i>	Not listed	Priority 1	A low, spreading shrubs to 40 cm tall and 60 cm wide, often multi-stemmed close to the base but single-stemmed at ground level with a fire-sensitive rootstock. <i>Leucopogon maritimus</i> is restricted to near-coastal Quindalup dunes, from a small area of coastline about 40–70 km north of Perth. It occurs in deep, calcareous sands, on the mid to upper slopes of dunes or in shallow sand over limestone, but avoiding the thicker vegetation of the swales. It grows in low heathland communities often dominated by <i>Melaleuca systema</i> , <i>Acanthocarpus preissii</i> , <i>Acacia lasiocarpa</i> and <i>Olearia axillaris</i> , sometimes in close proximity to the common coastal epacrids <i>Leucopogon parviflorus</i> and <i>L. insularis</i> (Hislop 2011).	Possible – Preferred habitat exists within the survey area.
<i>Leucopogon sp. Yanchep</i>	Not listed	Priority 3	An erect shrub, 0.15-1 m tall, to 0.6 m wide. Flowers are white/pink, occurring from April to June or September. This species occurs in light grey-yellow sand, brown loam, limestone, laterite or granite on coastal plain, breakaways, valley slopes or low hills (Western Australian Herbarium 1998-).	Unlikely – Preferred soil type/habitat does not occur within the survey area.
<i>Stylidium maritimum</i>	Not listed	Priority 3	Caespitose perennial herb to 70 cm tall. Leaves tufted, linear to narrowly oblanceolate. Flowers are white or purple and visible September to November. Habitat for this species is sandy soils over limestone on dune slopes and flats, typically growing within coastal heath and shrubland or open Banksia woodland (Western Australian Herbarium 1998-).	Possible – Preferred habitat exists within the survey area.

4.1.2 Threatened and Priority Ecological Communities

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 Australian Government as Threatened, Endangered or Vulnerable. There are four State categories of TECs (DEC 2010)²:

- presumed totally destroyed (PD)
- critically endangered (CR)
- endangered (EN)
- vulnerable (VU).

A description of each of these TEC categories is presented in Appendix 1. TECs are gazetted as such (DBCAs 2015a) and some Western Australian TECs are listed as Threatened under the EPBC Act.

Ecological communities identified as Threatened, but not listed as TECs, are classified as Priority Ecological Communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. DBCA categorises PECs according to their conservation priority, using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such ecological communities. Appendix 1 defines PECs (DEC 2010). A list of current PECs can be viewed at the DBCA (2015b) website.

Under the EPBC Act, a person must not undertake an action that has or will have a significant impact on a listed TEC without approval from the Australian Government Minister for the Environment, unless those actions are not prohibited under the EPBC Act. A description of each of these categories of TECs is presented in Appendix 1. The current EPBC Act list of TECs can be located on the DEE website (DEC 2010).

Three TECs and one PEC were identified within 5 km of the survey area (Figure 4);

- *Banksia dominated woodlands of the Swan Coastal Plain IBRA region* (Endangered – EPBC Act³; Priority 3 PEC)
- SCP01: *Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain* (Endangered – EPBC Act, Critically Endangered – WC Act)
- FCT 26a: *Melaleuca huegelii - Melaleuca acerosa (currently M. systema) shrublands on limestone ridges* (Endangered – WC Act)
- FCT19b: *Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain* (Endangered – EPBC Act, Critically Endangered – WC Act).

The closest known occurrences of TECs were SCP01 - *Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain*, which is listed as Critically Endangered under the EPBC Act and WC Act and is located approximately 1 km from the survey area, and *Banksia dominated woodlands of the Swan Coastal Plain Bioregion* (Priority 3; now EPBC Act listed TEC), which is located approximately 3 km from the survey area.

All other identified communities are located greater than 5 km from the survey area.

²The Department of Environment and Conservation is still listed as the author of all TEC and PEC databases and have been referred to as such in this document instead of the Department of Biodiversity, Conservation and Attractions.

³This community was identified during the database search and is also recognised as the recently listed TEC – *Banksia woodlands of the Swan Coastal Plain* (Endangered – EPBC Act). There has not been sufficient time since the listing of the EPBC Act TEC to update State records to reflect the new community name and conservation status.

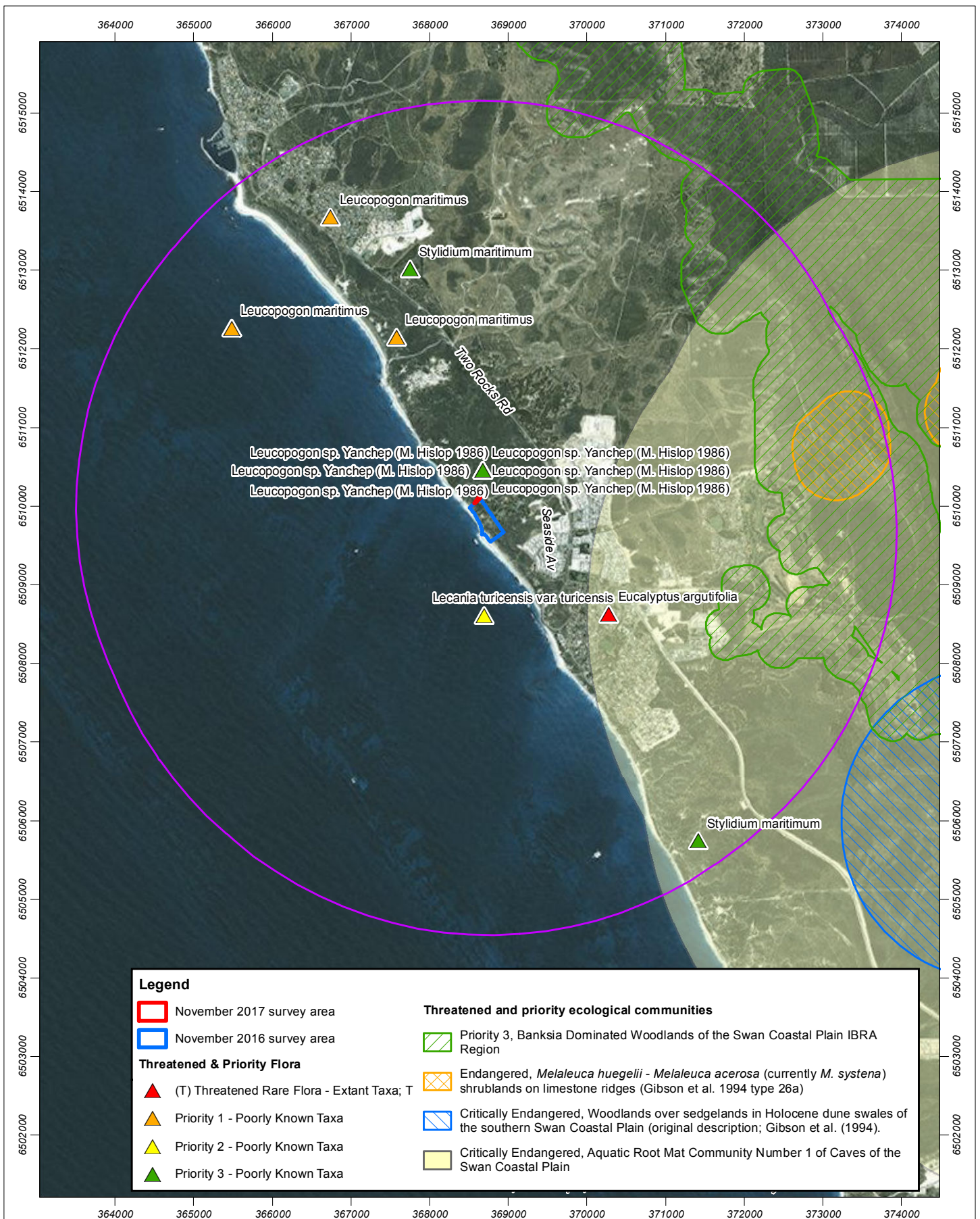


Figure 4: Location of TEC, PEC and Threatened/Priority Flora within 5km of the survey area

Scale 1:65,000 at A4



Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 21/12/2017
 Author: JCrute

Source: Aerial image: Nearmap, flown 12/2017. Existing cadastre, Landgate 2017. Flor, TEC/PECs: DBCA 2017.

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4.2 Field survey results

4.2.1 Native flora

A total of 38 native vascular plant taxa from 34 plant genera and 19 plant families were recorded within the survey area. The majority of taxa were recorded within the Poaceae (9 taxa), Myrtaceae (8 taxa), and Chenopodiaceae (6 taxa) families (Appendix 4). The relatively low number of plant genera recorded reflects the disturbed nature of the survey area.

4.2.2 Threatened and Priority flora

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by DBCA (2016) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey area at the time of assessment. The survey was conducted during the prime flowering time for these conservation significant species (spring), therefore during the optimum time for correct identification.

4.2.3 Introduced (exotic) taxa

A total of 18 introduced (exotic) taxa were recorded within the survey area (Appendix 4).

* None of these species are Declared Plant species in Western Australia pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2017).

Weed density within the survey area was mapped and is presented in Figure 5.



Figure 5: High level weed mapping

* 2016 area inferred

Scale 1:3,700 at A3
 0 35 70 105 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 21/12/2017
 Author: JCrute
 Source: Aerial image: Neamap, flown 12/2017.
 Path: Q:\Consult\2016\ADS\ADS1658501_GIS_documents\ArcMap_documents\ADS16585_G007_RevA.mxd

Legend

 November 2017 survey area
 November 2016 survey area

Weed mapping density

High
 Medium
 Low

Weed density	Cover
Low	<5%
Medium	6-75%
High	76-100%



4.2.4 Vegetation types

Five native vegetation types (VTs) were defined and mapped within the survey area (Figure 6) and are summarised in Table 4. Areas containing vegetation in parkland cleared or highly degraded state have not been counted as unique native VTs but have been included in Table 4 for area calculation purposes. Total areas occupied within the survey area by each of the identified VTs are set out in Table 5.

Table 4: Vegetation Types

Vegetation Type	Description
1	<i>Olearia axillaris</i> , <i>Atriplex isatidea</i> , <i>Spinifex hirsutus</i> , * <i>Cakile maritima</i> and * <i>Thinopyrum distichum</i> low shrubland on sandy soils.
2	<i>Olearia axillaris</i> , <i>Acacia rostellifera</i> , <i>Rhagodia baccata</i> and <i>Scaevola crassifolia</i> heath over <i>Spinifex longifolius</i> , <i>Acanthocarpus preissii</i> , <i>Cassytha flava</i> , * <i>Pelargonium capitatum</i> and exotic grasses including on sandy soils.
3	<i>Scaevola crassifolia</i> , <i>Olearia axillaris</i> , <i>Acacia rostellifera</i> , and <i>Spyridium globulosum</i> heath on dune crests and <i>Lepidosperma gladiatum</i> closed heath in dune swales over <i>Acanthocarpus preissii</i> , * <i>Pelargonium capitatum</i> * <i>Arctotis stoechadifolia</i> and exotic grasses on sandy soils.
4	<i>Olearia axillaris</i> , <i>Scaevola crassifolia</i> , <i>Acacia rostellifera</i> and <i>Acacia truncata</i> heath with emergent <i>Agonis flexuosa</i> over <i>Acanthocarpus preissii</i> , <i>Spinifex hirsutus</i> , * <i>Pelargonium capitatum</i> , and exotic grasses on sandy soils.
5	<i>Allocasuarina humilis</i> and <i>Spyridium globulosum</i> mid shrubland over <i>Rhagodia baccata</i> , <i>Olearia axillaris</i> and <i>Scaevola crassifolia</i> heath on dune crests over <i>Lepidosperma gladiatum</i> closed heath in dune swales over <i>Acanthocarpus preissii</i> , <i>Cassytha flava</i> and * <i>Pelargonium capitatum</i> on sandy soils.
Planted	Planted palms (* <i>Phoenix</i> sp.) and Japanese Pepper (* <i>Schinus terebinthifolius</i>).
C	Cleared areas.

Vegetation type coverage

The total area mapped within the survey area was 10.22 ha which includes highly degraded and fully cleared areas (Table 5). The dominant native VT within the survey area was VT 3 which can be broadly described as a *Scaevola crassifolia*, *Olearia axillaris*, *Acacia rostellifera*, and *Spyridium globulosum* heath on dune crests and *Lepidosperma gladiatum* closed heath in dune swales over *Acanthocarpus preissii*, **Pelargonium capitatum* **Arctotis stoechadifolia* and exotic grasses on sandy soils.

Table 5: Area (ha) covered by each VT within the survey area

VT	Area (ha)	Percentage of the Survey area
1	1.31	12.46
2	1.86	17.70
3	5.54	52.71
4	0.19	1.86
5	0.25	1.81
Planted	0.05	0.48
Cleared	1.31	12.46
TOTAL	10.51	100

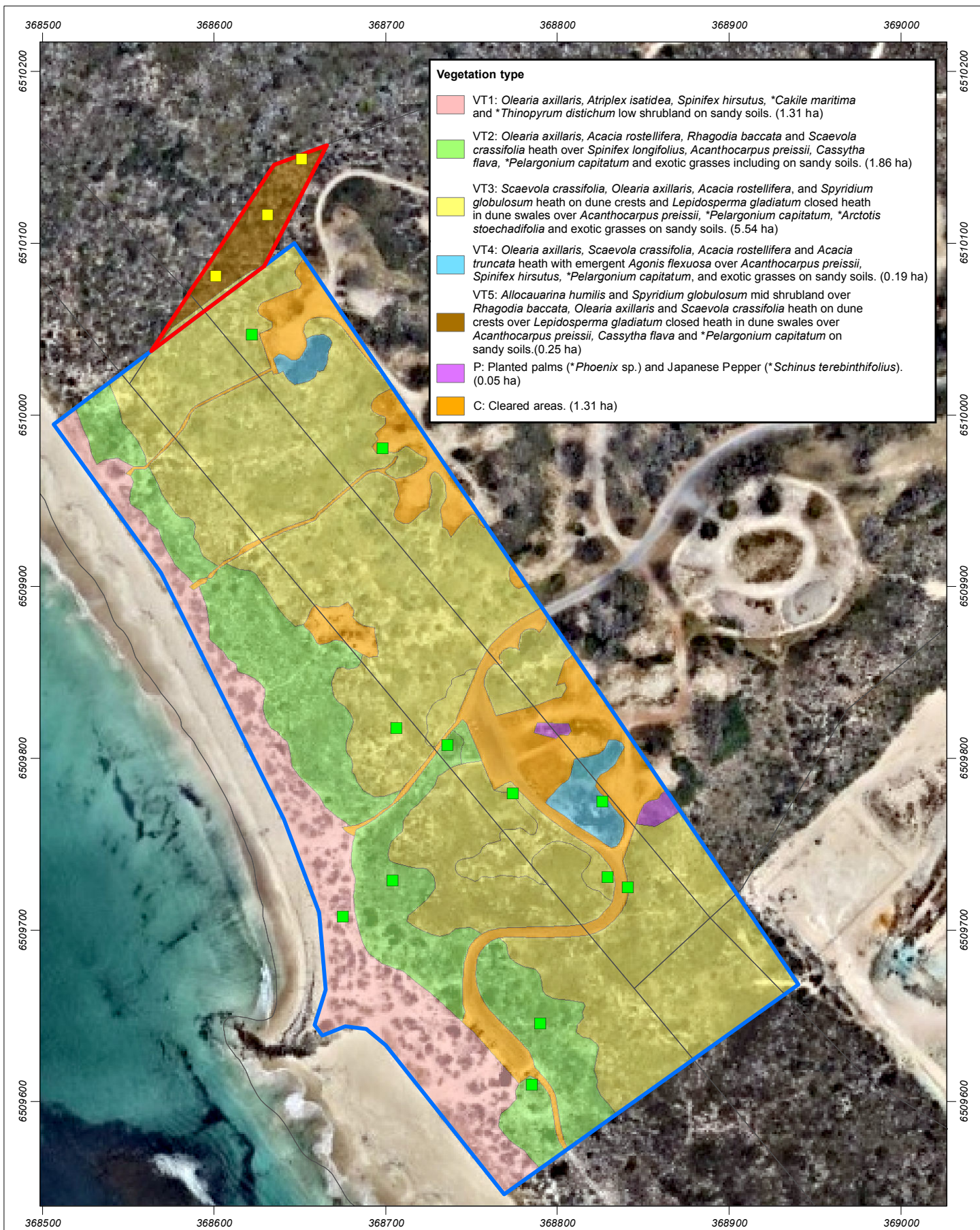
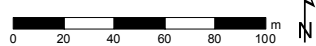


Figure 6: Vegetation types

Scale 1:3,000 at A4



Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 21/12/2017
 Author: JCrute

Source: Aerial image: Nearmap, flown 12/2017. Existing cadastre, Landgate 2017.

Legend

Quadrat locations

- November 2016 survey
- November 2017 survey
- November 2017 survey area
- November 2016 survey area
- Existing cadastre



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4.2.5 Vegetation condition

The survey area shows signs of having been degraded for a long period of time due to the widespread extent of weeds and human disturbance (e.g. trampling dune vegetation and vehicle tracks for access to the beach). As such, vegetation condition within the survey ranged from Completely Degraded to Good and generally aligned with the VT boundaries (Keighery 1994; Figure 7; Table 6).

Table 7 gives a numerical breakdown of the area occupied by each vegetation condition rating within the survey area.

Table 6: 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.

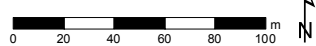
Table 7: Area (ha) covered by each vegetation condition category within the survey area

Vegetation Condition	Area (ha)	Percentage of the Survey area
Very Good	5.53	51.62
Good to Very Good	2.05	19.51
Good	1.56	14.84
Completely degraded	1.36	12.94
Total	10.51	100



Figure 7: Vegetation condition

Scale 1:3,000 at A4



Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 21/12/2017
 Author: JCrute

Source: Aerial image: Nearmap, flown 12/2017. Existing cadastral, Landgate 2017.

Legend

Quadrat locations

- November 2016 survey
- November 2017 survey
- November 2017 survey area
- November 2016 survey area
- Existing cadastral

Vegetation condition

- Very Good (5.53 ha)
- Good to Very Good (2.05 ha)
- Good (1.56 ha)
- Completely Degraded (1.36 ha)



4.2.6 Threatened and Priority Ecological Communities

Three TECs and one PEC were identified as having the potential to occur within 5 km of the survey area by the desktop survey.

The vegetation within the survey area did not resemble a known TEC, however the vegetation within VT 2 and VT 3 may resemble two Priority 3 PECs; FCTs 29a (Coastal Shrublands on shallow sands) and 29b (Acacia Shrublands on taller dunes), comprising 1.86 ha and 5.54 ha respectively. These FCTs were recorded in the previous vegetation surveys within the region (ATA 2007).

FCT 29 is largely restricted to the Quindalup System and contains two distinct subgroups. FCT 29a comprises mostly heaths on shallow sands over limestone close to the coast and occurs between Seabird and Garden Island. FCT 29a does not have a single dominant species but important species include *Spyridium globulosum*, *Rhagodia baccata* and *Olearia axillaris*. FCT 29b is dominated by Acacia Shrublands or mixed heaths of the larger dunes and ranges from Seabird to south of Mandurah. There is no consistent dominant species in FCT 29b, however species such as *Acacia rostellifera*, *Acacia lasiocarpa* and *Melaleuca systema* are important.

FCT 29a is inferred to potentially occur within VT2 (1.86 ha) based on the dominant species recorded during the survey (e.g. *Rhagodia baccata* and *Olearia axillaris*) while VT3 (5.54 ha) may represent FCT 29b as it comprises *Acacia rostellifera* and *Melaleuca systema*. These FCTs are also restricted to the Quindalup complex within which the survey area occurs (GoWA 2000). Therefore, it is considered likely for FCT 29a and FCT 29b to occur within the survey area based on previous survey results (ATA 2007), the known vegetation complex within the survey area and dominant taxa recorded.

5. Discussion

Vegetation within the survey area comprises five VTs and cleared areas. Transitions between VTs were generally discontinuous, though occasionally abrupt with margins representing admixtures of more than one VT. This discontinuity is primarily due to changes in soil profile and topography, and presence of cleared areas. Vegetation condition generally aligned with the VT boundaries and at a broad scale, the majority of the survey area was observed to be in various states of degradation due to coastal erosion and historical clearing within the survey area. The remnant vegetation shows signs of degradation and structural alteration particularly where the parking and beach access tracks are located.

The flora and vegetation assessment conducted within the survey area was undertaken during November 2016 and November 2017, during the prime flowering time for majority of species within the area with field reconnaissance focussing on traversing the entire survey area to delineate broad vegetation types. This is consistent with the requirements of a detailed flora and vegetation survey as specified in the technical guidance for flora and vegetation assessment in Western Australia (EPA 2016).

The number of species recorded within the survey area totalled 38 native vascular plant taxa from 34 plant genera and 19 plant families and 18 introduced taxa. No Declared Plant species pursuant to section 22 of the BAM Act were recorded within the survey area (DAFWA 2017).

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by DBCA (2015) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey area. Given that the survey was conducted during the prime flowering time for majority of the conservation significant species potentially occurring within the survey area, it is unlikely that occurrences of conservation significant species are present within the survey area.

Vegetation condition within the survey area ranged from Completely Degraded to Very Good (Keighery 1994), with majority of the survey area (51.62%) mapped to be in 'Very Good' condition. It is worth noting that a large portion of vegetation within the Survey Area has been historically cleared where the Club Capricorn infrastructure occurred previously.

The vegetation within the survey area did not resemble a known TEC, however, the survey area contains two Priority 3 PECs (FCT 29a – *Coastal Shrublands on shallow sands*, FCT 29b – *Acacia Shrublands on taller dunes*) based on dominant taxa recorded, the known vegetation complex within the survey area and previous survey results (ATA 2007). Whilst the PECs may occur in the survey area, these FCTs are very well represented within surrounding Bush Forever Site 397: *Coastal Strip from Wilbinga to Mindarie* which is under existing protection. Furthermore, these VTs will be retained within the larger foreshore reserve, subject to protection and management measures detailed in the Foreshore Management Plan.

6. Conclusion

The detailed flora and vegetation survey (conducted 25 November 2016 and 27 November 2017) was successful in collecting data to define and assess the presence, extent and significance of vegetation types within the survey area.

Approximately 10.51 ha of vegetation ranging from Completely Degraded to Very Good condition was recorded within the survey area. The majority of the survey area is considered to be in 'Very Good' condition (51.62%).

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by DBCA (2017) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey area. Given that the survey was conducted during the prime flowering time for majority of the conservation significant species potentially occurring within the survey area, it is highly unlikely that occurrences of conservation significant species are present within the survey area.

The vegetation within the survey area did not resemble a known TEC; however the vegetation within VT 2 and VT 3 may resemble two Priority 3 PECs; FCT 29a and FCT29b, comprising 1.86 ha and 5.54 ha respectively. These FCTs are well represented within surrounding Bush Forever Site 397: *Coastal Strip from Wilbinga to Mindarie* which is under existing protection.

This flora and vegetation assessment will support the Foreshore Management Plan for the proposed foreshore development which aligns with the *CoW Local Biodiversity Strategy* (2011) and the *CoW Coastal Management Plan* (CoW 2012) for the Capricorn coastal region.

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Appendix 1
Conservation significant flora and
ecological community definitions

Conservation Codes for Western Australia (Western Australian Herbarium 1998-)

Under the *Wildlife Conservation Act* (1950), the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 deal with those that are threatened and those that are presumed extinct, respectively.

T: Threatened Flora (Declared Rare Flora – Extant)

Species 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
- X: Presumed Extinct Flora (Declared Rare Flora – Extinct).

Species that have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the *Wildlife Conservation Act 1950*).

Priority Flora

Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

Priority One: Poorly-known Species

Species that are known from one or a few collections or sight records (generally less than 5), 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.

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 immediate threat from known threatening processes.

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.

Priority Four: Rare, Near Threatened and other species in need of monitoring

1. 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.
2. 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.
3. Species that have been removed from the list of threatened species during the past 5 years for reasons other than taxonomy.

Priority 5: 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 5 years.

Definition of Threatened Ecological Communities (DEC 2010)

Presumed Totally Destroyed (PD)

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:

- records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or
- all occurrences recorded within the last 50 years have since been destroyed.

Critically Endangered (CR)

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria:

1. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply:
 - (a) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years)
 - (b) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
2. Current distribution is limited, and one or more of the following apply:
 - (a) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years)
 - (b) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes
 - (c) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.
3. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria:

1. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply:
 - (a) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years)
 - (b) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

2. Current distribution is limited, and one or more of the following apply"
 - (a) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years)
 - (b) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes
 - (c) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
3. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria:

1. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.
2. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
3. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Definition of Priority Ecological Communities (DEC 2010)

Priority One: 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. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: 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, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- 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
- 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
- communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four

Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. These include:

1. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
2. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
3. Ecological communities that have been removed from the list of threatened communities during the past five years.

Appendix 2
Desktop assessment results (DBCA
2017-, DEE 2015b)



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/11/16 17:20:10

[Summary](#)

[Details](#)

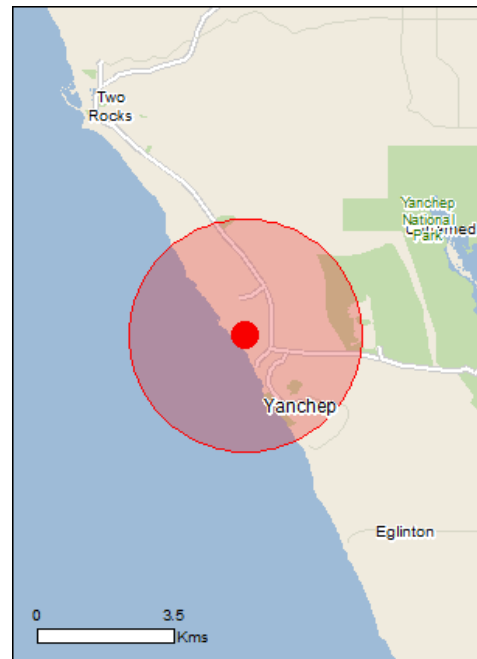
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

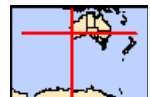
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 3.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	41
Listed Migratory Species:	39

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	65
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	33
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [\[Resource Information \]](#)

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

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

Listed Threatened Species [\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		

[Anous tenuirostris melanops](#)

Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
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[Calidris ferruginea](#)

Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
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[Calyptorhynchus latirostris](#)

Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
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[Diomedea amsterdamensis](#)

Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
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[Diomedea epomophora \(sensu stricto\)](#)

Southern Royal Albatross [1072]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
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[Diomedea exulans \(sensu lato\)](#)

Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
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[Diomedea sanfordi](#)

Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
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[Halobaena caerulea](#)

Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
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[Leipoa ocellata](#)

Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
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[Limosa lapponica baueri](#)

Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
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[Limosa lapponica menzbieri](#)

Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within
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Name	Status	Type of Presence area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Phoebastria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Status	Type of Presence
Plants		
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat may occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat may occur within area
Drakaea elastica Glossy-leaved Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Eucalyptus argutifolia Yanchep Mallee, Wabbling Hill Mallee [24263]	Vulnerable	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

Reptiles

Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Sharks

Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species

[[Resource Information](#)]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Phoebastria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Flesh-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [\[Resource Information \]](#)

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

Name

Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

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

Name	Threatened	Type of Presence
Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area

Name	Threatened	Type of Presence
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Phoebastria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area

Mammals

Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Reptiles

Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans

Name	Status	Type of Presence
[Resource Information]		
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within

Name	Status	Type of Presence area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Invasive Species [\[Resource Information \]](#)

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species

Name	Status	Type of Presence
Carduelis carduelis European Goldfinch [403]		habitat likely to occur within area Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large- leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-31.54362 115.62209

Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact Us](#) page.

NatureMap Species Report

Created By Guest user on 24/11/2016

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 37' 06" E, 31° 32' 28" S
Buffer 5km
Group By Family

Family	Species	Records
Acrotylaceae	1	1
Aizoaceae	1	1
Amaranthaceae	1	1
Apiaceae	3	3
Araliaceae	3	3
Areschougaceae	1	1
Asparagaceae	5	8
Asphodelaceae	1	2
Asteraceae	14	17
Bangiaceae	1	1
Brassicaceae	3	4
Campanulaceae	4	4
Caprifoliaceae	1	1
Caryophyllaceae	1	1
Casuarinaceae	1	1
Caulerpaceae	3	4
Ceramiaceae	2	2
Chenopodiaceae	2	3
Cladophoraceae	1	1
Convolvulaceae	1	1
Crassulaceae	1	1
Cyperaceae	3	8
Dasyaceae	1	1
Dilleniaceae	4	5
Droseraceae	1	1
Ericaceae	10	27
Euphorbiaceae	2	2
Fabaceae	14	15
Gentianaceae	1	1
Geraniaceae	1	1
Goodeniaceae	6	6
Haemodoraceae	2	3
Hemerocallidaceae	2	2
Iridaceae	3	4
Lamiaceae	3	5
Lauraceae	2	3
Loranthaceae	1	1
Malvaceae	4	4
Myrtaceae	7	9
Olacaceae	1	1
Onagraceae	1	1
Orchidaceae	5	6
Orobanchaceae	2	2
Oxalidaceae	1	1
Papaveraceae	1	1
Phyllanthaceae	1	1
Plantaginaceae	2	2
Plocamiaceae	1	1
Poaceae	5	5
Polygalaceae	3	3
Portulacaceae	1	1
Proteaceae	6	8
Ranunculaceae	2	4
Restionaceae	3	3
Rhamnaceae	4	5
Rhodomelaceae	3	5
Rubiaceae	2	2
Santalaceae	2	2
Scrophulariaceae	2	3
Solanaceae	3	5
Stylidiaceae	2	5
Tamaricaceae	1	1
Thymelaeaceae	1	2
Ulvaceae	1	1
Urticaceae	1	1
Violaceae	1	1
TOTAL	176	232

Name ID Species Name

Naturalised

Conservation Code

¹Endemic To Query Area

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Acrotylaceae				
1.	26665 <i>Claviconium ovatum</i>			
Aizoaceae				
2.	2798 <i>Carpobrotus virescens</i> (Coastal Pigface, Kolboko, Bain)			
Amaranthaceae				
3.	40841 <i>Ptilotus stirlingii</i> subsp. <i>stirlingii</i>			
Apiaceae				
4.	6218 <i>Daucus glochidiatus</i> (Australian Carrot)			
5.	6219 <i>Eryngium pinnatifidum</i> (Blue Devils)			
6.	6221 <i>Foeniculum vulgare</i> (Fennel)	Y		
Araliaceae				
7.	6229 <i>Hydrocotyle diantha</i>			
8.	19041 <i>Trachymene coerulea</i> subsp. <i>coerulea</i>			
9.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
Areschougiaceae				
10.	26534 <i>Callophycus dorsifer</i>			
Asparagaceae				
11.	1208 <i>Acanthocarpus preissii</i>			
12.	1231 <i>Lomandra maritima</i>			
13.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
14.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			
15.	1343 <i>Thysanotus patersonii</i>			
Asphodelaceae				
16.	1368 <i>Trachyandra divaricata</i>	Y		
Asteraceae				
17.	7838 <i>Arctotheca calendula</i> (Cape Weed, African Marigold)	Y		
18.	7840 <i>Arctotis stoechadifolia</i> (White Arctotis, Silver Arctotis)	Y		
19.	7947 <i>Cotula turbinata</i> (Funnel Weed)	Y		
20.	16311 <i>Gazania linearis</i>	Y		
21.	12741 <i>Hyalosperma cotula</i>			
22.	17852 <i>Leptorhynchus scaber</i> (Lanky Buttons)			
23.	16449 <i>Leucophyta brownii</i>			
24.	8105 <i>Millotia myosotidifolia</i>			
25.	8127 <i>Olearia axillaris</i> (Coastal Daisybush)			
26.	42281 <i>Pithocarpa cordata</i>			
27.	13300 <i>Rhodanthe citrina</i>			
28.	45146 <i>Roebuckiella oncocarpa</i>			
29.	25884 <i>Senecio pinnatifolius</i> var. <i>latilobus</i>			
30.	8231 <i>Sonchus oleraceus</i> (Common Sowthistle)	Y		
Bangiaceae				
31.	27184 <i>Porphyra lucasii</i>			
Brassicaceae				
32.	3000 <i>Brassica tournefortii</i> (Mediterranean Turnip)	Y		
33.	3011 <i>Diploaxis muralis</i> (Wall Rocket)	Y		
34.	3041 <i>Lepidium pseudoruderale</i>			
Campanulaceae				
35.	7396 <i>Isotoma hypocrateriformis</i> (Woodbridge Poison)			
36.	7402 <i>Lobelia gibbosa</i> (Tall Lobelia)			
37.	7403 <i>Lobelia heterophylla</i> (Wing-seeded Lobelia)			
38.	7405 <i>Lobelia rarifolia</i>			
Caprifoliaceae				
39.	7368 <i>Scabiosa atropurpurea</i> (Purple Pincushion)	Y		
Caryophyllaceae				
40.	2889 <i>Cerastium glomeratum</i> (Mouse Ear Chickweed)	Y		
Casuarinaceae				
41.	13908 <i>Allocasuarina lehmanniana</i> subsp. <i>lehmanniana</i>			
Caulerpaceae				
42.	44539 <i>Caulerpa cylindracea</i>			
43.	27382 <i>Caulerpa longifolia</i> forma <i>crispata</i>			
44.	26571 <i>Caulerpa papillosa</i>			
Ceramiaceae				
45.	26511 <i>Bornetia binderiana</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
46.	26599 <i>Ceramium puberulum</i>			
Chenopodiaceae				
47.	2463 <i>Atriplex isatidea</i> (Coast Saltbush)			
48.	11341 <i>Rhagodia baccata</i> subsp. <i>baccata</i>			
Cladophoraceae				
49.	26607 <i>Chaetomorpha aerea</i>			
Convolvulaceae				
50.	11021 <i>Cuscuta planiflora</i>	Y		
Crassulaceae				
51.	3140 <i>Crassula glomerata</i>	Y		
Cyperaceae				
52.	744 <i>Baumea laxa</i>			
53.	20216 <i>Ficinia nodosa</i> (Knotted Club Rush)			
54.	42742 <i>Lepidosperma calcicola</i>			
Dasyaceae				
55.	26738 <i>Dasya elongata</i>			
Dilleniaceae				
56.	5112 <i>Hibbertia aurea</i>			
57.	5134 <i>Hibbertia huegelii</i>			
58.	5162 <i>Hibbertia racemosa</i> (Stalked Guinea Flower)			
59.	<i>Hibbertia</i> sp.			
Droseraceae				
60.	3118 <i>Drosera pallida</i> (Pale Rainbow)			
Ericaceae				
61.	6295 <i>Acrotriche cordata</i> (Coast Ground Berry)			
62.	6349 <i>Conostephium preissii</i>			
63.	6405 <i>Leucopogon insularis</i>			
64.	40801 <i>Leucopogon maritimus</i>		P1	
65.	6427 <i>Leucopogon parviflorus</i> (Coast Beard-heath)			
66.	6434 <i>Leucopogon polymorphus</i>			
67.	6436 <i>Leucopogon propinquus</i>			
68.	6440 <i>Leucopogon racemosus</i>			
69.	19460 <i>Leucopogon</i> sp. <i>Yanchep</i> (M. Hislop 1986)		P3	
70.	34736 <i>Lysinema pentapetalum</i>			
Euphorbiaceae				
71.	4636 <i>Euphorbia paralias</i> (Sea Spurge)	Y		
72.	4648 <i>Euphorbia terracina</i> (Geraldton Carnation Weed)	Y		
Fabaceae				
73.	3262 <i>Acacia cochlearis</i> (Rigid Wattle)			
74.	11611 <i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>			
75.	3525 <i>Acacia rostellifera</i> (Summer-scented Wattle)			
76.	30032 <i>Acacia saligna</i> subsp. <i>saligna</i>			
77.	20482 <i>Gastrolobium nervosum</i>			
78.	3957 <i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
79.	3968 <i>Hovea trisperma</i> (Common Hovea)			
80.	14783 <i>Jacksonia calcicola</i>			
81.	4012 <i>Jacksonia furcellata</i> (Grey Stinkwood)			
82.	4042 <i>Kennedia nigricans</i> (Black Kennedia)			
83.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
84.	4256 <i>Templetonia retusa</i> (Cockies Tongues)			
85.	4292 <i>Trifolium campestre</i> (Hop Clover)	Y		
86.	4309 <i>Trifolium scabrum</i> (Rough Clover)	Y		
Gentianaceae				
87.	17800 <i>Centaurium pulchellum</i>	Y		
Geraniaceae				
88.	4339 <i>Geranium molle</i> (Dove's Foot Cranesbill)	Y		
Goodeniaceae				
89.	7606 <i>Scaevola crassifolia</i> (Thick-leaved Fan-flower)			
90.	7614 <i>Scaevola globulifera</i>			
91.	7626 <i>Scaevola nitida</i> (Shining Fanflower)			
92.	13181 <i>Scaevola repens</i> var. <i>angustifolia</i>			
93.	7647 <i>Scaevola thesioides</i>			
94.	13152 <i>Scaevola thesioides</i> subsp. <i>thesioides</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Haemodoraceae				
95.	11261 <i>Anigozanthos manglesii</i> subsp. <i>manglesii</i>			
96.	12027 <i>Conostylis candicans</i> subsp. <i>calcicola</i>			
Hemerocallidaceae				
97.	1260 <i>Stypandra glauca</i> (<i>Blind Grass</i>)			
98.	1361 <i>Tricoryne elatior</i> (<i>Yellow Autumn Lily</i>)			
Iridaceae				
99.	19179 <i>Moraea flaccida</i> (<i>One-leaf Cape Tulip</i>)	Y		
100.	1552 <i>Patersonia rudis</i> (<i>Hairy Flag</i>)			
101.	11544 <i>Romulea rosea</i> var. <i>australis</i> (<i>Guildford Grass</i>)	Y		
Lamiaceae				
102.	16933 <i>Hemiandra glabra</i>			
103.	38320 <i>Hemiandra</i> sp. <i>Jurien</i> (B.J. Conn & M.E. Tozer BJC 3885)			
104.	6939 <i>Westringia dampieri</i>			
Lauraceae				
105.	2956 <i>Cassytha pomiformis</i> (<i>Dodder Laurel</i>)			
106.	2957 <i>Cassytha racemosa</i> (<i>Dodder Laurel</i>)			
Loranthaceae				
107.	2401 <i>Nuytsia floribunda</i> (<i>Christmas Tree, Mudja</i>)			
Malvaceae				
108.	4906 <i>Alyogyne huegelii</i> (<i>Lilac Hibiscus</i>)			
109.	5011 <i>Guichenotia ledifolia</i>			
110.	5077 <i>Thomasia cognata</i>			
111.	5105 <i>Thomasia triphylla</i>			
Myrtaceae				
112.	13091 <i>Eucalyptus argutifolia</i> (<i>Wabling Hill Mallee</i>)		T	
113.	5649 <i>Eucalyptus foecunda</i> (<i>Narrow-leaved Red Mallee</i>)			
114.	13541 <i>Eucalyptus petrensis</i>			
115.	5887 <i>Melaleuca cardiophylla</i> (<i>Tangling Melaleuca</i>)			
116.	5922 <i>Melaleuca lanceolata</i> (<i>Rottnest Teatree, Moonah</i>)			
117.	18598 <i>Melaleuca systema</i>			
118.	6101 <i>Verticordia nitens</i> (<i>Morrison Featherflower, Kodjeningara</i>)			
Olacaceae				
119.	2365 <i>Olx benthamiana</i>			
Onagraceae				
120.	20052 <i>Oenothera jamesii</i>	Y		
Orchidaceae				
121.	1599 <i>Caladenia latifolia</i> (<i>Pink Fairy Orchid</i>)			
122.	1635 <i>Diuris longifolia</i> (<i>Common Donkey Orchid</i>)			
123.	15418 <i>Leptoceras menziesii</i>			
124.	15425 <i>Prasophyllum calcicola</i>			
125.	11118 <i>Pterostylis pyramidalis</i> (<i>Snail Orchid</i>)			
Orobanchaceae				
126.	7122 <i>Orobanche minor</i> (<i>Lesser Broomrape</i>)	Y		
127.	7089 <i>Parentucellia latifolia</i> (<i>Common Bartsia</i>)	Y		
Oxalidaceae				
128.	30375 <i>Oxalis exilis</i>			
Papaveraceae				
129.	31532 <i>Fumaria muralis</i> subsp. <i>muralis</i>	Y		
Phyllanthaceae				
130.	4675 <i>Phyllanthus calycinus</i> (<i>False Boronia</i>)			
Plantaginaceae				
131.	7303 <i>Plantago lanceolata</i> (<i>Ribwort Plantain</i>)	Y		
132.	7109 <i>Veronica calycina</i> (<i>Cup Speedwell</i>)			
Plocamiaceae				
133.	27156 <i>Plocamium mertensii</i>			
Poaceae				
134.	247 <i>Bromus arenarius</i> (<i>Sand Brome</i>)			
135.	249 <i>Bromus diandrus</i> (<i>Great Brome</i>)	Y		
136.	467 <i>Lagurus ovatus</i> (<i>Hare's Tail Grass</i>)	Y		
137.	10970 <i>Rostraria cristata</i>	Y		

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
138.	625 <i>Spinifex longifolius</i> (Beach Spinifex)			
Polygalaceae				
139.	4552 <i>Comesperma confertum</i>			
140.	4555 <i>Comesperma integerrimum</i>			
141.	4564 <i>Comesperma virgatum</i> (Milkwort)			
Portulacaceae				
142.	40827 <i>Calandrinia tholiformis</i>			
Proteaceae				
143.	1842 <i>Banksia prionotes</i> (Acorn Banksia)			
144.	15607 <i>Conospermum acerosum</i> subsp. <i>acerosum</i>			
145.	1885 <i>Conospermum triplinervium</i> (Tree Smokebush)			
146.	2146 <i>Hakea costata</i> (Ribbed Hakea)			
147.	2175 <i>Hakea lissocarpha</i> (Honey Bush)			
148.	2214 <i>Hakea trifurcata</i> (Two-leaf Hakea)			
Ranunculaceae				
149.	10804 <i>Clematis linearifolia</i>			
150.	2932 <i>Ranunculus colonorum</i> (Common Buttercup)			
Restionaceae				
151.	1056 <i>Alexgeorgea nitens</i>			
152.	17663 <i>Desmocladus asper</i>			
153.	16595 <i>Desmocladus flexuosus</i>			
Rhamnaceae				
154.	4802 <i>Cryptandra mutila</i>			
155.	4809 <i>Cryptandra pungens</i>			
156.	4828 <i>Spyridium globulosum</i> (Basket Bush)			
157.	11665 <i>Trymalium ledifolium</i> var. <i>ledifolium</i>			
Rhodomelaceae				
158.	26689 <i>Coeloclonium umbellula</i>			
159.	26752 <i>Dasyclonium incisum</i>			
160.	27013 <i>Lenormandia spectabilis</i>			
Rubiaceae				
161.	7323 <i>Galium murale</i> (Small Goosegrass)	Y		
162.	18255 <i>Opercularia vaginata</i> (Dog Weed)			
Santalaceae				
163.	10765 <i>Exocarpos sparteus</i> (Broom Ballart, Djuk)			
164.	2344 <i>Leptomeria empetriformis</i>			
Scrophulariaceae				
165.	7289 <i>Myoporum caprarioides</i> (Slender Myoporum)			
166.	7291 <i>Myoporum insulare</i> (Blueberry Tree, boobialla)			
Solanaceae				
167.	11725 <i>Anthocercis ilicifolia</i> subsp. <i>ilicifolia</i>			
168.	6949 <i>Anthocercis littorea</i> (Yellow Tailflower)			
169.	7020 <i>Solanum linnaeanum</i> (Apple of Sodom)	Y		
Stylidiaceae				
170.	7710 <i>Stylidium cygnorum</i>			
171.	13127 <i>Stylidium maritimum</i>		P3	
Tamaricaceae				
172.	15741 <i>Tamarix aphylla</i> (Athel Tree)	Y		
Thymelaeaceae				
173.	5243 <i>Pimelea ferruginea</i>			
Ulvaceae				
174.	27352 <i>Ulva lactuca</i>			
Urticaceae				
175.	1762 <i>Parietaria debilis</i> (Pellitory)			
Violaceae				
176.	5216 <i>Hybanthus calycinus</i> (Wild Violet)			

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

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
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3 - Priority 3
4 - Priority 4
5 - Priority 5

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

Appendix 3
Photographic record of site and
vegetation types



Plate 1: VT1 – *Olearia axillaris*, *Atriplex isatidea*, *Spinifex hirsutus*, **Cakile maritima* and **Thinopyrum distichum* low shrubland on sandy soils

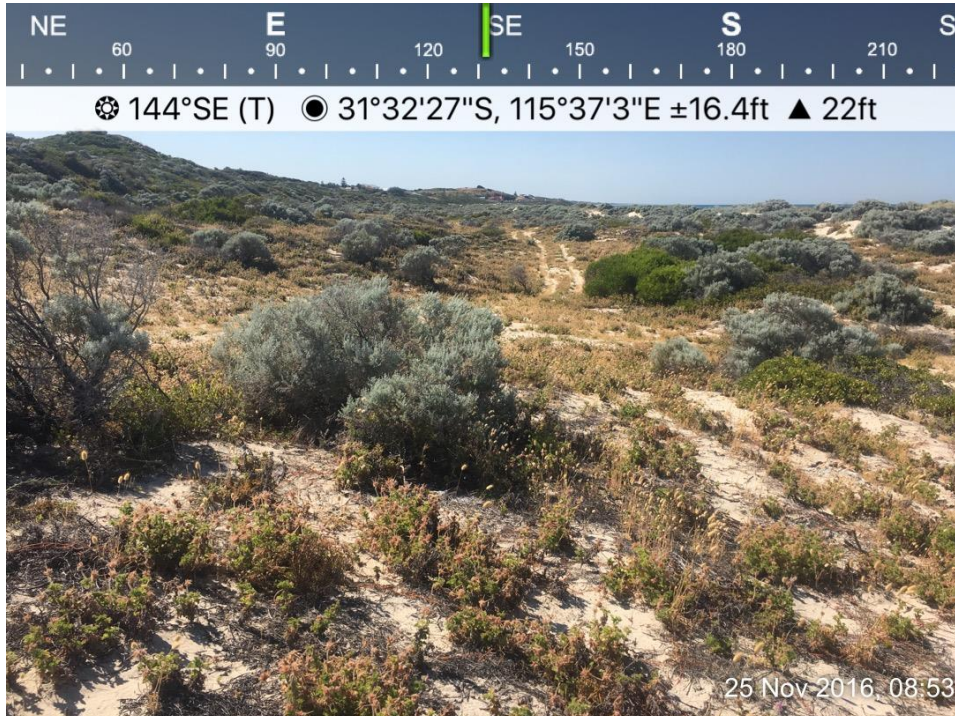


Plate 2: VT2 – *Olearia axillaris*, *Acacia rostellifera*, *Rhagodia baccata* and *Scaevola crassifolia* heath over *Spinifex longifolia*, *Acanthocarpus preissii*, *Cassytha flava*, **Pelargonium capitatum* and exotic grasses including on sandy soils



Plate 3: VT3 – *Scaevola crassifolia*, *Olearia axillaris*, *Acacia rostelifera*, and *Spyridium globulosum* heath on dune crests and *Lepidosperma gladiatum* closed heath in dune swales over *Acanthocarpus preissii*, **Pelargonium capitatum* **Arctotis stoechadifolia* and exotic grasses on sandy soils



Plate 4: VT4 – *Olearia axillaris*, *Scaevola crassifolia*, *Acacia rostelifera* and *Acacia truncata* heath with emergent *Agonis flexuosa* over *Acanthocarpus preissii*, *Spinifex hirsutus*, **Pelargonium capitatum*, and exotic grasses on sandy soils



Plate 5: VT5 – *Allocuarina humilis* and *Spyridium globulosum* mid shrubland over *Rhagodia baccata*, *Olearia axillaris* and *Scaevola crassifolia* heath on dune crests over *Lepidosperma gladiatum* closed heath in dune swales over *Acanthocarpus preissii*, *Cassytha flava* and **Pelargonium capitatum* on sandy soils.



Plate 6: Planted **Schinus terebinthifolius*

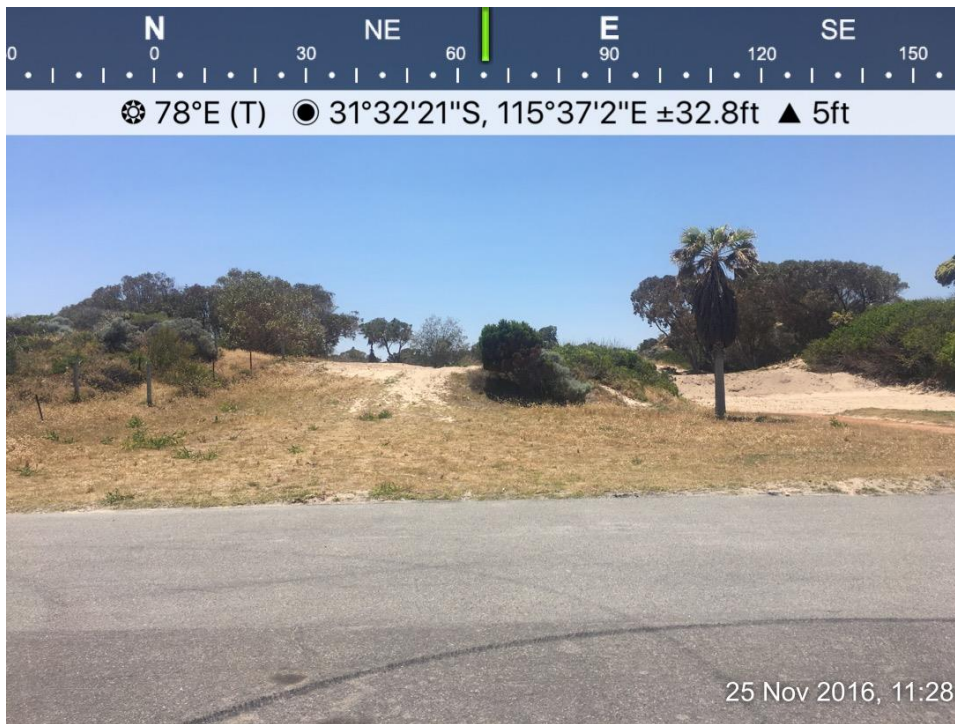


Plate 7: Cleared areas and planted palm

Appendix 4
Vascular plant taxa recorded from
quadrats within the survey area

Family	Taxa
Aizoaceae	<i>Carpobrotus virescens</i>
Anacardiaceae	* <i>Schinus terebinthifolius</i>
Arecaceae	* <i>Phoenix</i> sp.
Asparagaceae	<i>Acanthocarpus preissii</i>
	<i>Lomandra maritima</i>
Asphodelaceae	* <i>Trachyandra divaricata</i>
Asteraceae	* <i>Arctotis stoechadifolia</i>
	<i>Olearia axillaris</i>
	<i>Senecio pinnatifolius</i>
	* <i>Sonchus oleraceus</i>
	<i>Waitzia suaveolens</i> var. <i>suaveolens</i>
Brassicaceae	* <i>Brassica tournefortii</i>
	* <i>Cakile maritima</i>
	* <i>Raphanus raphanistrum</i>
Casuarinaceae	<i>Allocasuarina humilis</i>
	<i>Casuarina</i> sp.
Crassulaceae	* <i>Crassula glomerata</i>
Chenopodiaceae	<i>Atriplex isatidea</i>
	<i>Atriplex cinerea</i>
	<i>Rhagodia baccata</i>
	<i>Salsola australis</i>
	<i>Threlkeldia diffusa</i>
Cupressaceae	<i>Callitris preissii</i>
Cyperaceae	<i>Ficinia nodosa</i>
	<i>Lepidosperma gladiatum</i>
	<i>Sporobolus virginicus</i>
Ericaceae	<i>Leucopogon parviflorus</i>
Fabaceae	<i>Acacia cyclops</i>
	<i>Acacia rostellifera</i>
	<i>Acacia truncata</i>
	<i>Hardenbergia comptoniana</i>
	* <i>Trifolium arvense</i>
Geraniaceae	* <i>Pelargonium capitatum</i>
Goodeniaceae	<i>Scaevola crassifolia</i>
	<i>Lechenaultia linarioides</i>
Haemodoraceae	<i>Conostylis candicans</i>
Hemerocallidaceae	<i>Dianella revoluta</i>
Lauraceae	<i>Cassytha flava</i>
Myrtaceae	<i>Agonis flexuosa</i>
	<i>Eucalyptus gomphocephala</i>
	<i>Melaleuca nesophila</i>

Family	Taxa
	<i>Melaleuca systema</i>
	<i>Scholtzia involucrata</i>
Poaceae	* <i>Avena barbata</i>
	* <i>Bromus diandrus</i>
	* <i>Cynodon dactylon</i>
	* <i>Ehrharta calycina</i>
	* <i>Lagurus ovatus</i>
	<i>Poa poiformis</i>
	<i>Spinifex hirsutus</i>
	<i>Spinifex longifolia</i>
	* <i>Thinopyrum distichum</i>
Rhamnaceae	<i>Spyridium globulosum</i>
Santalaceae	<i>Exocarpos sparteus</i>
	<i>Santalum acuminatum</i>
Thymelaeaceae	<i>Pimelea</i> sp.
Scrophulariaceae	<i>Myoporum insulare</i>

Appendix 5
Supplementary flora and vegetation
survey

To: Jarrod Rendell

Date: 5 October 2017

Company: Acumen Development Solutions

Project No: ADS16585.01

Fax/email: jarrod@acumends.com.au

Inquiries: Carli Turner

Capricorn foreshore reserve Supplementary flora and vegetation surveys

Background

Capricorn Village Joint Venture (CVJV) is proposing to develop the Capricorn Coastal Village and Coastal Node, located in Yanchep, Western Australia, approximately 51 km north-northwest of the Perth Central Business District (CBD). The Capricorn Coastal Village and Coastal Node (the Project), incorporates Part Lot 312 and Lots 2, 303 and 304, Two Rocks Road, Yanchep, in the City of Wanneroo (CoW, Figure 1).

The foreshore reserve provides a link between the Indian Ocean and urban development and as such provides opportunity for both conservation and development purposes. The proposed foreshore development will require clearing of native vegetation and as such, a flora and vegetation survey was deemed necessary to determine the environmental values of the proposed clearing area. The original survey area was designed based on the draft Coastal Node concept plan, focussing on areas of proposed disturbance and a buffer area (Figure 1). The balance of the foreshore reserve (comprising the 2017 survey area; Figure 1) was traversed to confirm broad vegetation types on 23 May 2017, and was subject to a detailed Spring survey on 3 October 2017.

This memo presents the findings of a flora and vegetation survey to be supplemented to a Level 2 flora and vegetation survey conducted within the Project area on 25 November 2016. The supplementary survey was undertaken within the southern portion of the foreshore reserve; to the south of the 2016 survey area, including detailed quadrat analysis to support the proposed development of the Capricorn foreshore reserve that forms part of the Coastal Village and Coastal Node, Yanchep (the survey area; Figure 1).

This flora and vegetation assessment will support the Foreshore Management Plan for the proposed foreshore development.



Figure 1: The survey area

Scale 1:6,500 at A4



Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 6/10/2017

Author: JCrute

Source: Aerial image: nearmap, flown 01/2017. Existing cadastre: SLIP, Landgate 2017. Master plan: Client 03/2017.

Legend

- Survey area 2017
- Survey area 2016
- Existing cadastre



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Methods

The field survey was conducted according to standards set out in Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). The assessment of flora and vegetation within the survey area was undertaken by one ecologist on 23 May 2017 and one botanist on 3 October 2017 from Strategen. Table 1 identifies the staff involved in the field surveys, their role and qualifications. The survey area was traversed on foot to record changes in vegetation structure and type, with four vegetation quadrats surveyed in May 2017 with an additional six vegetation quadrats surveyed in the Spring October 2017 survey, with two quadrats being placed in each of the three vegetation types occurring in the survey area.

Table 1: Personnel

Name	Role
Ms. C. Courtauld Strategen (Ecologist)	Planning, fieldwork, plant identification, data interpretation and report preparation.
Ms. A. Dalton Strategen (Botanist)	Fieldwork, plant identification, data interpretation and report preparation.

Site selection for vegetation mapping was based on differences in structure and species composition of the communities present within the survey area. Vegetation mapping sites were determined from aerial photographs. The survey area was traversed on foot, allowing for opportunistic sites to be placed where a change in vegetation structure or composition was observed.

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

- GPS location
- topography
- soil type and colour
- outcropping rocks and their type
- percentage cover and average height of each vegetation stratum.

For each vascular plant species, the average height, number of plants and percent cover were recorded.

The entire survey area was traversed to record the density of weed species. The GPS locations and population of each weed species were recorded.

All plant specimens collected during the field surveys were identified using appropriate reference material or through comparisons with pressed specimens housed at the Western Australian Herbarium where necessary. Nomenclature of the species recorded is in accordance with Western Australian Herbarium (1998-).

Results

Native flora

A total of 56 native vascular plant taxa from 50 plant genera and 25 plant families were recorded within the survey area. The majority of the taxa were recorded within the Poaceae (8 taxa) and Asteraceae (6 taxa) families (Table 2). The flora species recorded in the survey area were consistent with the 2016 survey.

Table 2: Flora taxa recorded during the 2017 survey

Family	Species
Aizoaceae	<i>Carpobrotus virescens</i>
	* <i>Tetragonia decumbens</i>
Araliaceae	<i>Trachymene pilosa</i>
Asparagaceae	<i>Acanthocarpus preissii</i>
	<i>Lomandra maritima</i>
Asphodelaceae	* <i>Trachyandra divaricata</i>
Asteraceae	* <i>Arctotheca calendula</i>
	* <i>Arctotis stoechadifolia</i>
	<i>Olearia axillaris</i>
	<i>Pithocarpa cordata</i>
	<i>Senecio pinnatifolius</i>
	* <i>Sonchus oleraceus</i>
Brassicaceae	* <i>Brassica tournefortii</i>
	* <i>Cakile maritima</i>
	<i>Raphanus raphanistrum</i>
Chenopodiaceae	<i>Atriplex cinerea</i>
	<i>Atriplex isatidea</i>
	<i>Rhagodia baccata</i>
	<i>Salsola australis</i>
	<i>Threlkeldia diffusa</i>
Crassulaceae	<i>Crassula glomerata</i>
Cupressaceae	<i>Callitris preissii</i>
Cyperaceae	<i>Ficinia nodosa</i>
	<i>Lepidosperma gladiatum</i>
	<i>Sporobolus virginicus</i>
Cupressaceae	<i>Callitris preissii</i>
Fabaceae	<i>Acacia lasiocarpa</i>
	<i>Acacia rostellifera</i>
	<i>Acacia truncata</i>
	<i>Hardenbergia comptoniana</i>
	* <i>Lupinus angustifolius</i>
Geraniaceae	* <i>Pelargonium capitatum</i>
Goodeniaceae	<i>Hibbertia subvaginata</i>
	<i>Scaevola crassifolia</i>
	<i>Scaevola nitida</i>
Haemodoraceae	<i>Conostylis candicans</i>
Lauraceae	<i>Cassytha flava</i>
Myrtaceae	* <i>Leptospermum laevigatum</i>
	<i>Melaleuca systema</i>
	<i>Scholtzia involucrata</i>
Onagraceae	* <i>Oenothera drummondii</i>
Oxalidaceae	* <i>Oxalis exilis</i>
Poaceae	* <i>Avena barbata</i>

Family	Species
	<i>*Bromus diandrus</i>
	<i>*Ehrharta calycina</i>
	<i>*Lagurus ovatus</i>
	<i>*Poaceae poiformis</i>
	<i>Spinifex hirsutus</i>
	<i>Spinifex longifolius</i>
	<i>*Thinopyrum distichum</i>
Ranunculaceae	<i>Clematis linearifolia</i>
Rhamnaceae	<i>Spyridium globulosum</i>
Santalaceae	<i>Exocarpos sparteus</i>
	<i>Santalum acuminatum</i>
Scrophulariaceae	<i>Myoporum insulare</i>

Threatened and Priority flora

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey area at the time of assessment. The survey was conducted during the prime flowering time for these conservation significant species (spring), with no rare flora being observed in spring 2016 or 2017 and therefore it is unlikely that Threatened or Priority flora are likely to occur within the survey area.

Introduced (exotic) taxa

A total of 18 introduced (exotic) taxa were recorded within the survey area (Table 2). None of these species are Declared Plant species in Western Australia pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2016). The density of introduced taxa in the survey area is displayed in Figure 2.

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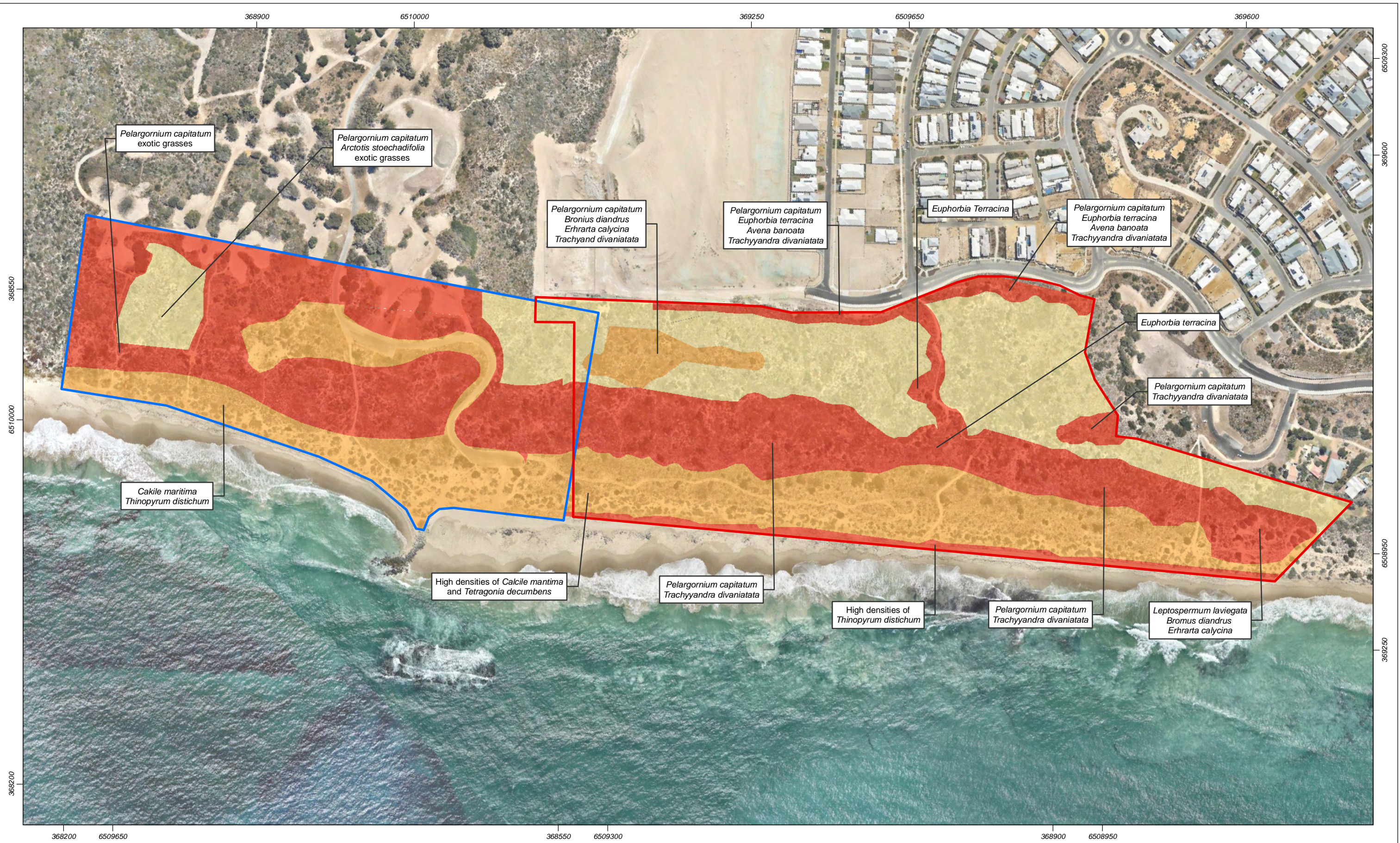


Figure 2: High level weed mapping

* 2016 area inferred

Scale 1:3,500 at A3
 0 35 70 105 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 6/10/2017
 Author: JCrute
 Source: Topography: Geoscience Australia 2011.
 Path: Q:\Consult\2017\ADS\ADS17225\ArcMap_documents\ADS17225_G002_RevA.mxd

Legend

- 2016 survey area
- 2017 Survey area
- Weed mapping density**
- High
- Medium
- Low

Weed density	Cover
Low	< 5%
Medium	6 - 75 %
High	76 - 100 %

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Vegetation types

Four native vegetation types (VTs) were previously defined and mapped within the survey area in 2016 (Strategen 2016). The survey area comprised VTs 1, 2, and 3 and cleared areas as summarised in Table 3. All VTs recorded in the 2017 survey area were recorded in the 2016 survey area, except for VT 4 (*Olearia axillaris*, *Scaevola crassifolia*, *Acacia rostellifera*, *Acacia truncata* heath with emergent *Agonis flexuosa* over *Acanthocarpus preissii*, *Spinifex hirsutus*, **Pelargonium capitatum*, and exotic grasses on sandy soils), comprising only 0.19 ha of the 2016 survey area. Areas containing vegetation in a highly degraded state were not counted as unique native VTs but have been included in Table 3 for area calculation purposes. Total areas occupied within the survey area by each of the identified VTs are set out in Table 4.

Table 3: Vegetation Types

Vegetation Type	Description
1	<i>Olearia axillaris</i> , <i>Atriplex isatidea</i> , <i>Spinifex hirsutus</i> , * <i>Cakile maritima</i> and * <i>Thinopyrum distichum</i> low shrubland on sandy soils.
2	<i>Olearia axillaris</i> , <i>Acacia rostellifera</i> , <i>Rhagodia baccata</i> and <i>Scaevola crassifolia</i> heath over <i>Spinifex longifolius</i> , <i>Acanthocarpus preissii</i> , <i>Cassutha flava</i> , * <i>Pelargonium capitatum</i> and exotic grasses including on sandy soils.
3	<i>Scaevola crassifolia</i> , <i>Olearia axillaris</i> , <i>Acacia rostellifera</i> , and <i>Spyridium globulosum</i> heath on dune crests and <i>Lepidosperma gladiatum</i> closed heath in dune swales over <i>Acanthocarpus preissii</i> , * <i>Pelargonium capitatum</i> * <i>Arctotis stoechadifolia</i> and exotic grasses on sandy soils.
C	Cleared areas.

Vegetation type coverage

The total area mapped within the survey area was 14.46 ha which includes highly degraded and fully cleared areas (Table 4). The dominant native VT within the survey area was VT 3 which can be described as a *Scaevola crassifolia*, *Olearia axillaris*, *Acacia rostellifera*, and *Spyridium globulosum* heath on dune crests and *Lepidosperma gladiatum* closed heath in dune swales over *Acanthocarpus preissii*, **Pelargonium capitatum* **Arctotis stoechadifolia* and exotic grasses on sandy soils.

Table 4: Area (ha) covered by each VT within the survey area

VT	Area (ha)	Percentage of the Survey area
1	2.13	14.73
2	3.81	26.35
3	8.33	57.61
Cleared	0.19	1.31
TOTAL	14.46	100

Vegetation condition

The survey area shows signs of having been degraded for a long period of time due to the widespread extent of weeds and human disturbance (e.g. trampling of dune vegetation and use of vehicle tracks for beach access). Other disturbances included the presence of rabbits, with rabbit droppings being found in the survey area. As such, vegetation condition within the survey ranged from Completely Degraded to Very Good and generally aligned with the VT boundaries (Keighery 1994; Figure 4; Table 5). Much of VT 2 is dominated by the weed species **Pelargonium capitatum* which may be a result of degradation caused by vehicle tracks which run through much of this vegetation type.

Table 6 gives a numerical breakdown of the area occupied by each vegetation condition rating within the survey area.

Table 5: 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.

Table 6: Area (ha) covered by each vegetation condition category within the survey area

Vegetation Condition	Area (ha)	Percentage of the Survey area
Very Good	8.33	57.61
Good to Very Good	3.81	26.35
Good	2.13	14.73
Completely degraded	0.19	1.31
Total	14.46	100

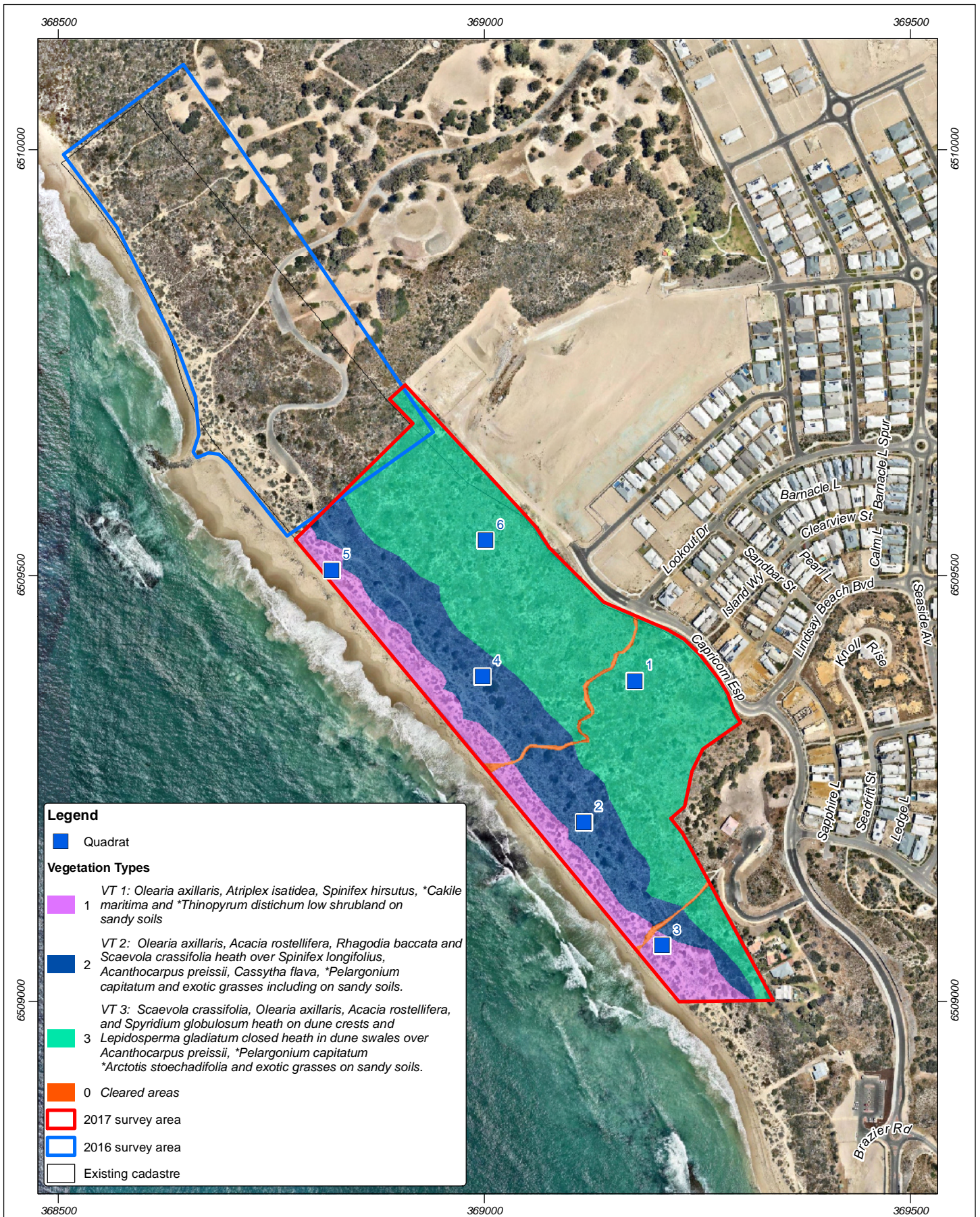


Figure 3: Vegetation Types (VTs) mapped within the survey area

Scale 1:6,000 at A4



Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 6/10/2017

Author: JCrute

Source: Aerial image: nearmap, flown 01/2017. Existing cadastre: SLIP, Landgate 2017. Master plan: Client 03/2017.

Path: Q:\Consult\2017\ADS\ADS17225\ArcMap_documents\ADS17225_G001_RevA.mxd

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Figure 4: Vegetation condition mapped within the survey area

Scale 1:6,000 at A4



Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas

Date: 6/10/2017

Author: JCrute

Source: Nearmap: Aerial 2017.

Legend

- | | | | | | |
|--|-------------------|-----------------------------|----------------|------|---------------------|
| | 2017 survey area | Vegetation condition | | Good | |
| | 2016 survey area | | Very Good | | Completely degraded |
| | Existing cadastre | | Good-Very Good | | |



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Threatened and Priority ecological communities

As recorded within the 2016 report (Strategen 2016), the vegetation within the survey area did not resemble a known TEC, however it contains two Priority 3 PECs (FCT 29a – *Coastal Shrublands on shallow sands*, FCT 29b – *Acacia Shrublands on taller dunes*) based on dominant taxa recorded, the known vegetation complex within the survey area and previous survey results.

Discussion

Vegetation within the survey area comprises three VTs and cleared areas and was overall consistent with the 2016 vegetation mapping (Strategen 2016). Transitions between VTs were generally discontinuous, though occasionally abrupt with margins representing admixtures of more than one VT. This discontinuity is primarily due to changes in soil profile and topography. Vegetation condition generally aligned with the VT boundaries and at a broad scale, the majority of the survey area was observed to be in various states of degradation due to coastal erosion and historical clearing within the survey area. The remnant vegetation shows signs of degradation and structural alteration particularly where the beach access tracks are located.

A total of 56 native vascular plant taxa from 50 plant genera and 25 plant families, along with 18 introduced species were recorded within the survey area. No Declared Plant species pursuant to section 22 of the BAM Act were recorded within the survey area (DAFWA 2016).

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey area.

Approximately 14.46 ha of vegetation ranging from Completely Degraded to Very Good condition was recorded within the survey area.

The vegetation within the survey area did not resemble a known TEC. Whilst two Priority 3 PECs (FCT 29a – *Coastal Shrublands on shallow sands*, FCT 29b – *Acacia Shrublands on taller dunes*) may occur in the survey area, these FCTs are very well represented within surrounding Bush Forever Site 397: *Coastal Strip from Wilbinga to Mindarie* which is under existing protection. Furthermore, these VTs will be retained within the foreshore reserve, subject to protection and management measures detailed in the Foreshore Management Plan.

Conclusion

The Level 2 flora and vegetation survey (conducted May and October 2017) has been successful in collecting data to define and assess the presence, extent and significance of vegetation types within the survey area.

This flora and vegetation assessment will support the Foreshore Management Plan for the proposed foreshore development which aligns with the *CoW Local Biodiversity Strategy* (2011) and the *CoW Coastal Management Plan* (CoW 2012) for the Capricorn coastal region.

References

Department of Agriculture and Food (DAFWA) 2017, *Declared Pests (s22) list*, [Online], Government of Western Australia, Available from: <http://www.biosecurity.wa.gov.au/organisms/export/PER-DP> [May 2017].

Environmental Protection Authority (EPA) 2016, *Technical Guidance (in accordance with the Environmental Protection Act 1986) – Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia*. Government of Western Australia, Perth.

Keighery B 1994, *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*, Wildflower Society, Floreat.

Strategen 2016, *Capricorn Foreshore Reserve flora and vegetation survey*, Prepared for Acumen Development Solutions, Perth WA.

Western Australian Herbarium 1998-, *FloraBase – the Western Australian Flora*, [Online], Government of Western Australia, Available from: <http://florabase.dpaw.wa.gov.au/> [May 2017].

To: Jarrod Rendell

Date: 5 October 2017

Company: Acumen Development Solutions

Project No: ADS16585.01

Fax/email: jarrod@acumends.com.au

Inquiries: Carli Turner

Capricorn foreshore reserve Supplementary flora and vegetation surveys

Background

Capricorn Village Joint Venture (CVJV) is proposing to develop the Capricorn Coastal Village and Coastal Node, located in Yanchep, Western Australia, approximately 51 km north-northwest of the Perth Central Business District (CBD). The Capricorn Coastal Village and Coastal Node (the Project), incorporates Part Lot 312 and Lots 2, 303 and 304, Two Rocks Road, Yanchep, in the City of Wanneroo (CoW, Figure 1).

The foreshore reserve provides a link between the Indian Ocean and urban development and as such provides opportunity for both conservation and development purposes. The proposed foreshore development will require clearing of native vegetation and as such, a flora and vegetation survey was deemed necessary to determine the environmental values of the proposed clearing area. The original survey area was designed based on the draft Coastal Node concept plan, focussing on areas of proposed disturbance and a buffer area (Figure 1). The balance of the foreshore reserve (comprising the 2017 survey area; Figure 1) was traversed to confirm broad vegetation types on 23 May 2017, and was subject to a detailed Spring survey on 3 October 2017.

This memo presents the findings of a flora and vegetation survey to be supplemented to a Level 2 flora and vegetation survey conducted within the Project area on 25 November 2016. The supplementary survey was undertaken within the southern portion of the foreshore reserve; to the south of the 2016 survey area, including detailed quadrat analysis to support the proposed development of the Capricorn foreshore reserve that forms part of the Coastal Village and Coastal Node, Yanchep (the survey area; Figure 1).

This flora and vegetation assessment will support the Foreshore Management Plan for the proposed foreshore development.



Figure 1: The survey area

Scale 1:6,500 at A4



Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 6/10/2017

Author: JCrute

Source: Aerial image: nearmap, flown 01/2017. Existing cadastre: SLIP, Landgate 2017. Master plan: Client 03/2017.

Legend

- Survey area 2017
- Survey area 2016
- Existing cadastre



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Methods

The field survey was conducted according to standards set out in Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). The assessment of flora and vegetation within the survey area was undertaken by one ecologist on 23 May 2017 and one botanist on 3 October 2017 from Strategen. Table 1 identifies the staff involved in the field surveys, their role and qualifications. The survey area was traversed on foot to record changes in vegetation structure and type, with four vegetation quadrats surveyed in May 2017 with an additional six vegetation quadrats surveyed in the Spring October 2017 survey, with two quadrats being placed in each of the three vegetation types occurring in the survey area.

Table 1: Personnel

Name	Role
Ms. C. Courtauld Strategen (Ecologist)	Planning, fieldwork, plant identification, data interpretation and report preparation.
Ms. A. Dalton Strategen (Botanist)	Fieldwork, plant identification, data interpretation and report preparation.

Site selection for vegetation mapping was based on differences in structure and species composition of the communities present within the survey area. Vegetation mapping sites were determined from aerial photographs. The survey area was traversed on foot, allowing for opportunistic sites to be placed where a change in vegetation structure or composition was observed.

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

- GPS location
- topography
- soil type and colour
- outcropping rocks and their type
- percentage cover and average height of each vegetation stratum.

For each vascular plant species, the average height, number of plants and percent cover were recorded.

The entire survey area was traversed to record the density of weed species. The GPS locations and population of each weed species were recorded.

All plant specimens collected during the field surveys were identified using appropriate reference material or through comparisons with pressed specimens housed at the Western Australian Herbarium where necessary. Nomenclature of the species recorded is in accordance with Western Australian Herbarium (1998-).

Results

Native flora

A total of 56 native vascular plant taxa from 50 plant genera and 25 plant families were recorded within the survey area. The majority of the taxa were recorded within the Poaceae (8 taxa) and Asteraceae (6 taxa) families (Table 2). The flora species recorded in the survey area were consistent with the 2016 survey.

Table 2: Flora taxa recorded during the 2017 survey

Family	Species
Aizoaceae	<i>Carpobrotus virescens</i>
	* <i>Tetragonia decumbens</i>
Araliaceae	<i>Trachymene pilosa</i>
Asparagaceae	<i>Acanthocarpus preissii</i>
	<i>Lomandra maritima</i>
Asphodelaceae	* <i>Trachyandra divaricata</i>
Asteraceae	* <i>Arctotheca calendula</i>
	* <i>Arctotis stoechadifolia</i>
	<i>Olearia axillaris</i>
	<i>Pithocarpa cordata</i>
	<i>Senecio pinnatifolius</i>
	* <i>Sonchus oleraceus</i>
Brassicaceae	* <i>Brassica tournefortii</i>
	* <i>Cakile maritima</i>
	<i>Raphanus raphanistrum</i>
Chenopodiaceae	<i>Atriplex cinerea</i>
	<i>Atriplex isatidea</i>
	<i>Rhagodia baccata</i>
	<i>Salsola australis</i>
	<i>Threlkeldia diffusa</i>
Crassulaceae	<i>Crassula glomerata</i>
Cupressaceae	<i>Callitris preissii</i>
Cyperaceae	<i>Ficinia nodosa</i>
	<i>Lepidosperma gladiatum</i>
	<i>Sporobolus virginicus</i>
Cupressaceae	<i>Callitris preissii</i>
Fabaceae	<i>Acacia lasiocarpa</i>
	<i>Acacia rostellifera</i>
	<i>Acacia truncata</i>
	<i>Hardenbergia comptoniana</i>
	* <i>Lupinus angustifolius</i>
Geraniaceae	* <i>Pelargonium capitatum</i>
Goodeniaceae	<i>Hibbertia subvaginata</i>
	<i>Scaevola crassifolia</i>
	<i>Scaevola nitida</i>
Haemodoraceae	<i>Conostylis candicans</i>
Lauraceae	<i>Cassytha flava</i>
Myrtaceae	* <i>Leptospermum laevigatum</i>
	<i>Melaleuca systema</i>
	<i>Scholtzia involucrata</i>
Onagraceae	* <i>Oenothera drummondii</i>
Oxalidaceae	* <i>Oxalis exilis</i>
Poaceae	* <i>Avena barbata</i>

Family	Species
	<i>*Bromus diandrus</i>
	<i>*Ehrharta calycina</i>
	<i>*Lagurus ovatus</i>
	<i>*Poaceae poiformis</i>
	<i>Spinifex hirsutus</i>
	<i>Spinifex longifolius</i>
	<i>*Thinopyrum distichum</i>
Ranunculaceae	<i>Clematis linearifolia</i>
Rhamnaceae	<i>Spyridium globulosum</i>
Santalaceae	<i>Exocarpos sparteus</i>
	<i>Santalum acuminatum</i>
Scrophulariaceae	<i>Myoporum insulare</i>

Threatened and Priority flora

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey area at the time of assessment. The survey was conducted during the prime flowering time for these conservation significant species (spring), with no rare flora being observed in spring 2016 or 2017 and therefore it is unlikely that Threatened or Priority flora are likely to occur within the survey area.

Introduced (exotic) taxa

A total of 18 introduced (exotic) taxa were recorded within the survey area (Table 2). None of these species are Declared Plant species in Western Australia pursuant to section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2016). The density of introduced taxa in the survey area is displayed in Figure 2.

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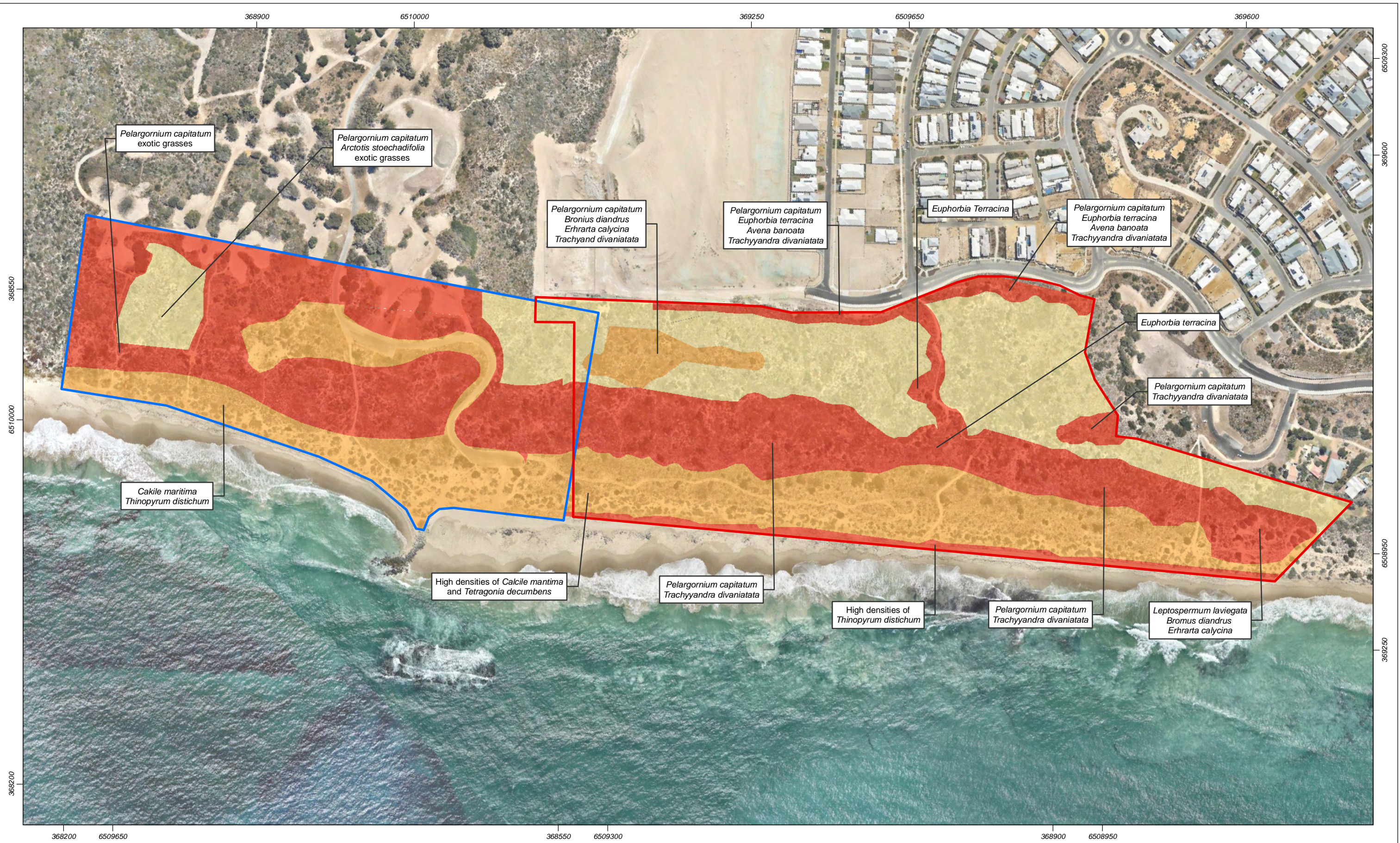


Figure 2: High level weed mapping

* 2016 area inferred

Scale 1:3,500 at A3
 0 35 70 105 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 6/10/2017
 Author: JCrute
 Source: Topography: Geoscience Australia 2011.
 Path: Q:\Consult\2017\ADS\ADS17225\ArcMap_documents\ADS17225_G002_RevA.mxd

Legend

- 2016 survey area
- 2017 Survey area
- Weed mapping density**
- High
- Medium
- Low

Weed density	Cover
Low	< 5%
Medium	6 - 75 %
High	76 - 100 %

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Vegetation types

Four native vegetation types (VTs) were previously defined and mapped within the survey area in 2016 (Strategen 2016). The survey area comprised VTs 1, 2, and 3 and cleared areas as summarised in Table 3. All VTs recorded in the 2017 survey area were recorded in the 2016 survey area, except for VT 4 (*Olearia axillaris*, *Scaevola crassifolia*, *Acacia rostellifera*, *Acacia truncata* heath with emergent *Agonis flexuosa* over *Acanthocarpus preissii*, *Spinifex hirsutus*, **Pelargonium capitatum*, and exotic grasses on sandy soils), comprising only 0.19 ha of the 2016 survey area. Areas containing vegetation in a highly degraded state were not counted as unique native VTs but have been included in Table 3 for area calculation purposes. Total areas occupied within the survey area by each of the identified VTs are set out in Table 4.

Table 3: Vegetation Types

Vegetation Type	Description
1	<i>Olearia axillaris</i> , <i>Atriplex isatidea</i> , <i>Spinifex hirsutus</i> , * <i>Cakile maritima</i> and * <i>Thinopyrum distichum</i> low shrubland on sandy soils.
2	<i>Olearia axillaris</i> , <i>Acacia rostellifera</i> , <i>Rhagodia baccata</i> and <i>Scaevola crassifolia</i> heath over <i>Spinifex longifolius</i> , <i>Acanthocarpus preissii</i> , <i>Cassutha flava</i> , * <i>Pelargonium capitatum</i> and exotic grasses including on sandy soils.
3	<i>Scaevola crassifolia</i> , <i>Olearia axillaris</i> , <i>Acacia rostellifera</i> , and <i>Spyridium globulosum</i> heath on dune crests and <i>Lepidosperma gladiatum</i> closed heath in dune swales over <i>Acanthocarpus preissii</i> , * <i>Pelargonium capitatum</i> * <i>Arctotis stoechadifolia</i> and exotic grasses on sandy soils.
C	Cleared areas.

Vegetation type coverage

The total area mapped within the survey area was 14.46 ha which includes highly degraded and fully cleared areas (Table 4). The dominant native VT within the survey area was VT 3 which can be described as a *Scaevola crassifolia*, *Olearia axillaris*, *Acacia rostellifera*, and *Spyridium globulosum* heath on dune crests and *Lepidosperma gladiatum* closed heath in dune swales over *Acanthocarpus preissii*, **Pelargonium capitatum* **Arctotis stoechadifolia* and exotic grasses on sandy soils.

Table 4: Area (ha) covered by each VT within the survey area

VT	Area (ha)	Percentage of the Survey area
1	2.13	14.73
2	3.81	26.35
3	8.33	57.61
Cleared	0.19	1.31
TOTAL	14.46	100

Vegetation condition

The survey area shows signs of having been degraded for a long period of time due to the widespread extent of weeds and human disturbance (e.g. trampling of dune vegetation and use of vehicle tracks for beach access). Other disturbances included the presence of rabbits, with rabbit droppings being found in the survey area. As such, vegetation condition within the survey ranged from Completely Degraded to Very Good and generally aligned with the VT boundaries (Keighery 1994; Figure 4; Table 5). Much of VT 2 is dominated by the weed species **Pelargonium capitatum* which may be a result of degradation caused by vehicle tracks which run through much of this vegetation type.

Table 6 gives a numerical breakdown of the area occupied by each vegetation condition rating within the survey area.

Table 5: 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.

Table 6: Area (ha) covered by each vegetation condition category within the survey area

Vegetation Condition	Area (ha)	Percentage of the Survey area
Very Good	8.33	57.61
Good to Very Good	3.81	26.35
Good	2.13	14.73
Completely degraded	0.19	1.31
Total	14.46	100

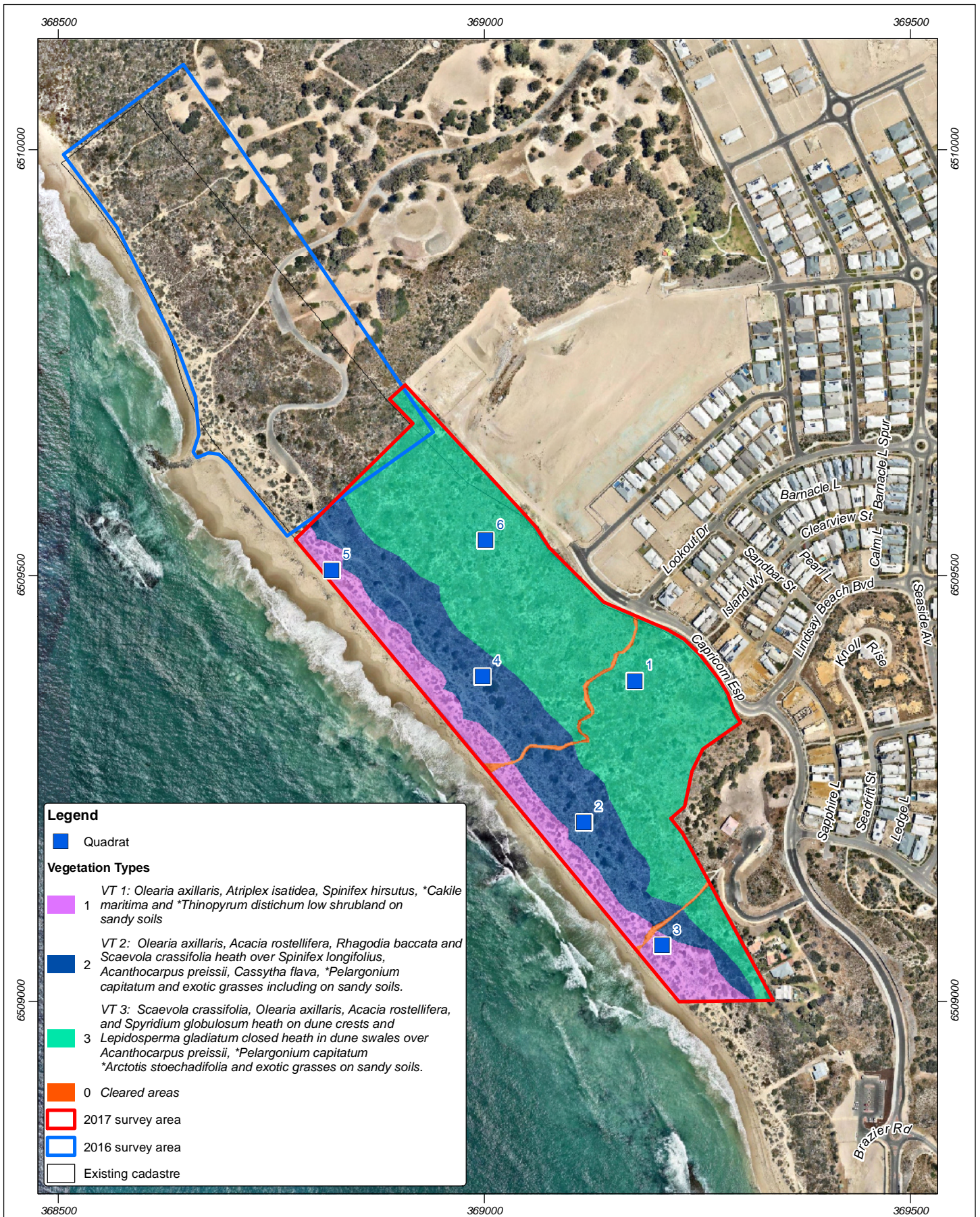


Figure 3: Vegetation Types (VTs) mapped within the survey area

Scale 1:6,000 at A4



Coordinate System: GDA 1994 MGA Zone 50

Note that positional errors may occur in some areas

Date: 6/10/2017

Author: JCrute

Source: Aerial image: nearmap, flown 01/2017. Existing cadastre: SLIP, Landgate 2017. Master plan: Client 03/2017.

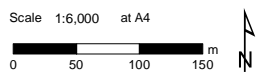
Path: Q:\Consult\2017\ADS\ADS17225\ArcMap_documents\ADS17225_G001_RevA.mxd

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Figure 4: Vegetation condition mapped within the survey area



Coordinate System: GDA 1994 MGA Zone 50
 Note that positional errors may occur in some areas
 Date: 6/10/2017
 Author: JCrute
 Source: Nearmap: Aerial 2017.

Legend

- | | | | | | |
|---|-------------------|---|---|---|---------------------|
|  | 2017 survey area | Vegetation condition |  | Good | |
|  | 2016 survey area |  | Very Good |  | Completely degraded |
|  | Existing cadastre |  | Good-Very Good | | |



Threatened and Priority ecological communities

As recorded within the 2016 report (Strategen 2016), the vegetation within the survey area did not resemble a known TEC, however it contains two Priority 3 PECs (FCT 29a – *Coastal Shrublands on shallow sands*, FCT 29b – *Acacia Shrublands on taller dunes*) based on dominant taxa recorded, the known vegetation complex within the survey area and previous survey results.

Discussion

Vegetation within the survey area comprises three VTs and cleared areas and was overall consistent with the 2016 vegetation mapping (Strategen 2016). Transitions between VTs were generally discontinuous, though occasionally abrupt with margins representing admixtures of more than one VT. This discontinuity is primarily due to changes in soil profile and topography. Vegetation condition generally aligned with the VT boundaries and at a broad scale, the majority of the survey area was observed to be in various states of degradation due to coastal erosion and historical clearing within the survey area. The remnant vegetation shows signs of degradation and structural alteration particularly where the beach access tracks are located.

A total of 56 native vascular plant taxa from 50 plant genera and 25 plant families, along with 18 introduced species were recorded within the survey area. No Declared Plant species pursuant to section 22 of the BAM Act were recorded within the survey area (DAFWA 2016).

No Threatened flora species as listed under section 178 of the EPBC Act or pursuant to Schedule 1 of the WC Act and as listed by Parks and Wildlife (2015) or Priority flora species as listed by Western Australian Herbarium (1998-) were recorded within the survey area.

Approximately 14.46 ha of vegetation ranging from Completely Degraded to Very Good condition was recorded within the survey area.

The vegetation within the survey area did not resemble a known TEC. Whilst two Priority 3 PECs (FCT 29a – *Coastal Shrublands on shallow sands*, FCT 29b – *Acacia Shrublands on taller dunes*) may occur in the survey area, these FCTs are very well represented within surrounding Bush Forever Site 397: *Coastal Strip from Wilbinga to Mindarie* which is under existing protection. Furthermore, these VTs will be retained within the foreshore reserve, subject to protection and management measures detailed in the Foreshore Management Plan.

Conclusion

The Level 2 flora and vegetation survey (conducted May and October 2017) has been successful in collecting data to define and assess the presence, extent and significance of vegetation types within the survey area.

This flora and vegetation assessment will support the Foreshore Management Plan for the proposed foreshore development which aligns with the *CoW Local Biodiversity Strategy* (2011) and the *CoW Coastal Management Plan* (CoW 2012) for the Capricorn coastal region.

References

Department of Agriculture and Food (DAFWA) 2017, *Declared Pests (s22) list*, [Online], Government of Western Australia, Available from: <http://www.biosecurity.wa.gov.au/organisms/export/PER-DP> [May 2017].

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Western Australian Herbarium 1998-, *FloraBase – the Western Australian Flora*, [Online], Government of Western Australia, Available from: <http://florabase.dpaw.wa.gov.au/> [May 2017].

Appendix 4
Level 1 fauna survey

Capricorn Coastal Reserve Fauna Assessment



View from east to west over the survey area (photo: M. Bamford)

Prepared for: Strategen Environmental
Level 1, 50 Subiaco Square Road,
Subiaco, WA, 6153

Prepared by: Mike Bamford and Cameron Everard
Bamford Consulting Ecologists
23 Plover Way,
Kingsley, WA, 6026



1st February 2017

Executive summary

Bamford Consulting Ecologists (BCE) was commissioned by Strategen Environmental to conduct a level 1 fauna assessment of a coastal reserve at the Capricorn estate, located approximately 50 kilometres (km) north of Perth. The proposal is for development of approximately 1.5 hectares (ha) within a coastal foreshore reserve of 27ha.

A level 1 assessment involves a site inspection and desktop review, and can be a powerful approach for impact assessment where there is abundant information available on the fauna assemblage and the general region is familiar to the consultant, as is the case in this instance. Databases contain extensive information on fauna in the region, and BCE has undertaken several level 1 assessments nearby (Bamford and Davis 2005, Everard and Bamford 2017), as well as two level 2 (comprehensive trapping) assessments (Bamford 1998; 2006, Turpin and Bamford 2008).

BCE uses a 'values and impacts' approach to impact assessment with respect to fauna. Components of this approach are:

- The identification of **fauna values**:
 - Assemblage characteristics: uniqueness, completeness and richness;
 - Species of conservation significance;
 - Recognition of vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
 - Patterns of biodiversity across the landscape; and
 - Ecological processes upon which the fauna depend.
- The review of **impacting processes** such as:
 - Habitat loss leading to population decline;
 - Habitat loss leading to population fragmentation;
 - Degradation of habitat due to weed invasion leading to population decline;
 - Ongoing mortality from operations;
 - Species interactions including feral and overabundant native species;
 - Hydrological change;
 - Altered fire regimes; and
 - Disturbance (dust, light and noise).
- The **recommendation** of actions to mitigate impacts.

The purpose of this report is to provide information on the fauna values of the survey area, particularly for significant species and an overview of the ecological function of the site within the local and regional context, and to provide discussion on the interaction of the proposal on these fauna values and functions.

The fauna investigations were based on a desktop assessment and site inspection in December 2016. The desktop study identified 166 vertebrate fauna species as potentially occurring in the survey area: four frogs, 53 reptiles, 92 birds, 12 native and five introduced mammals. The vertebrate assemblage includes up to 38 species of conservation significance. Some species have been excluded from the assemblage as they are almost certainly locally extinct. A further three conservation significant invertebrate species were identified from the desktop assessment.

Key fauna values are:

Fauna assemblage. Largely intact but with some mammals locally extinct. The assemblage is typical of heathland on coastal dunes, located throughout the Swan Coastal Plain Bioregion. A slightly

depauperate fauna assemblage is likely to occur in the coastal heathland as some reptile, mammal and bird species are expected to be locally extinct. The assemblage contains a moderate level of richness to be expected in relatively undisturbed intact heathland vegetation.

Species of conservation significance. Several significant species are likely to occur in the survey area. Carnaby's Black-Cockatoo (CS1) is an irregular non-breeding visitor to the area, although the coastal heathland present at the site provides minimal foraging value for the species. No evidence of roosting or nesting was recorded during the site inspection, and based on the lack of suitable habitat is unlikely to occur. The Graceful Sun-Moth (CS2) has been recorded south of Yanchep and also has the potential to occur at the site. The Moodit or Southern Bush-rat (CS3) is also of interest, as it occurs in near-coastal heathlands north of Perth and is likely to be present in the survey area.

Vegetation and Substrate Associations (VSAs). The coastal heath on calcareous sand can be considered a single VSA that is well-represented to the north and south. It also tends to be the coastal strip of native vegetation that is retained during urban development. Vegetation includes a mix of low shrubs comprising, *Acacia rostellifera*, *Olearia axillaris* and *Scaevola* sp. over coastal sand dunes.

Sedgeland of *Lepidosperma gladiatum* sometimes form a distinct VSA in some locations (i.e. in deep swales) but are also mixed with other vegetation types across the site. The lack of variety in VSAs with the separation of the coastal heaths from more inland VSAs such as shrublands and woodlands will slightly reduce the number of species present. This is because some species will move between vegetation types seasonally but this opportunity has been lost with development nearby. This VSA type is widespread in the local area, particularly to the north of the survey area.

Patterns of biodiversity. Species are likely to have distinct distributions even over short distances but understanding these requires very detailed investigation. Of interest, however, is that the Graceful Sun-Moth will breed on the upper slopes of dunes where *Lomandra* spp. occur (its food-plant), the White-breasted Robin will be associated with thickets of taller vegetation and the Moodit often occurs on the margins of sedgelands. The coastal fringe (foredunes) may support slightly fewer species and possibly lower levels of abundance than the more developed and complex vegetation of the secondary dunes 50m or so inland.

Key ecological processes. Processes can include factors such as fire, interactions with other species and hydrology, but the key process in the context of the survey area is likely to be its shape and relationship with other areas of native vegetation. This affects connectivity and the ability of species to move through the landscape (landscape permeability). The presence of a large Bush Forever site to the north is important in allowing fauna species to persist and move into and out of the survey area. Landscape permeability is likely to be reduced to the east and particularly to the south towards Yanchep, due to urban development.

Impacting processes

Impacting processes (listed above) have to be considered in the context of fauna values and the nature of the proposed action. The impacts of greatest concern are those of fragmentation, degradation and feral species (in particular domestic Cats). The proposed development is small within the context of the foreshore reserve; it represents about 5% of the reserve. However, it will constrict the reserve at one point.

Recommendations

General recommendations include:

- Minimise the disturbance footprint where possible;
- Clearly delineate areas to be cleared to minimise unnecessary vegetation loss;
- Maintain linkages to adjacent vegetation where possible (i.e. to the Bush Forever site north of the survey area);
- Rehabilitate as soon as practical;
- Employ industry standard hygiene management measures to avoid introducing weeds into the area;
- Educate employees on the vulnerability of some species to roadkill (e.g. Quenda);
- Provide signage in areas of known wildlife activity;
- Rehabilitate access tracks as soon as possible to discourage access by feral fauna. In the long term, it may be necessary to develop a feral fauna management plan in conjunction with the Department of Parks and Wildlife;
- Ensure appropriate waste disposal during construction activities to avoid attracting feral species to the area;
- Educate personnel not to feed (deliberately or inadvertently) feral species;
- Ensure local hydrology is not affected, including alterations to runoff through the landscape; and
- Avoid runoff to ensure sediment or any chemicals do not contaminate soil and groundwater and install appropriate erosion control, if required;
- Implement a fire management plan in consultation with the Department of Parks and Wildlife during construction and operational activities to ensure wildfires do not occur as a result of activities and appropriate responses are in place should a wildfire occur; and
- Reduce dust, noise and light impacts where possible, with onsite management procedures.

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1 Introduction

1.1 Background

Bamford Consulting Ecologists (BCE) was commissioned by Strategen Environmental to conduct a level 1 fauna assessment of a coastal reserve at the Capricorn estate, located approximately 50 kilometres (km) north of Perth. A level 1 assessment involves a site inspection and desktop review, and can be a powerful approach for impact assessment where there is abundant information available on the fauna assemblage and the general region is familiar to the consultant, as is the case in this instance. Databases contain extensive information on fauna in the region, and BCE has undertaken several level 1 assessments nearby (Bamford and Davis 2005, Everard and Bamford 2017), as well as two level 2 (comprehensive trapping) assessments (Bamford 1998; 2006, Turpin and Bamford 2008) (see section 3.2.2).

The proposal is for development of approximately 1.5 hectares (ha) within a coastal foreshore reserve of 27ha. The reserve is adjacent to substantial urban subdivisions immediately to the east and a Bush Forever site lies immediately to the north (Figure 1).

BCE uses a 'values and impacts' approach to impact assessment with respect to fauna. Components of this approach are:

- The identification of **fauna values**:
 - Assemblage characteristics: uniqueness, completeness and richness;
 - Species of conservation significance;
 - Recognition of vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
 - Patterns of biodiversity across the landscape; and
 - Ecological processes upon which the fauna depend.
- The review of **impacting processes** such as:
 - Habitat loss leading to population decline;
 - Habitat loss leading to population fragmentation;
 - Degradation of habitat due to weed invasion leading to population decline;
 - Ongoing mortality from operations;
 - Species interactions including feral and overabundant native species;
 - Hydrological change;
 - Altered fire regimes; and
 - Disturbance (dust, light and noise).
- The **recommendation** of actions to mitigate impacts.

Descriptions and background information on these values and processes can be found in Appendices 1 to 3. The purpose of this report is to provide information on the fauna values of the survey area, particularly for significant species and an overview of the ecological function of the site within the local and regional context, and to provide discussion on the interaction of the proposal on these fauna values and functions.

1.2 Description of the survey area

The foreshore reserve is long and narrow; about 1.25km north-south and up to 250m wide from the coast to the inland boundary (Figure 1). It consists of Quindalup dune systems which are steeply undulating with soils of pale calcareous sands over limestone. The vegetation is coastal heath with areas of sedgeland (Coastal Sword-Sedge *Lepidosperma gladiatum*) in some valleys (Plate 1). The Bush

Forever site to the north includes similar vegetation and landforms (Plate 2), and is continuous with Yanchep National Park to the east. Residential development occurs immediately to the south and east of the survey area. The site is situated in the City of Wanneroo.



Figure 1. Location of survey area.



Plate 1. Coastal heath in the foreshore reserve. Note sedgeland in valley (central middle distance).



Plate 2. View from Two Rocks Road looking across the Bush Forever area towards the foreshore reserve.

2 Regional description

The Interim Biogeographic Regionalisation of Australia (IBRA) (Environment Australia 2000) has identified 26 bioregions in Western Australia that are further divided into subregions (Figure 2). Bioregions are classified on the basis of climate, geology, landforms, vegetation and fauna (Thackway and Cresswell 1995). IBRA Bioregions are affected by a range of different threatening processes and have varying levels of sensitivity to impact (EPA 2004). The survey area lies in the Swan Coastal Plain Bioregion (DSEWPaC 2012) and in the Swan Coastal Plain subregion (SWA2) as shown in Figure 2.

The Swan Coastal Plain subregion is broadly characterised by ‘low lying coastal plain, mainly covered with woodlands and dominated by Banksia or Tuart on sandy soils.’ The Perth subregion is composed of colluvial and Aeolian sands, alluvial river flats, coastal limestone. Heath and/or Tuart woodlands on limestone, Banksia and Jarrah Banksia woodlands on Quaternary marine dunes of various ages (Mitchell *et al.* 2002)



Figure 2. IBRA Subregions in Western Australia. Note the survey area (indicated by red circle) lies in the SWA2 Perth IBRA subregion.

3 Methods

3.1 Overview

The methods used for this assessment are based upon the general approach to fauna investigations for impact assessment as outlined in Section 1.1 and with reference to Appendices 1 to 3. This approach to fauna impact assessment has been developed with reference to guidelines and recommendations set out by the Western Australian Environmental Protection Authority (EPA) on fauna surveys and environmental protection, and Commonwealth biodiversity legislation (EPA 2002; EPA 2004).

The EPA proposes two levels of investigation that differ in the approach to field investigations, level 1 being a review of data and a site reconnaissance to place data into the perspective of the site, and level 2 being a literature review and intensive field investigations (e.g. trapping and other intensive sampling). The level of assessment recommended by the EPA is determined by the size and location of the proposed disturbance, the sensitivity of the surrounding environment in which the disturbance is planned, and the availability of pre-existing data.

This report does not provide an assessment of specific impacts upon fauna, rather evaluates and discusses the fauna values and impacting processes of the proposal, with a particular focus on conservation significant species.

The approach consisted of a desktop assessment and field investigation (site visit) and are summarised below:

- Desktop assessment. The purpose of the desktop review is to produce a species list that can be considered to represent the vertebrate fauna assemblage of the project area based on unpublished and published data using a precautionary approach; and
- Field investigations. The purpose of the field investigations is to gather information on this assemblage: confirm the presence of as many species as possible (with an emphasis on species of conservation significance), place the list generated by the desktop review into the context of the environment of the project area, collect information on the distribution and abundance of this assemblage, and develop an understanding of the project area's ecological processes that maintain the fauna. Note that field investigations cannot confirm the presence of an entire assemblage, or confirm the absence of a species. This requires far more work than is possible in the EIA process. For example, in an intensive trapping study, How and Dell (1990) recorded in any one year only about 70% of the vertebrate species found over three years. In a study spanning over two decades, Bamford *et al.* (2010) has found that the vertebrate assemblage varies over time and space, meaning that even complete sampling at a set of sites only defines the assemblage of those sites at the time of sampling.

3.2 Desktop assessment

3.2.1 Sources of information

Information on the fauna assemblage of the survey area was drawn from a wide range of sources. These included state and federal government databases and results of regional studies. Databases accessed were the Atlas of Living Australia (ALA), DPaW NatureMap (incorporating the Western Australian Museum's FaunaBase and the DPaW Threatened and Priority Fauna Database), BirdLife Australia's Atlas Database (BA), the EPBC Protected Matters Search Tool and the BCE database (Table 1). Information from the above sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns were:

- Fish: Allan *et al.* (2002);
- Frogs: Tyler *et al.* (2000) and Anstis (2013);
- Reptiles: Storr *et al.* (1983); Storr *et al.* (1990); Storr *et al.* (1999); Storr *et al.* (2002) and Wilson and Swan (2013);
- Birds: Blakers *et al.* (1984); Johnstone and Storr (1998, 2004) and Barrett *et al.* (2003); and
- Mammals: Menkhorst & Knight (2004); Churchill (2008); and Van Dyck and Strahan (2008).

Table 1. Sources of information used for the desktop assessment.

Database	Type of records held on database	Area searched
Atlas of Living Australia (ALA 2017)	Records of biodiversity data from multiple sources across Australia.	Point search: 31° 32' 24" S, 115° 37' 02" E plus 10 km buffer. Searched: January 2017.
NatureMap (DPaW 2017)	Records in the WAM and DPaW databases. Includes historical data and records on Threatened and Priority species in WA.	Point search: 31° 32' 24" S, 115° 37' 02" E plus 20 km buffer. Searched: January 2017.
BirdLife Australia Atlas Database (Birdlife Australia 2017)	Records of bird observations in Australia, 1998-2017.	Point search: 31° 32' 24" S, 115° 37' 02" E plus 10 km buffer. Searched: January 2017.
EPBC Protected Matters (DoEE 2017a)	Records on matters of national environmental significance protected under the EPBC Act.	Point search: 31° 32' 24" S, 115° 37' 02" E plus 20 km buffer. Searched: January 2017.
Birdlife Australia Great Cocky Count roost data 2016 (Peck <i>et al.</i> 2016)	Black-Cockatoo roost sites (confirmed, potential, and unconfirmed).	Data search for any roost sites known in the Capricorn/Yanchep region.

3.2.2 *Previous fauna surveys*

The desktop assessment included a review of numerous fauna surveys conducted by BCE in the local and regional area. Reports reviewed include two level 1 assessments of the Alkimos Wastewater Treatment Plant, located approximately 10km to the south (Bamford and Davis 2005; Everard and Bamford 2017) and level 2 surveys (site inspection and field sampling) nearby at Burns Beach (Bamford 1998), Jindee (Bamford 2006) and South Yanchep (Turpin and Bamford 2008). The reports provide data on conservation significant species recorded in vegetation and substrate associations (VSAs) in some cases similar to those found in the current fauna assessment.

3.2.3 *Nomenclature and taxonomy*

As per the recommendations of EPA (2004), the nomenclature and taxonomic order presented in this report are based on the Western Australian Museum's (WAM) *Checklist of the Fauna of Western Australia 2016*. The authorities used for each vertebrate group were: amphibians (Doughty *et al.* 2016), reptiles (Doughty *et al.* 2016), birds (Johnstone and Darnell 2016), and mammals (Travouillon 2016). In some cases, more widely-recognised names and naming conventions have been followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds). English names of species, where available, are used throughout the text; Latin species names are presented with corresponding English names in tables in the appendices.

3.2.4 *Interpretation of species lists*

Species lists generated from the review of sources of information are generous as they include records drawn from a large region and possibly from environments not represented in the survey area. Therefore, some species that were returned by one or more of the data searches have been excluded because their ecology, or the environment within the survey area, meant that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the site is of no importance. Species returned from databases but excluded from species lists are presented in Appendix 5.

Species returned from the databases and not excluded on the basis of ecology or environment are therefore considered potentially present or expected to be present in the survey area at least occasionally, whether or not they were recorded during field surveys, and whether or not the survey area is likely to be important for them. This list of expected species is therefore subject to interpretation by assigning each a predicted status in the survey area.

The status categories used are:

- Resident: species with a population permanently present in the survey area;
- Regular migrant or visitor: species that occur within the survey area regularly in at least moderate numbers, such as part of annual cycle;

- Irregular Visitor: species that occur within the survey area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the survey area in at least moderate numbers and for some time;
- Vagrant: species that occur within the survey area unpredictably, in small numbers and/or for very brief periods. Therefore, the survey area is unlikely to be of importance for the species; and
- Locally extinct: species that would have been present but has not been recently recorded in the local area and therefore is almost certainly no longer present in the survey area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the site is not important in a conservation sense, and species which use the site in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times. The status categories are assigned conservatively. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence the site will not support it, and even then it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals.

3.3 Field survey

3.3.1 Overview

The field survey included the identification of VSAs and general searching for conservation significant fauna, particularly foraging evidence of the Carnaby's Black-Cockatoo and Southern Brown Bandicoot or Quenda.

Vegetation and Substrate Associations (VSAs) in the survey area were assessed during the desktop review and as part of the field investigations. Within the survey area, all major VSAs were visited to develop an understanding of major fauna habitat types present and to assess the likelihood of conservation significant species being present in the area.

The survey area was searched for ecological values for the species and these were based on the definitions of breeding, foraging and roosting habitat as per the EPBC Act referral guidelines for black-cockatoos (DSEWPac 2012), with foraging values assessed using systems developed by Bamford Consulting Ecologists. Black-cockatoos are known to forage in suitable vegetation in the Southern, Coastal and Southwest regions, leaving distinctive marks on dropped feeding material such as eucalypt fruit, and foraging signs on trees. The native vegetation within the site was assessed for foraging value based on the method outlined in Appendix 6.

3.3.2 Dates and personnel

The survey area was visited on the 8th December 2016 by Dr Mike Bamford (B.Sc. Hons. Ph.D.). The fauna assessment report was prepared by Cameron Everard (B.Sc. M.Sc.) and Dr Mike Bamford.

3.4 Survey limitations

The EPA Guidance Statement 56 (EPA 2004) outlines a number of limitations that may arise during surveying. The survey limitations are discussed in the context of the site inspection in Table 2.

Table 2. Survey limitations as outlined by EPA (2004).

EPA Limitation	BCE Comment
Level of survey.	Level 1 (desktop study with reconnaissance survey). Survey intensity was deemed adequate due to the small area and availability of previous studies in the region.
Competency/experience of the consultant(s) carrying out the survey.	The authors have had extensive experience in conducting desktop reviews and have conducted multiple fauna surveys in the Swan Coastal Plain bioregion with surveys focussed on relevant local species including black-cockatoos.
Scope. (What faunal groups were sampled and were some sampling methods not able to be employed because of constraints?)	The site investigation targeted descriptions of the environment and fauna values for the significant species potentially occurring to occur.
Proportion of fauna identified, recorded and/or collected.	Key significant species were identified and the desktop provided information on other species.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Sources include previous fauna surveys in the Alkimos, Yanchepp and Burns beach area (Bamford 1998, Bamford and Davis 2005, Bamford 2006, Turpin and Bamford 2008 and Everard and Bamford 2017) and databases (BA, DPaW, EPBC, BCE and ALA database).
The proportion of the task achieved and further work which might be needed.	This report provides fauna values for significant species.
Timing/weather/season/cycle.	There were no constraints from the weather and conditions allowed personnel to move around readily.
Disturbances (e.g. fire, flood, accidental human intervention etc.) that affected results of survey.	None
Intensity. (In retrospect, was the intensity adequate?)	All major VSAs were visited and significant species habitat and traces were identified.
Completeness (e.g. was relevant area fully surveyed).	Site was fully surveyed to the level appropriate for a level 1 assessment and identifying fauna values.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Field personnel have extensive experience with fauna in the region.
Remoteness and/or access problems.	There were no remoteness/access problems encountered.
Availability of contextual (e.g. biogeographic) information on the region.	Extensive regional information was available and was consulted.

3 Fauna values

3.1 Vegetation and Substrate Associations

The coastal heath on calcareous sand can be considered a single VSA. It tends to be the coastal strip of native vegetation that is retained during urban development with some representation to the south and extensive representation to the north. Vegetation includes a mix of low shrubs comprising, *Acacia rostellifera*, *Olearia axillaris* and *Scaevola* sp. over coastal sand dunes. Sedgelands of *Lepidosperma gladiatum* sometimes form a distinct VSA in some locations (i.e deep swales) but are also mixed with other vegetation types across the site. The lack of variety in VSAs with the separation of the coastal heaths from more inland VSAs such as shrublands and woodlands will slightly reduce the number of species present. This is because some species will move between vegetation types seasonally but this opportunity has been lost with development nearby.

3.2 Vertebrate fauna

3.2.1 Overview of the fauna assemblage

The desktop study identified 166 vertebrate fauna species as potentially occurring in the survey area: four frogs, 53 reptiles, 92 birds, 12 native and five introduced mammals (Appendix 4). There are several locally extinct mammal species that would have occurred in the survey area and include the Honey Possum *Tarsipes rostratus*, Ashy-grey Mouse *Pseudomys albocinereus*, White-tailed Dunnart *Sminthopsis granulipes* and Grey-bellied Dunnart *Sminthopsis griseoventer*. These species are locally extinct and therefore have not been included in the list. Species returned from databases but which are not considered to be part of the survey area's fauna assemblage are presented in Appendix 5.

Frogs. Up to four species, of which three species, the Pobblebonk, Guenther's Toadlet and Moaning Frog, utilise areas several kilometres away from wetlands during the non-breeding season (Bamford 1992). Frog species are likely to be locally common, regionally widespread and can be expected to breed in seasonal wetlands in the region.

Reptiles. 53 species are known from the general area in coastal heaths, but distributions can be patchy and therefore not all 53 species may be present in such a small area. The majority of the reptile species expected in the area are common and regionally widespread on the coastal plain north of Perth. In a sampling survey of six days at Jindee, Bamford (2006) recorded 22 reptile species. Furthermore, sampling at South Yanchep recorded 16 reptile species (Turpin and Bamford 2008).

Birds. Up to 92 species may be present, but these would include birds that might fly over the site only occasionally, and species that occur along the coast and thus do not strictly use the survey area. The Jindee study (Bamford 2006) recorded 35 bird species. Sampling at South Yanchep recorded 51 bird species (Turpin and Bamford 2008).

Mammals. Up to 17 species could be present in the survey area, five of these are introduced and several species are almost certainly locally extinct. Almost half the native species are bats that are

known from the general region north of Perth. Bamford (2006) recorded three native and four introduced species at Jindee. Sampling at South Yanchep recorded four native and four introduced species (including the CS3 Bush-Rat/Moodit) (Turpin and Bamford 2008).

Invertebrates. Invertebrate assemblages are extremely hard to document but some species of conservation significance are known from the region. These are discussed below.

Overall, the fauna assemblage may consist of up to 166 vertebrate species, but all these are unlikely to occur due to the limited range of environments present in the survey area.

Key features of the fauna assemblage expected in the survey area are:

- Uniqueness: The assemblage is typical of heathland on coastal dunes, located throughout the Swan Coastal Plain Bioregion.
- Completeness: A slightly depauperate fauna assemblage is likely to occur in the coastal heathland as some reptile, mammal and bird species are expected to be locally extinct.
- Richness: The assemblage in the survey area contains a moderate level of richness to be expected in relatively undisturbed intact heathland vegetation.

3.5.2 Species of Conservation Significance

The current vertebrate assemblage potentially includes 38 species of conservation significance, with a further four species considered to be locally extinct. The overall list of significant species includes six CS1 species, three CS2 species and 29 CS3 species. Numbers and classes of significant species broken down by major taxonomic group and still expected to be present are listed in Tables 3 and 4.

Species classed as CS1 are those listed under legislation, while those classed as CS2 are listed as Priority by the Department of Parks and Wildlife. The CS3 class is more subjective, but includes species that have declined extensively across the Swan Coastal Plain due to land clearing, for urban development and species that occur at the edge of their range. This makes their presence in the survey area significant as populations on the edge of a species' range are often less abundant and more vulnerable to extinction than populations at the centre of the range (Curnutt *et al.* 1996).

Table 3. Conservation significant vertebrate species expected in the survey area.

Taxon	CS1	CS2	CS3	Total
Frogs	-	-	-	-
Reptiles	-	1	1	2
Birds	6	-	26	32
Mammals*	-	2	2	4
Total	6	3	29	38

*Excludes four local extinct mammal species.

Table 4. Conservation significant fauna species expected to occur in the survey area.

This list is based on desktop review and their expected status within the site.

Common Name	Latin Name	Conservation Status			Expected status in project area
		CS1	CS2	CS3	
Reptiles					
South-West Carpet Python	<i>Morelia spilota imbricata</i>			CS3	Resident
Black-striped Snake	<i>Neelaps calonotos</i>		P3		Resident
Birds					
Eastern Osprey	<i>Pandion cristatus</i>	Mar S5			Irregular visitor
Square-tailed Kite	<i>Lophoictinia isura</i>			CS3	Irregular visitor
Whistling Kite	<i>Haliastur sphenurus</i>			CS3	Irregular visitor
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Mar			Irregular visitor
Brown Goshawk	<i>Accipiter fasciatus</i>			CS3	Irregular visitor
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>			CS3	Visitor
Wedge-tailed Eagle	<i>Aquila audax</i>			CS3	Irregular visitor
Little Eagle	<i>Hieraaetus morphnoides</i>			CS3	Irregular visitor
Peregrine Falcon	<i>Falco peregrinus</i>	S7			Irregular visitor
Painted Button-quail	<i>Turnix varia</i>			CS3	Irregular visitor
Carnaby's Black-Cockatoo	<i>Calyptorhynchus latirostris</i>	E S2			Visitor
Rock Parrot	<i>Neophema petrophila</i>			CS3	Vagrant
Fork-tailed Swift	<i>Apus pacificus</i>	Mig S5			Migrant, occasional visitor
Rainbow Bee-eater	<i>Merops ornatus</i>	Mar S5			Migrant, occasional visitor
Splendid Fairy-wren	<i>Malurus splendens</i>			CS3	Resident
Variiegated Fairy-wren	<i>Malurus lamberti</i>			CS3	Resident
White-winged Fairy-wren	<i>Malurus leucopterus</i>			CS3	Resident
Southern Emu-wren	<i>Stipiturus malachurus</i>			CS3	Resident
White-browed Scrubwren	<i>Sericornis frontalis</i>			CS3	Resident
Weebill	<i>Smircornis brevirostris</i>			CS3	Resident
Inland Thornbill	<i>Acanthiza apicalis</i>			CS3	Resident
Western Thornbill	<i>Acanthiza inornata</i>			CS3	Resident
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>			CS3	Resident
Western Wattlebird	<i>Anthochaera lunulata</i>			CS3	Resident
White-cheeked Honeyeater	<i>Phylidonyris nigra</i>			CS3	Resident
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>			CS3	Resident
Tawny-crowned Honeyeater	<i>Phylidonyris melanops</i>			CS3	Resident
Western Spinebill	<i>Acanthorhynchus superciliosus</i>			CS3	Resident
Hooded Robin	<i>Melanodryas cucullata</i>			CS3	Resident
White-breasted Robin	<i>Eopsaltria georgiana</i>			CS3	Resident
Grey Shrike-thrush	<i>Colluricincla harmonica</i>			CS3	Resident

Common Name	Latin Name	Conservation Status			Expected status in project area
Black-faced Woodswallow	<i>Artamus cinereus</i>			CS3	Visitor
Mammals					
Quenda, Southern Brown Bandicoot	<i>Isoodon obesulus fusciventer</i>		P5		Resident
Brush Wallaby	<i>Notamacropus irma</i>		P4		Resident
Brush-tailed Possum	<i>Trichosurus vulpecula</i>			CS3	Resident
Moodit or Bush-Rat	<i>Rattus fuscipes</i>			CS3	Resident
Invertebrates					
A land snail	<i>Bothriembryon perobesus</i>		P1		Resident
A biting midge	<i>Austroconops mcmillani</i>		P2		Resident
Graceful Sun-Moth	<i>Synemon gratiosa</i>		P4		Resident

See Appendix 1 and 2 for descriptions of conservation significance levels. Species recorded are indicated and the predicted status of each species in the survey area is also given.

EPBC Act listed species: V = Vulnerable, E = Endangered, C = Critically Endangered, Mig = Migratory, Mar = Marine.

WC Act listed species: S1 – S7 = Schedule 1 - 7; DPaW Priority Species: P1 - P5 = Priority 1 - 5.

Species of Conservation Significance level 1

No frogs, reptiles or mammals are listed as conservation significance level 1. Six bird species were identified, but most are likely to be infrequent visitors only. These include:

Carnaby's Black-Cockatoo (Endangered – EPBC Act, WC Act)

The Carnaby's Black-Cockatoo is listed as Endangered at the state and federal level. The species is likely to be an irregular non-breeding visitor to the Capricorn area; it is common and with some pairs breeding slightly inland around Yanchep National Park. It is known to feed on seeding *Banksia* and *Eucalyptus* as well as proteaceous heaths (Johnstone and Storr 1998), which does not occur in the survey area. The coastal heathland present at the site provides minimal foraging value for the species. Due to the lack of suitable plant species, the foraging value ranges from a score of 1 to 2 out of 6 (foraging value categories and descriptions are provided in Appendix 6). Carnaby's Black-Cockatoo was recorded foraging at Burns Beach by Bamford (1998) and flying over the survey area at South Yanchep (Turpin and Bamford 2008).

No evidence of roosting or nesting was recorded during the site inspection, and based on the lack of suitable habitat is unlikely to occur. Several known roosting sites occur to the east of the survey area at Yanchep National Park (approximately 5 km from the survey area), Carabooda and Nowergup (Department of Planning Western Australia 2011). Data from Birdlife Australia's Great Cocky Count survey indicate that a single roost site located east of Yanchep had a count of 4,897 Carnaby's Black-Cockatoos and accounted for 45% of all of the Carnaby's recorded on the Perth-Peel Coastal Plain (Peck *et al.* 2016). Breeding is known to occur further inland, east of the survey area. There are several small resident populations on the northern Swan Coastal Plain at Yanchep National Park, Boonanarring and Mooliabeenee. Birds at these sites are known to forage in remnant bushland and in adjacent pine plantations (Johnstone *et al.* 2011 in DoEE 2017b).

Rainbow Bee-eater (Marine – EPBC Act, Schedule 5 – WC Act)

Until recently listed as Migratory under the EPBC Act, the Rainbow Bee-eater now appears under the EPBC Act only as Marine, despite being migratory but not marine, and this curious revision means that it is no longer a Matter of National Environmental Significance (MNES) under the federal legislation. Its listing under the WC Act is also likely to change as a result. The Rainbow Bee-eater was not recorded during the site inspection, but is likely to nest in the area during spring and was recorded at Burns Beach (Bamford 1998). The species will often construct its burrows on slopes that are sparsely vegetated, including slopes around construction sites.

Eastern Osprey (Marine – EPBC Act, Schedule 5 – WC Act) and **White-bellied Sea-Eagle** (Marine – EPBC Act)

Several other species listed as Migratory until recently have also been removed from the EPBC list, including the Eastern Osprey and White-bellied Sea-Eagle. These are likely to be infrequent visitors to the area. Both Ospreys and White-bellied Sea-Eagles are known to nest in Tuart trees around the Peel Inlet. They nest on the ground or on the tops of high dunes on islands, but are unlikely to do so on the mainland.

Fork-tailed Swift (Schedule 5 – WC Act)

This species occurs is a spring to autumn, non-breeding migrant to Australia, and is widespread but infrequently observed in coastal and subcoastal areas between Augusta and Carnarvon, including nearshore and offshore islands (DoEE 2017b). This species was not recorded during the survey but may occur occasionally on site, although it is a largely aerial species mostly independent of terrestrial ecosystems.

Peregrine Falcon (Schedule 7 – WC Act)

This species is known to occur over a wide range of environments across Australia. Preferred nesting locations include a range of elevated locations with steep topography such as rocky hills, breakaways, cliffs and high artificial structures. It will also nest in very large, horizontally-aligned tree hollows, and in old Raven nests in tall trees (M. Bamford pers. obs.). The Peregrine Falcon may be a regular foraging visitor to the site, but the area would represent a very small proportion of a pair's range.

Species of Conservation Significance level 2

No frog or bird species are listed as conservation significance level 2. One reptile, two mammal and three invertebrate species are listed and include:

Black-striped Snake (Priority 3 – WC Act)

The Black-striped Snake is restricted to the west coast from just north of Lancelin to Mandurah and, although locally common in some environments on the Swan Coastal Plain, its persistence is threatened by continuing loss of habitat due to urban development throughout its range. The

species may be locally extinct at Capricorn and Yanchep due to habitat fragmentation. It was not recorded during the site inspection but can be very difficult to find.

Quenda/Southern Brown Bandicoot (Priority 5 – WC Act)

The Quenda occurs in the south-west coast from Guilderton north of Perth to east of Esperance. This species previously occurred north to Geraldton but like many mammals in the region has undergone a large range reduction (Maxwell *et al.* 1996). It is commonly associated with dense, low vegetation, so may be present in heathland habitats within the survey area. No evidence (diggings or tracks) of the species was recorded, however the species has been recorded at South Yanchep, approximately 3km to the south (Turpin and Bamford 2008).

Brush Wallaby (Priority 4 – WC Act)

The Brush Wallaby occurs in a range of shrublands and woodlands across much of the south-west of Western Australia, but is at risk from clearing and Foxes. This species has been recorded previously in the Neerabup National Park (DPaW 2017). The species was not recorded during the site inspection.

CS2 Invertebrates

Detailed searching for potential Short Range Endemic (SRE) invertebrates is beyond the scope of a site inspection and is based on the results of the desktop assessment. The DPaW (2017) lists three CS2 invertebrates for the general area. These are: the terrestrial snail *Bothriembryon perobesus* (Priority 1), a biting midge *Austroconops mcmillani* (Priority 2) and the Graceful Sun-Moth *Synemon gratiosa* (Priority 4).

The terrestrial snail has been recorded in coastal vegetation near Yanchep and Guilderton (DPaW 2017) and has the potential to be present. The biting midge has been recorded at Yanchep National Park (DPaW 2017) and may occur in the survey area. The Graceful Sun-Moth has also been recorded south of Yanchep and also has the potential to occur at the site.

Species of Conservation Significance level 3

No frogs, one reptile, 26 bird and two mammal species are locally significant if they occur on the site. These are all species that have declined in the Perth region and include:

Carpet Python

The south-west race of the Carpet Python was until recently listed as Priority by DPaW and a population in the survey area would be locally significant as the species is still at risk from feral species and clearing. This species is likely to occur due to the presence of suitable habitat in survey area. There are also several records to the north and east of the site (DPaW 2017).

Conservation Significance level 3 Birds

Up to 26 bird species are considered to be of local significance (Table 4), because their populations have declined dramatically across much of their range due to clearing for agricultural and urban

developments. These species also show poor persistence in fragmented landscapes, and therefore populations in large tracts of native vegetation are important for their long-term conservation.

Of concern include habitat specialists such as sedentary insectivorous birds that rely on intact and continuous native vegetation. Probably of most significance are the White-winged Fairy-wren and White-breasted Robin, which have few populations in the Perth area and favour coastal heaths. They are also sensitive to habitat loss, fragmentation and predation by feral and domestic species.

Conservation Significance level 3 Mammals

The Moodit or Southern Bush-rat is locally common in near-coastal heathlands north of Perth and is likely to occur at the site. The species was recorded at South Yanchep in *Lepidosperma gladiatum* Sedgeland (Turpin and Bamford 2008). Other native small mammals may be present, but appear to have disappeared from the outskirts of Perth.

The Brush-tailed Possum is patchily distributed north of Perth. The species has been recorded at Burns Beach (Bamford 1998) and at Neerabup (DPaW 2017), and may occur in the survey area.

4.3 Patterns of biodiversity

Species are likely to have distinct distributions even over short distances but understanding these requires very detailed investigation. Of interest, however, is that the Graceful Sun-Moth will breed on the upper slopes of dunes where *Lomandra* spp. occur (its food-plant), the White-breasted Robin will be associated with thickets of taller vegetation and the Moodit often occurs on the margins of sedgelands. The coastal fringe (foredunes) may support slightly fewer species and possibly lower levels of abundance than the more developed and complex vegetation of the secondary dunes 50m or so inland. Areas with dense heath are important for species that prefer dense cover such as some birds and mammals. There are no ephemeral or permanent wetlands at the site and as a result, are unlikely to attract species dependant on this type of habitat.

Due the extensive fragmentation of native vegetation on the northern Swan Coastal Plain some fauna species likely to occur in the survey area have isolated and restricted distributions in the region. Such species may include Black-striped Snake, Brush Wallaby, Quenda, White-winged Fairy-wren, White-breasted Robin, Bush Rat and some invertebrate species. Ongoing development of the northern coastal plain (to Two Rocks and beyond) is likely to contribute to further isolation and fragmentation of fauna populations. Habitats supporting species with fragmented and restricted ranges (including short-range endemics, Quenda and Bush-Rat) need to be managed to minimise any potential impacts.

4.4 Ecological processes

The nature of the landscape and the fauna assemblage indicate some of the ecological processes that may be important for ecosystem function (refer to Appendix 3 for descriptions and other ecological processes). These include:

Local hydrology. Interruptions of hydroecological processes can have significant effects upon vertebrate and invertebrate fauna because they underpin primary production in ecosystems. Construction of roads and other civil earthworks have the potential to alter both surface and sub-surface hydrology. Maintaining local hydrological flows is considered key to managing impacts upon fauna in the survey area. While the sands of the study area are likely to absorb water with little surface flow, drainage from hard surfaces could alter the movement of water through the site.

Fire. Fire is a natural feature of the environment and banksia woodlands of the Swan Coastal Plain Bioregion are fire-adapted but the flora and fauna assemblages can be altered by too-frequent fires; and even by fire exclusion. Some species are particularly sensitive to wildfires and altered fire regimes. Fire season may also be important in seed germination. As the site consists of open banksia woodland to dense heaths and thickets, fire is expected to occur at the site. Fire could further reduce recruitment of vegetation and hence the biodiversity and resilience of the area in the absence of remedial action. Fire Management strategies may be implemented as part of the management of the area to protect long-unburnt habitats that may be important for fauna.

Feral species and interactions with over-abundant native species. Feral species occur throughout Western Australia and it is expected that the fauna assemblage within the survey area has been impacted by feral species (particularly foxes and cats), which has resulted in the loss of some mammal and bird species. Rabbits and introduced rodents may cause further degradation to the native vegetation and, in combination with introduced predators (cats and foxes), reduce the capacity of the area to support native fauna diversity.

Connectivity and landscape permeability. The survey area is part of a greater area of native vegetation, located to the north and to some extent to the south. Some fauna, such as birds and mammals, are likely to move across the landscape, although permeability is reduced due to urban development situated to the east and particularly to the south towards Yanchep.

4.5 Summary of fauna values

The desktop study identified 166 vertebrate fauna species as potentially occurring in the Capricorn survey area: four frogs, 53 reptiles, 92 birds, 12 native and five introduced mammals, but with local extinction of some species. The vertebrate assemblage comprises of up to 38 species of conservation significance, including the Endangered Carnaby's Black-Cockatoo.

Fauna values within the study area can be summarised as follows:

Fauna assemblage. Largely intact but with some mammals locally extinct. The assemblage is typical of heathland on coastal dunes, located throughout the Swan Coastal Plain Bioregion. A slightly depauperate fauna assemblage is likely to occur in the coastal heathland as some reptile, mammal and bird species are expected to be locally extinct. The assemblage contains a moderate level of richness to be expected in relatively undisturbed intact heathland vegetation.

Species of conservation significance. Several significant species are likely to occur in the survey area. Carnaby's Black-Cockatoo (CS1) is an irregular non-breeding visitor to the area, although the coastal heathland present at the site provides minimal foraging value for the species. No evidence of roosting or nesting was recorded during the site inspection, and based on the lack of suitable habitat is unlikely to occur. The Graceful Sun-Moth (CS2) has been recorded south of Yanchep and also has the potential to occur at the site. The Moodit or Southern Bush-rat (CS3) is also of interest, as it occurs in near-coastal heathlands north of Perth and is likely to be present in the survey area.

Vegetation and Substrate Associations (VSAs). The coastal heath on calcareous sand can be considered a single VSA that is well-represented to the north and south. It also tends to be the coastal strip of native vegetation that is retained during urban development. Vegetation includes a mix of low shrubs comprising, *Acacia rostellifera*, *Olearia axillaris* and *Scaevola* sp. over coastal sand dunes.

Sedgeland of *Lepidosperma gladiatum* sometimes form a distinct VSA in some locations (i.e. in deep swales) but are also mixed with other vegetation types across the site. The lack of variety in VSAs with the separation of the coastal heaths from more inland VSAs such as shrublands and woodlands will slightly reduce the number of species present. This is because some species will move between vegetation types seasonally but this opportunity has been lost with development nearby. This VSA type is widespread in the local area, particularly to the north of the survey area.

Patterns of biodiversity. Species are likely to have distinct distributions even over short distances but understanding these requires very detailed investigation. Of interest, however, is that the Graceful Sun-Moth will breed on the upper slopes of dunes where *Lomandra* spp. occur (its food-plant), the White-breasted Robin will be associated with thickets of taller vegetation and the Moodit often occurs on the margins of sedgelands. The coastal fringe (foredunes) may support slightly fewer species and possibly lower levels of abundance than the more developed and complex vegetation of the secondary dunes 50m or so inland.

Key ecological processes. Processes can include factors such as fire, interactions with other species and hydrology, but the key process in the context of the survey area is likely to be its shape and relationship with other areas of native vegetation. This affects connectivity and the ability of species to move through the landscape (landscape permeability). The presence of a large Bush Forever site to the north is important in allowing fauna species to persist and move into and out of the survey

area. Landscape permeability is likely to be reduced to the east and particularly to the south towards Yanchep, due to urban development.

Overview of fauna values. Overall, the fauna assemblage is somewhat limited by the limited range of environments present in the survey area and the development of vegetation immediately inland. Few species of conservation significance are present, but there is a suite of locally significant birds and mammals that may rely on the site. The assemblage is affected by its long, narrow shape and its relationship with a large area of native vegetation to the north.

5 Impacting processes

Impacting processes have to be considered in the context of fauna values and the nature of the proposed action, and are examined below. The proposed development is small within the context of the foreshore reserve; it represents about 5% of the reserve. However, it will constrict the reserve at one point.

Habitat loss leading to population decline. Only a small proportion of habitat will be lost and it is typical of the vegetation across the foreshore reserve. This could be interpreted as a 5% decline in population size of most species, although the decline might be slightly larger than this as the development affects secondary dunes rather than foredunes which may be poorer (fewer species and possibly lower levels of abundance) in fauna species.

Habitat loss leading to population fragmentation. There is some potential for fragmentation as the development will reduce the width of the foreshore reserve at one point. In particular, this will reduce the width of the belt of vegetation along the secondary dunes which may be more important for some species.

Degradation of habitat due to weed invasion leading to population decline. There is potential for weed invasion on the edges of the area to be developed and along the pathway and lookout to be established. Trampling and general vegetation degradation could also occur. This risk needs to be managed.

Ongoing mortality from operations. This is unlikely to be an impacting process of concern with respect to the proposed development except possibly from roadkill in new parking areas.

Species interactions including feral and overabundant native species. The development and in particular the pathway will improve access into the foreshore reserve for feral species such as Foxes and Cats. In this respect, the key concern is probably the management of domestic Cats in the neighbouring urban development. Some local governments now have a 'three strikes' policy for domestic Cats caught in reserves to encourage owners to keep their pets on their own property, particularly at night.

Hydrological change. This is unlikely to be a concern assuming runoff and drainage are appropriately managed.

Altered fire regimes. Some of the vegetation in the foreshore reserve is fire-retardant but there will be an increased fire risk with increased access; and especially so if grassy weeds become established. Controlling grassy weeds may become important. Revegetation along the pathway using fire-retardant species could reduce the fire risk.

Disturbance (dust, light, noise). Disturbance due to the proposed development is unlikely to be a concern as it is small scale compared with the adjacent urban development. Despite this, some measures to reduce disturbance could be implemented, such as using shielded lighting.

Based on the above review, the impacts of greatest concern are those of fragmentation, degradation and feral species (in particular domestic Cats).

6 Recommendations

Section 5 (Impacting processes) identified several potential adverse impacts upon fauna that may occur. Although impacts are mostly expected to be minor or less, any reduction in impacts is desirable.

Some general management strategies are provided below.

Loss of habitat and fragmentation

- Minimise the disturbance footprint where possible;
- Clearly delineate areas to be cleared to minimise unnecessary vegetation loss;
- Maintain linkages to adjacent vegetation where possible (i.e. to the Bush Forever site north of the survey area); and
- Where required, rehabilitate as soon as practical.

Weed invasion

- Employ industry standard hygiene management measures to avoid introducing weeds into the area.

Ongoing mortality

- Educate employees on the vulnerability of some species to roadkill (e.g. Quenda); and
- Provide signage in areas of known wildlife activity.

Species interactions

- Rehabilitate access tracks as soon as possible to discourage access by feral fauna. In the long term, it may be necessary to develop a feral fauna management plan in conjunction with the Department of Parks and Wildlife;
- Ensure appropriate waste disposal during construction activities to avoid attracting feral species to the area; and
- Educate personnel not to feed (deliberately or inadvertently) feral species.

Hydrological changes

- Ensure local hydrology is not affected, including alterations to runoff through the landscape from hard surfaces; and
- Avoid runoff to ensure sediment or any chemicals do not contaminate soil and groundwater and install appropriate erosion control, if required.

Changes in fire regime

- Implement a fire management plan in consultation with the Department of Parks and Wildlife to ensure wildfires do not occur as a result of activities and appropriate responses are in place should a wildfire occur.

Dust, noise, light and disturbance

- Reduce dust, noise and light impacts where possible, with onsite management procedures.

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8 Appendices

Appendix 1. Explanation of fauna values.

Fauna values are the features of a site and its fauna that contribute to biodiversity, and it is these values that are potentially at threat from a development proposal. Fauna values can be examined under the five headings outlined below. It must be stressed that these values are interdependent and should not be considered equal, but contribute to an understanding of the biodiversity of a site. Understanding fauna values provides opportunities to predict and therefore mitigate impacts.

Assemblage characteristics

Uniqueness. This refers to the combination of species present at a site. For example, a site may support an unusual assemblage that has elements from adjacent biogeographic zones, it may have species present or absent that might be otherwise expected, or it may have an assemblage that is typical of a very large region. For the purposes of impact assessment, an unusual assemblage has greater value for biodiversity than a typical assemblage.

Completeness. An assemblage may be complete (i.e. has all the species that would have been present at the time of European settlement), or it may have lost species due to a variety of factors. Note that a complete assemblage, such as on an island, may have fewer species than an incomplete assemblage (such as in a species-rich but degraded site on the mainland).

Richness. This is a measure of the number of species at a site. At a simple level, a species rich site is more valuable than a species poor site, but value is also determined, for example, by the sorts of species present.

Vegetation and substrate associations (VSAs)

VSAs combine broad vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna. The term habitat is widely used in this context, but by definition an animal's habitat is the environment that it utilises (Calver *et al.* 2009), not the environment as a whole. Habitat is a function of the animal and its ecology, rather than being a function of the environment. For example, a species may occur in eucalypt canopy or in leaf-litter on sand, and that habitat may be found in only one or in several VSAs. VSAs are not the same as vegetation types since these may not incorporate soil and landform, and recognise floristics to a degree that VSAs do not. Vegetation types may also not recognise minor but often significant (for fauna) structural differences in the environment. VSAs also do not necessarily correspond with soil types, but may reflect some of these elements.

Because VSAs provide the habitat for fauna, they are important in determining assemblage characteristics. For the purposes of impact assessment, VSAs can also provide a surrogate for detailed information on the fauna assemblage. For example, rare, relictual or restricted VSAs should automatically be considered a significant fauna value. Impacts may be significant if the VSA is rare, a

large proportion of the VSA is affected and/or the VSA supports significant fauna. The disturbance of even small amounts of habitat in a localised area can have significant impacts to fauna if rare or unusual habitats are disturbed.

Patterns of biodiversity across the landscape

This fauna value relates to how the assemblage is organised across the landscape. Generally, the fauna assemblage is not distributed evenly across the landscape or even within one VSA. There may be zones of high biodiversity such as particular environments or ecotones (transitions between VSAs). There may also be zones of low biodiversity. Impacts may be significant if a wide range of species is affected even if most of those species are not significant per se.

Species of conservation significance

Species of conservation significance are of special importance in impact assessment. The conservation status of fauna species in Australia is assessed under Commonwealth and State Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Western Australian Wildlife Conservation Act 1950* (Wildlife Conservation Act). In addition, the Western Australian Department of Parks and Wildlife (DPaW) recognises priority levels, while local populations of some species may be significant even if the species as a whole has no formal recognition. Therefore, three broad levels of conservation significance can be recognised and are used for the purposes of this report, and are outlined below. A full description of the conservation significance categories, schedules and priority levels mentioned below is provided in Appendix 2.

Conservation Significance (CS) 1: Species listed under State or Commonwealth Acts.

Species listed under the EPBC Act are assigned to categories recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN) and reviewed by Mace and Stuart (1994), or are listed as migratory. Migratory species are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA), the Republic of South Korea Australia Migratory Bird Agreement (ROKAMBA), and/or the Convention on the Conservation of Migratory Species of Wild Animals (CMS; also referred to as the Bonn Convention). The Wildlife Conservation Act uses a series of Schedules to classify status, but also recognizes the IUCN categories and ranks species within the Schedules using the categories of Mace and Stuart (1994).

Conservation Significance (CS) 2: Species listed as Priority by the DPaW but not listed under State or Commonwealth Acts.

In Western Australia, the DPaW has produced a supplementary list of Priority Fauna, being species that are not considered threatened under the Wildlife Conservation Act but for which the DPaW feels there is cause for concern. Some Priority species are also assigned to the Conservation Dependent category of the IUCN.

Conservation Significance (CS) 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

This level of significance has no legislative or published recognition and is based on interpretation of distribution information, but is used here as it may have links to preserving biodiversity at the genetic level (EPA 2002). If a population is isolated but a subset of a widespread (common) species, then it may not be recognised as threatened, but may have unique genetic characteristics. Conservation significance is applied to allow for the preservation of genetic richness at a population level, and not just at a species level. Species on the edge of their range, or that are sensitive to impacts such as habitat fragmentation, may also be classed as CS3, as may colonies of waterbirds. The Western Australian Department of Environmental Protection, now DPaW, used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of the Perth Bushplan (DEP 2000).

Invertebrate species considered to be short range endemics (SREs) also fall within the CS3 category, as they have no legislative or published recognition and their significance is based on interpretation of distribution information. Harvey (2002) notes that the majority of species that have been classified as short-range endemics have common life history characteristics such as poor powers of dispersal or confinement to discontinuous habitats. Several groups, therefore, have particularly high instances of short-range endemic species: Gastropoda (snails and slugs), Oligochaeta (earthworms), Onychophora (velvet worms), Araneae (mygalomorph spiders), Pseudoscorpionida (pseudoscorpions), Schizomida (schizomids), Diplopoda (millipedes), Phreatoicidea (phreatoicidan crustaceans), and Decapoda (freshwater crayfish). The poor understanding of the taxonomy of many of the short-range endemic species hinders their conservation (Harvey 2002).

Introduced species

In addition to these conservation levels, species that have been introduced (INT) are indicated throughout the report. Introduced species may be important to the native fauna assemblage through effects by predation and/or competition.

Ecological processes upon which the fauna depend

These are the processes that affect and maintain fauna populations in an area and as such are very complex; for example, populations are maintained through the dynamic of mortality, survival and recruitment being more or less in balance, and these are affected by a myriad of factors. The dynamics of fauna populations in a project may be affected by processes such as fire regime, landscape patterns (such as fragmentation and/or linkage), the presence of feral species and hydrology. Impacts may be significant if processes are altered such that fauna populations are adversely affected, resulting in declines and even localised loss of species. Threatening processes as outlined below are effectively the ecological processes that can be altered to result in impacts upon fauna.

Appendix 2. Categories used in the assessment of conservation status.

IUCN categories (based on review by Mace and Stuart 1994) as used for the *Environment Protection and Biodiversity Conservation Act 1999* and the *Western Australian Wildlife Conservation Act 1950*.

Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (Ex)	Taxa known to survive only in captivity.
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (E)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (V)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern.	Taxa that are not Threatened.

Schedules used in the *WA Wildlife Conservation Act 1950*

Schedule 1 (S1)	Critically Endangered fauna.
Schedule 2 (S2)	Endangered fauna
Schedule 3 (S3)	Vulnerable Migratory species listed under international treaties.
Schedule 4 (S4)	Presumed extinct fauna
Schedule 5 (S5)	Migratory birds under international agreement
Schedule 6 (S6)	Conservation dependant fauna
Schedule 7 (S7)	Other specially protected fauna

WA Department of Parks and Wildlife Priority species (species not listed under the *Wildlife Conservation Act 1950*, but for which there is some concern).

Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands. Taxa in need of monitoring.
Priority 4. (P4)	Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
Priority 5 (P5)	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent).

Appendix 3. Ecological and threatening processes identified under legislation and in the literature. Ecological processes are processes that maintain ecosystems and biodiversity. They are important for the assessment of impacts of development proposals, because ecological processes make ecosystems sensitive to change. The issue of ecological processes, impacts and conservation of biodiversity has an extensive literature. Following are examples of the sorts of ecological processes that need to be considered.

Ecological processes relevant to the conservation of biodiversity in Australia (Soule *et al.* 2004):

- Critical species interactions (highly interactive species);
- Long distance biological movement;
- Disturbance at local and regional scales;
- Global climate change;
- Hydroecology;
- Coastal zone fluxes;
- Spatially-dependent evolutionary processes (range expansion and gene flow); and
- Geographic and temporal variation of plant productivity across Australia.

Threatening processes (EPBC Act)

Under the EPBC Act, a key threatening process is an ecological interaction that threatens or may threaten the survival, abundance or evolutionary development of a threatened species or ecological community. There are currently 20 key threatening processes listed by the federal Department of the Environment and Energy (DoEE 2017c):

- Competition and land degradation by rabbits.
- Competition and land degradation by unmanaged goats.
- Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*).
- Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South.
- Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations.
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis.
- Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris.
- Invasion of northern Australia by Gamba Grass and other introduced grasses.
- Land clearance.
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.
- Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean.
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases.
- Novel biota and their impact on biodiversity.
- Predation by European red fox.

- Predation by exotic rats on Australian offshore islands of less than 1000 km² (100,000 ha).
- Predation by feral cats.
- Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs.
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species.
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*).
- The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta* (fire ant).

General processes that threaten biodiversity across Australia (The National Land and Water Resources Audit):

- Vegetation clearing;
- Increasing fragmentation, loss of remnants and lack of recruitment;
- Firewood collection;
- Grazing pressure;
- Feral animals;
- Exotic weeds;
- Changed fire regimes;
- Pathogens;
- Changed hydrology—dryland salinity and salt water intrusion;
- Changed hydrology— such as altered flow regimes affecting riparian vegetation; and
- Pollution.

In addition to the above processes, DSEWPaC has produced Significant Impact Guidelines that provide criteria for the assessment of the significance of impacts. These criteria provide a framework for the assessment of significant impacts. The criteria are listed below.

- Will the proposed action lead to a long-term decrease in the size of a population?
- Will the proposed action reduce the area of occupancy of the species?
- Will the proposed action fragment an existing population?
- Will the proposed action adversely affect habitat critical to the survival of a species?
- Will the proposed action disrupt the breeding cycle of a population?
- Will the proposed action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?
- Will the proposed action result in introducing invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?
- Will the proposed action introduce disease that may cause the species to decline?
- Will the proposed action interfere with the recovery of the species?

Appendix 4. Vertebrate fauna expected to occur in the survey area.

These lists are derived from the results of database and literature searches and from previous field surveys conducted in the local area. These are:

- ALA = Atlas of Living Australia, searched January 2017;
- Nat Map = Naturemap Database, searched January 2017;
- Bird Data = Birdlife Australia's Birddata database, searched January 2017;
- BCE 05 = Alkimos site inspection and desktop assessment (Bamford and Davis 2005);
- BCE 08 = South Yanchep Level 2 fauna assessment (Turpin and Bamford 2008); and
- BCE 17 = Alkimos site inspection and desktop assessment (Everard and Bamford 2017).

Status codes include: CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 2 for full explanation.

Frogs

Species	CS Status	ALA	Nat Map	BCE05	BCE08	BCE17
Myobatrachidae (ground frogs)						
Moaning Frog <i>Heleioporus eyrei</i>		X	X			
Pobblebonk <i>Limnodynastes dorsalis</i>		X	X			
Turtle Frog <i>Myobatrachus gouldii</i>		X	X			
Guenther's Toadlet <i>Pseudophryne guentheri</i>		X	X			
Total number of frog species expected: 4	-	4	4	-	-	-

Reptiles

Species	CS Status	ALA	Nat Map	BCE05	BCE08	BCE17
Gekkonidae (geckoes)						
Marbled Gecko <i>Christinus marmoratus</i>		X	X			
Diplodactylidae						
Clawless Gecko <i>Crenadactylus ocellatus</i>		X	X			
Spiny-tailed Gecko <i>Strophurus spinigerus</i>		X	X		X	
Pygopodidae						
Sandplain Worm Lizard <i>Aprasia repens</i>		X	X			
Javelin Legless Lizard <i>Delma concinna</i>		X	X		X	
Fraser's Legless Lizard <i>Delma fraseri</i>		X	X			
Gray's Legless Lizard <i>Delma grayii</i>		X	X			
Burton's Legless Lizard <i>Lialis burtonis</i>		X	X		X	
Keeled Legless Lizard <i>Pletholax gracilis</i>		X	X			
Common Scaly foot <i>Pygopus lepidopodus</i>		X	X			
Agamidae (dragon lizards)						
Western Bearded Dragon <i>Pogona minor</i>		X	X		X	
Sandhill Dragon <i>Ctenophorus adelaidensis</i>		X	X			
Varanidae (monitors or goannas)						
Gould's Sand Goanna <i>Varanus gouldii</i>		X	X			X

Species	CS Status	ALA	Nat Map	BCE05	BCE08	BCE17
Black-tailed Tree Goanna <i>Varanus tristis</i>		X	X			
Scincidae (skink lizards)						
Cool Skink <i>Acritoscincus trilineatus</i>		X	X			
<i>Cryptoblepharus buchananii</i>		X	X		X	
Limestone Ctenotus <i>Ctenotus australis</i>		X	X			
West Coast Ctenotus <i>Ctenotus fallens</i>		X	X		X	
<i>Cyclodomorphus celatus</i>		X	X		X	
King's Skink <i>Egernia kingii</i>		X	X			
<i>Egernia napoleonis</i>		X	X		X	
<i>Hemiergis quadrilineata</i>		X	X			
<i>Lerista elegans</i>		X	X		X	
<i>Lerista lineopunctulata</i>		X	X			
Western Worm Lerista <i>Lerista praepedita</i>		X	X		X	
Dwarf Skink <i>Menetia greyii</i>		X	X		X	
Spotted Morethia <i>Morethia lineoocellata</i>		X	X			
Dusky Morethia <i>Morethia obscura</i>		X	X		X	
Western Bluetongue <i>Tiliqua occipitalis</i>		X	X		X	
Bobtail <i>Tiliqua rugosa</i>		X	X	X	X	X
Typhlopidae (blind snakes)						
Southern Blind Snake <i>Ramphotyphlops australis</i>						
Boidae (pythons)						
Carpet Python <i>Morelia spilota imbricata</i>	CS3	X	X			
Elapidae (front-fanged snakes)						
Half-ringed Snake <i>Brachyuropsis semifasciata</i>		X	X			
Narrow Banded Snake <i>Brachyuropsis fasciolata</i>		X	X			
Yellow-faced Whip-Snake <i>Demansia psammoph</i>		X	X		X	
Bardick <i>Echiopsis curtus</i>		X	X			
Black-naped Snake <i>Neelaps bimaculatus</i>		X	X			
Black-striped Snake <i>Neelaps calonotos</i>	CS2	X	X			
Tiger Snake <i>Notechis scutatus</i>		X	X			
Dugite <i>Pseudonaja affinis</i>		X	X	X	X	X
Gould's Snake <i>Parasuta gouldii</i>		X	X			
<i>Parasuta nigriceps</i>		X	X			
Jan's Bandy-Bandy <i>Simoselaps bertholdi</i>		X	X			
Total number of reptile species expected: 53	2	42	42	2	16	3

Birds

Bird Species	CS Status	ALA	Nat Map	Bird Data	BCE05	BCE08	BCE17
Dromaiidae (emus)							
Emu <i>Dromaius novaehollandiae</i>		X	X	X	X	X	X
Threskiornithidae							
Australian White Ibis <i>Threskiornis molucca</i>		X	X	X			
Accipitridae (kites, hawks and eagles)							
Eastern Osprey <i>Pandion cristatus</i>	CS1	X	X	X	X	X	X
Black-shouldered Kite <i>Elanus axillaris</i>		X	X	X			
Square-tailed Kite <i>Lophoictinia isura</i>	CS3	X	X			X	
Whistling Kite <i>Haliastur sphenurus</i>	CS3	X	X	X		X	
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>	CS1	X	X				
Spotted Harrier <i>Circus assimilis</i>		X	X	X			
Brown Goshawk <i>Accipiter fasciatus</i>	CS3	X	X	X		X	
Collared Sparrowhawk <i>Accipiter cirrhocephalus</i>	CS3	X	X	X		X	
Wedge-tailed Eagle <i>Aquila audax</i>	CS3	X	X	X			
Little Eagle <i>Hieraetus morphnoides</i>	CS3	X	X	X		X	
Falconidae (falcons)							
Peregrine Falcon <i>Falco peregrinus</i>	CS1	X	X	X			
Australian Hobby <i>Falco longipennis</i>		X	X	X			
Brown Falcon <i>Falco berigora</i>		X	X	X			
Nankeen Kestrel <i>Falco cenchroides</i>		X	X	X		X	
Turnicidae (button-quails)							
Painted Button-quail <i>Turnix varia</i>	CS3						
Little Button-quail <i>Turnix velox</i>		X	X	X			
Phasianidae (pheasants and quails)							
Stubble Quail <i>Coturnix p</i>		X	X	X		X	
Charadriidae (lapwings and plovers)							
Banded Lapwing <i>Vanellus tricolor</i>		X	X				
Laridae (gulls and terns)							
Silver Gull <i>Larus novaehollandiae</i>		X	X	X	X	X	
Columbidae (pigeons and doves)							
Rock Dove (Domestic Pigeon) <i>Columba livia</i>	Int	X	X	X			
Laughing Turtle-Dove <i>Streptopelia senegalensis</i>	Int	X	X	X		X	
Common Bronzewing <i>Phaps chalcoptera</i>		X	X	X		X	
Brush Bronzewing <i>Phaps elegans</i>		X	X	X			
Crested Pigeon <i>Ocyphaps lophotes</i>		X	X	X			
Cacatuidae (cockatoos)							
Long-billed Corella <i>Cacatua tenuirostris</i>		X		X			
Galah <i>Cacatua roseicapilla</i>		X	X	X		X	X
Little Corella <i>Cacatua sanguinea</i>	Int	X	X	X			
Carnaby's Black-Cockatoo <i>Calyptorhynchus</i>	CS1	X	X	X		X	X
Psittacidae (lorikeets and parrots)							
Rainbow Lorikeet <i>Trichoglossus haematodus</i>	Int	X	X	X			
Australian Ringneck <i>Barnardius zonarius</i>		X	X	X		X	
Red-capped Parrot <i>Purpureicephalus spurius</i>		X	X	X		X	

Bird Species	CS Status	ALA	Nat Map	Bird Data	BCE05	BCE08	BCE17
Rock Parrot <i>Neophema petrophila</i>	CS3						
Elegant Parrot <i>Neophema elegans</i>		X	X	X		X	
Cuculidae (cuckoos)							
Fan-tailed Cuckoo <i>Cacomantis flabelliformis</i>		X	X	X			
Pallid Cuckoo <i>Cuculus pallidus</i>		X	X	X			
Horsfield's Bronze-Cuckoo <i>Chrysococcyx basalus</i>		X	X	X		X	
Shining Bronze-Cuckoo <i>Chrysococcyx lucidus</i>		X	X	X			
Strigidae (hawk-owls)							
Southern Boobook <i>Ninox novaeseelandiae</i>		X	X	X			
Tytonidae (barn owls)							
Barn Owl <i>Tyto alba</i>		X	X	X			
Podargidae (frogmouths)							
Tawny Frogmouth <i>Podargus strigoides</i>		X	X	X			
Aegothelidae (owlet-nightjars)							
Australian Owlet-nightjar <i>Aegotheles cristatus</i>		X	X	X			
Caprimulgidae (nightjars)							
Spotted Nightjar <i>Eurostopodus argus</i>		X	X				
Apodidae (swifts)							
Fork-tailed Swift <i>Apus pacificus</i>	CS1	X	X	X			
Halcyonidae (forest kingfishers)							
Laughing Kookaburra <i>Dacelo novaeguineae</i>	Int	X	X	X			
Sacred Kingfisher <i>Todiramphus sanctus</i>		X	X	X			
Meropidae (bee-eaters)							
Rainbow Bee-eater <i>Merops ornatus</i>	CS1	X	X	X		X	
Maluridae (fairy-wrens)							
Splendid Fairy-wren <i>Malurus splendens</i>	CS3	X	X	X		X	
Variiegated Fairy-wren <i>Malurus lamberti</i>	CS3	X	X	X		X	
White-winged Fairy-wren <i>Malurus leucopterus</i>	CS3	X	X	X	X	X	
Southern Emu-wren <i>Stipiturus malachurus</i>	CS3						
Pardalotidae (pardalotes)							
Spotted Pardalote <i>Pardalotus punctatus</i>		X	X	X			
Striated Pardalote <i>Pardalotus striatus</i>		X	X	X			
White-browed Scrubwren <i>Sericornis frontalis</i>	CS3	X	X	X	X	X	
Weebill <i>Smircornis brevirostris</i>	CS3	X	X	X			
Western Gerygone <i>Gerygone fusca</i>		X	X	X		X	
Inland Thornbill <i>Acanthiza apicalis</i>	CS3	X	X	X		X	
Western Thornbill <i>Acanthiza inornata</i>	CS3	X	X	X		X	
Yellow-rumped Thornbill <i>Acanthiza chrysorrhoa</i>	CS3	X	X	X		X	
Meliphagidae (honeyeaters)							
Red Wattlebird <i>Anthochaera carunculata</i>		X	X	X	X	X	X
Western Wattlebird <i>Anthochaera lunulata</i>	CS3	X	X	X		X	
Yellow-throated Miner <i>Manorina flavigula</i>		X	X	X		X	
Singing Honeyeater <i>Lichenostomus virescens</i>		X	X	X	X	X	X
Brown Honeyeater <i>Lichmera indistincta</i>		X	X	X		X	
White-cheeked Honeyeater <i>Phylidonyris nigra</i>	CS3	X	X	X		X	

Bird Species	CS Status	ALA	Nat Map	Bird Data	BCE05	BCE08	BCE17
New Holland Honeyeater <i>Phylidonyris novaehollandiae</i>	CS3	X	X	X		X	
Tawny-crowned Honeyeater <i>Phylidonyris melanotis</i>	CS3			X			
Western Spinebill <i>Acanthorhynchus superciliosus</i>	CS3	X	X	X		X	
White-fronted Chat <i>Epthianura albifrons</i>		X	X	X			
Petroicidae (Australian robins)							
Hooded Robin <i>Melanodryas cucullata</i>	CS3	X	X				
White-breasted Robin <i>Eopsaltria georgiana</i>	CS3	X	X	X		X	
Neosittidae							
Varied Sittella <i>Daphoenositta chrysoptera</i>		X	X	X			
Pachycephalidae (whistlers)							
Rufous Whistler <i>Pachycephala rufiventris</i>		X	X	X		X	
Grey Shrike-thrush <i>Colluricincla harmonica</i>	CS3	X	X	X		X	
Dicruridae (flycatchers)							
Magpie-lark <i>Grallina cyanoleuca</i>		X	X	X			
Grey Fantail <i>Rhipidura fuliginosa</i>		X	X	X		X	
Willie Wagtail <i>Rhipidura leucophrys</i>		X	X	X	X	X	X
Campephagidae (cuckoo-shrikes)							
Black-faced Cuckoo-shrike <i>Coracina novaehollandiae</i>		X	X	X	X	X	
White-winged Triller <i>Lalage sueurii</i>		X	X	X		X	
Artamidae (woodswallows)							
Black-faced Woodswallow <i>Artamus cinereus</i>	CS3	X	X	X		X	X
Grey Butcherbird <i>Cracticus torquatus</i>		X	X	X	X	X	
Australian Magpie <i>Gymnorhina tibicen</i>		X	X	X	X	X	X
Corvidae (ravens and crows)							
Australian Raven <i>Corvus coronoides</i>		X	X	X		X	X
Motacillidae (pipits and true wagtails)							
Australian Pipit <i>Anthus novaeseelandiae</i>		X	X	X	X	X	
Dicaeidae (flower-peckers)							
Mistletoebird <i>Dicaeum hirundinaceum</i>		X	X	X			
Hirundinidae (swallows)							
White-backed Swallow <i>Cheramoeca leucosterna</i>		X	X	X			
Welcome Swallow <i>Hirundo neoxena</i>		X	X	X	X	X	X
Tree Martin <i>Hirundo nigricans</i>		X	X	X	X	X	
Sylviidae (Old World warblers)							
Rufous Songlark <i>Cincloramphus mathewsi</i>		X	X	X			
Brown Songlark <i>Cincloramphus cruralis</i>					X	X	
Zosteropidae (white-eyes)							
Silvereye <i>Zosterops lateralis</i>		X	X	X	X	X	X
Total number of bird species expected: 92	CS: 32 Int: 5	87	86	83	16	51	12

Mammals

Mammal Species	Status	ALA	Nat Map	BCE05	BCE08	BCE17
Tachyglossidae (echidnas)						
Echidna <i>Tachyglossus aculeatus</i>		X	X			
Peramelidae (bandicoots)						
Quenda or Brown Bandicoot <i>Isoodon obesulus</i>	CS2	X	X		X	
Phalangeridae (brush-tail possums)						
Brush-tailed Possum <i>Trichosurus vulpecula</i>	CS3	X	X		X	
Macropodidae (kangaroos and wallabies)						
Western Grey Kangaroo <i>Macropus fuliginosus</i>		X	X	X		X
Brush Wallaby <i>Notamacropus irma</i>	CS2	X	X			
Mollosidae (mastiff bats)						
White-striped Bat <i>Tadarida australis</i>		X	X		X	
Western Freetail Bat <i>Mormopterus planiceps</i>						
Vespertilionidae (vesper bats)						
Gould's Wattled Bat <i>Chalinolobus gouldii</i>		X	X			
Chocolate Wattled Bat <i>Chalinolobus morio</i>		X	X			
Lesser Long-eared Bat <i>Nyctophilus geoffroyi</i>		X	X			
Southern Forest Bat <i>Vespadelus regulus</i>		X	X			
Muridae (rats and mice)						
House Mouse <i>Mus musculus</i>	Int.	X	X	X	X	
Moodit or Bush-Rat <i>Rattus fuscipes</i>	CS3	X	X		X	?*
Black Rat <i>Rattus rattus</i>	Int.	X	X			
Leporidae (rabbits and hares)						
Rabbit <i>Oryctolagus cuniculus</i>	Int.	X	X	X	X	X
Canidae (foxes and dogs)						
European Red Fox <i>Vulpes vulpes</i>	Int.	X	X	X	X	X
Felidae (cats)						
Feral Cat <i>Felis catus</i>	Int.	X	X	X	X	
Total number of mammal species expected:	CS: 4					
17	Int: 5	16	16	5	8	4

*Potential *R.fuscipes* diggings recorded in cleared area (December 2016)

Appendix 5. Vertebrate species returned in database searches but unlikely to occur in the survey area.

Database searches often return found nearby but that are unlikely to be present in the survey area due to lack of suitable habitat (e.g. aquatic species) or ecological barriers preventing them from reaching the area (e.g. island species). There are also some errors, out-of-date Latin names, zoo specimens and subtleties of distribution that are not recognised in databases. The species listed below are considered highly unlikely to be found in the survey area (although some species could occur as very rare vagrants).

Common name	Latin name
Reptiles	
Stimson's Python	<i>Antaresia stimsoni</i>
Loggerhead Turtle	<i>Caretta caretta</i>
Oblong Turtle	<i>Chelodina colliei</i>
Green Turtle	<i>Chelonia mydas</i>
Squelching Froglet	<i>Crinia insignifera</i>
Fence Skink	<i>Cryptoblepharus plagiocephalus</i>
Odd-striped Ctenotus	<i>Ctenotus impar</i>
Leatherback Turtle	<i>Dermochelys coriacea</i>
Western Stone Gecko	<i>Diplodactylus granariensis</i>
Spotted Sandplain Gecko	<i>Diplodactylus polyophthalmus</i>
Crowned Snake	<i>Elapognathus calonotos</i>
Sand Frog	<i>Heleioporus psammophilus</i>
Yellow-bellied Seasnake	<i>Hydrophis platurus</i>
Bold-striped-Slider	<i>Lerista christinae</i>
South-western Orange-tailed Slider	<i>Lerista distinguenda</i>
Slender Tree Frog	<i>Litoria adelaidensis</i>
Motorbike Frog	<i>Litoria moorei</i>
Flatback Turtle	<i>Natator depressus</i>
Birds	
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>
Australian Reed Warbler	<i>Acrocephalus australis</i>
Common Sandpiper	<i>Actitis hypoleucos</i>
Chestnut Teal	<i>Anas castanea</i>
Grey Teal	<i>Anas gracilis</i>
Northern Mallard	<i>Anas platyrhynchos</i>
Australasian Shoveler	<i>Anas rhynchotis</i>
Pacific Black Duck	<i>Anas superciliosa</i>
Australasian Darter	<i>Anhinga novaehollandiae</i>
Australian Lesser Noddy	<i>Anous tenuirostris subsp. melanops</i>
Cattle Egret	<i>Ardea ibis</i>
Eastern Great Egret	<i>Ardea modesta</i>
White-faced Heron	<i>Ardea novaehollandiae</i>

White-necked Heron	<i>Ardea pacifica</i>
Ruddy Turnstone	<i>Arenaria interpres</i>
Dusky Woodswallow	<i>Artamus cyanopterus</i>
Masked Woodswallow	<i>Artamus personatus</i>
Hardhead	<i>Aythya australis</i>
Musk Duck	<i>Biziura lobata</i>
Australasian Bittern	<i>Botaurus poiciloptilus</i>
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>
Western Corella	<i>Cacatua pastinator</i>
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>
Sanderling	<i>Calidris alba</i>
Red Knot	<i>Calidris canutus</i>
Curlew Sandpiper	<i>Calidris ferruginea</i>
Red-necked Stint	<i>Calidris ruficollis</i>
Long-toed Stint	<i>Calidris subminuta</i>
Great Knot	<i>Calidris tenuirostris</i>
Forest Red-tailed Black-Cockatoo	<i>Calyptorhynchus banksii naso</i>
Baudin's Black-Cockatoo	<i>Calyptorhynchus baudinii</i>
Greater Sand Plover	<i>Charadrius leschenaultii</i>
Black-fronted Dotterel	<i>Charadrius melanops</i>
Red-capped Plover	<i>Charadrius ruficapillus</i>
Australian Wood Duck	<i>Chenonetta jubata</i>
Swamp Harrier	<i>Circus approximans</i>
Banded Stilt	<i>Cladorhynchus leucocephalus</i>
Rufous Treecreeper	<i>Climacteris rufa</i>
Little Crow	<i>Corvus bennetti</i>
Brown Quail	<i>Coturnix ypsilophora</i>
Pied Butcherbird	<i>Cracticus nigrogularis</i>
White-backed Magpie	<i>Cracticus tibicen subsp. dorsalis</i>
Black Swan	<i>Cygnus atratus</i>
Amsterdam Albatross	<i>Diomedea amsterdamensis</i>
Yellow-nosed Albatross	<i>Diomedea chlororhynchos</i>
Grey-headed Albatross	<i>Diomedea chrysostoma</i>
Southern Royal Albatross	<i>Diomedea epomophora (sensu stricto)</i>
Wandering Albatross	<i>Diomedea exulans (sensu lato)</i>
Northern Royal Albatross	<i>Diomedea sanfordi</i>
Little Egret	<i>Egretta garzetta</i>
Eastern Reef Egret	<i>Egretta sacra</i>
Western Yellow Robin	<i>Eopsaltria australis subsp. Griseogularis</i>
Red-kneed Dotterel	<i>Erythrogonys cinctus</i>
Little Penguin	<i>Eudyptula minor subsp. novaehollandiae</i>

Western Shrike-tit, Crested Shrike-tit	<i>Falcunculus frontatus subsp. leucogaster</i>
Eurasian Coot	<i>Fulica atra</i>
Dusky Moorhen	<i>Gallinula tenebrosa</i>
Buff-banded Rail	<i>Gallirallus philippensis</i>
Purple-crowned Lorikeet	<i>Glossopsitta porphyrocephala</i>
Pied Oystercatcher	<i>Haematopus longirostris</i>
Blue Petrel	<i>Halobaena caerulea</i>
Black-winged Stilt	<i>Himantopus himantopus</i>
Australian Black Bittern	<i>Ixobrychus flavicollis subsp. australis</i>
Australian Little Bittern	<i>Ixobrychus minutus subsp. dubius</i>
Pacific Gull	<i>Larus pacificus</i>
Malleefowl	<i>Leipoa ocellata</i>
White-eared Honeyeater	<i>Lichenostomus leucotis</i>
Bar-tailed Godwit	<i>Limosa lapponica</i>
Black-tailed Godwit	<i>Limosa limosa</i>
Southern Giant Petrel	<i>Macronectes giganteus</i>
Northern Giant Petrel	<i>Macronectes halli</i>
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>
Little Grassbird	<i>Megalurus gramineus</i>
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>
White-naped Honeyeater	<i>Melithreptus lunatus</i>
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>
Jacky Winter	<i>Microeca fascinans</i>
Australasian Gannet	<i>Morus serrator</i>
Restless Flycatcher	<i>Myiagra inquieta</i>
Eastern Curlew	<i>Numenius madagascariensis</i>
Nankeen Night-Heron	<i>Nycticorax caledonicus</i>
Bridled Tern	<i>Onychoprion anaethetus</i>
Crested Bellbird	<i>Oreoica gutturalis gutturalis</i>
Blue-billed Duck	<i>Oxyura australis</i>
Golden Whistler	<i>Pachycephala pectoralis</i>
Slender-billed Prion	<i>Pachyptila belcheri</i>
Antarctic Prion	<i>Pachyptila desolata</i>
Fairy Prion	<i>Pachyptila turtur</i>
Australian Pelican	<i>Pelecanus conspicillatus</i>
Fairy Martin	<i>Petrochelidon ariel</i>
Red-capped Robin	<i>Petroica goodenovii</i>
Scarlet Robin	<i>Petroica multicolor</i>
Great Cormorant	<i>Phalacrocorax carbo</i>
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>
Pied Cormorant	<i>Phalacrocorax varius</i>

Sooty Albatross	<i>Phoebetria fusca</i>
Yellow-billed Spoonbill	<i>Platalea flavipes</i>
Royal Spoonbill	<i>Platalea regia</i>
Western Rosella	<i>Platycercus icterotis</i>
Glossy Ibis	<i>Plegadis falcinellus</i>
Grey Plover	<i>Pluvialis squatarola</i>
Great Crested Grebe	<i>Podiceps cristatus</i>
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>
Regent Parrot	<i>Polytelis anthopeplus</i>
Little Grassbird	<i>Poodytes gramineus</i>
Purple Swamphen	<i>Porphyrio porphyrio</i>
Australian Spotted Crake	<i>Porzana fluminea</i>
Baillon's Crake	<i>Porzana pusilla subsp. palustris</i>
Spotless Crake	<i>Porzana tabuensis</i>
White-chinned Petrel	<i>Procellaria aequinoctialis</i>
Kerguelen Petrel	<i>Pterodroma brevirostris</i>
Soft-plumaged Petrel	<i>Pterodroma mollis</i>
Yellow-plumed Honeyeater	<i>Ptilotula ornatus</i>
Fleshy-footed Shearwater	<i>Puffinus carneipes</i>
Wedge-tailed Shearwater	<i>Puffinus pacificus</i>
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>
Australian Painted Snipe	<i>Rostratula australis</i>
Crested Tern	<i>Sterna bergii</i>
Caspian Tern	<i>Sterna caspia</i>
Roseate Tern	<i>Sterna dougallii subsp. gracilis</i>
Australian Fairy Tern	<i>Sternula nereis nereis</i>
Freckled Duck	<i>Stictonetta naevosa</i>
Grey Currawong	<i>Strepera versicolor</i>
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>
Australian Shelduck	<i>Tadorna tadornoides</i>
Indian Yellow-nosed Albatross	<i>Thalassarche carteri</i>
Shy Albatross	<i>Thalassarche cauta cauta</i>
White-capped Albatross	<i>Thalassarche cauta steadi</i>
Campbell Albatross,	<i>Thalassarche impavida</i>
Black-browed Albatross	<i>Thalassarche melanophris</i>
Hooded Plover	<i>Thinornis rubricollis</i>
Straw-necked Ibis	<i>Threskiornis spinicollis</i>
Black-tailed Native-hen	<i>Tribonyx ventralis</i>
Common Greenshank	<i>Tringa nebularia</i>
Masked Owl	<i>Tyto novaehollandiae</i>
Masked Lapwing	<i>Vanellus miles</i>

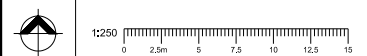
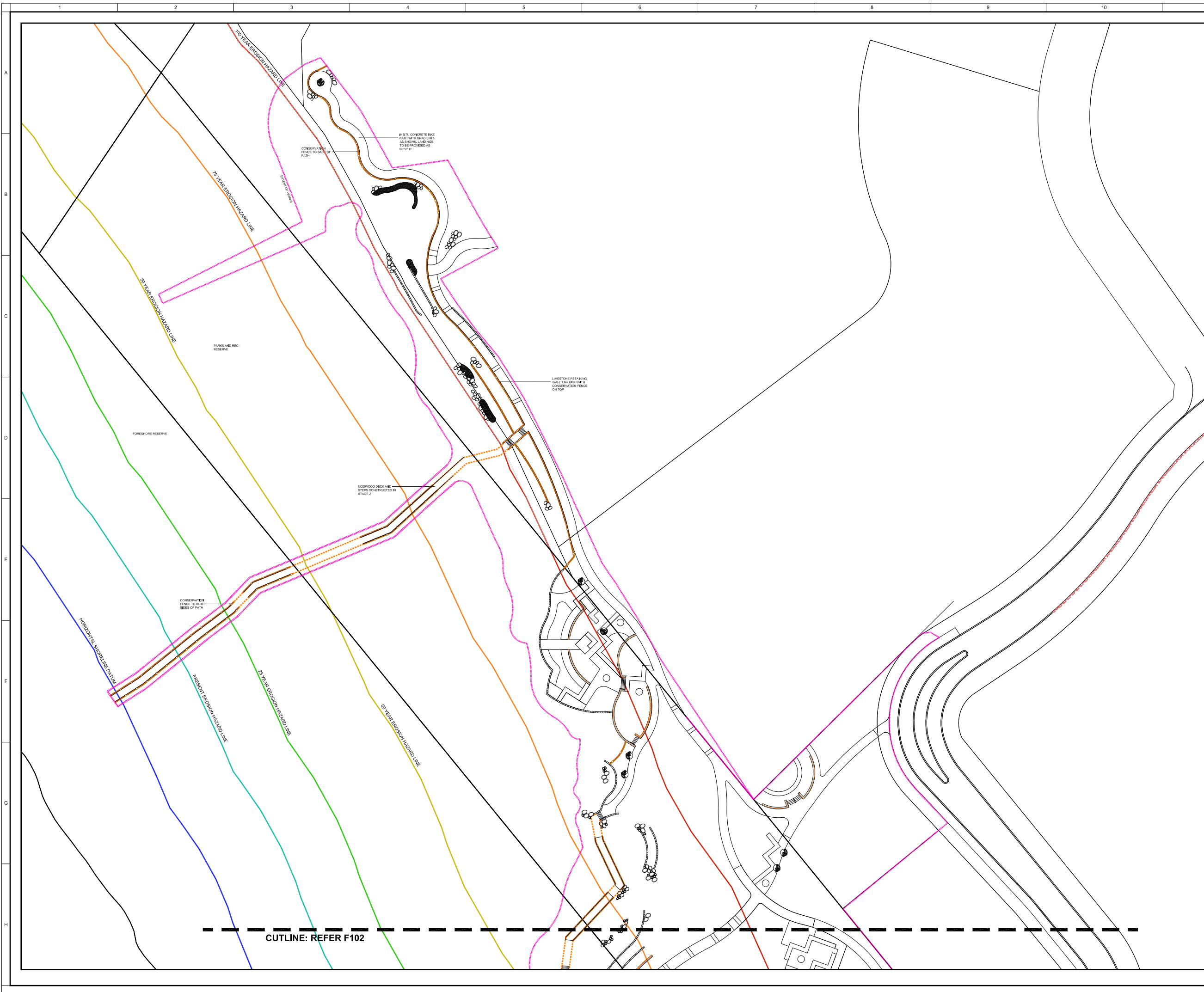
Mammals	
New Zealand Fur Seal	<i>Arctocephalus forsteri</i>
Sub-antarctic Fur Seal	<i>Arctocephalus tropicalis</i>
Dwarf Minke Whale	<i>Balaenoptera acutorostrata</i>
Blue Whale	<i>Balaenoptera musculus</i>
Boodie, Burrowing Bettong	<i>Bettongia lesueur subsp. graii</i>
Woylie, Brush-tailed Bettong	<i>Bettongia penicillata subsp. ogilbyi</i>
European Cattle	<i>Bos taurus</i>
Camel	<i>Camelus dromedarius</i>
Dog, Dingo	<i>Canis lupus</i>
Western Pygmy-possum	<i>Cercartetus concinnus</i>
Chuditch, Western Quoll	<i>Dasyurus geoffroii</i>
Southern Right Whale	<i>Eubalaena australis</i>
Water-rat	<i>Hydromys chrysogaster</i>
Pygmy Sperm Whale	<i>Kogia breviceps</i>
Humpback Whale	<i>Megaptera novaeangliae</i>
Andrew's Beaked Whale	<i>Mesoplodon bowdoini</i>
European Polecat, Ferret	<i>Mustela putorius</i>
Australian Sea Lion	<i>Neophoca cinerea</i>
Greater Long-eared Bat	<i>Nyctophilus timoriensis</i>
Sheep	<i>Ovis aries</i>
Western Barred Bandicoot	<i>Perameles bougainville subsp. Bougainville</i>
Desert Bandicoot	<i>Perameles eremiana</i>
Sugar Glider	<i>Petaurus breviceps subsp. ariel</i>
Black-flanked Rock-wallaby	<i>Petrogale lateralis subsp. lateralis</i>
Sperm Whale	<i>Physeter macrocephalus</i>
Ashy-grey Mouse	<i>Pseudomys albocinereus</i>
Fat-tailed Dunnart	<i>Sminthopsis crassicaudata</i>
Gilbert's Dunnart	<i>Sminthopsis gilberti</i>
White-tailed Dunnart	<i>Sminthopsis granulipes</i>
Grey-bellied Dunnart	<i>Sminthopsis griseoventer</i>
Honey Possum	<i>Tarsipes rostratus</i>
Northern Brushtail Possum	<i>Trichosurus vulpecula subsp. arnhemensis</i>
Bottlenose Dolphin	<i>Tursiops truncatus</i>

Appendix 6. Scoring system for the assessment of Black-Cockatoo foraging values.

Site Score	Vegetation Description Carnaby's Black-Cockatoo
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples would be salt lakes and bare ground.
1	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these <2%. Could include urban areas with scattered foraging trees. Blue Gum plantations are considered to have a score of 1 as foraging by Black-Cockatoos has been reported but appears to be unusual.
2	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> • Shrubland in which species of foraging value, such as shrubby banksias, with <10% projected foliage cover. • Open eucalypt woodland/mallee of small-fruited species. • Paddocks with melons or other weeds (a short-term, seasonal food source).
3	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> • Shrubland in which species of foraging value, such as shrubby banksias, with 10-20% projected foliage cover. • Woodland with tree banksias 2-10% projected foliage cover. • Eucalypt woodland/mallee of small-fruited species; Marri, if present, <10% project foliage cover.
4	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> • Woodland with tree banksias 20-40% projected foliage cover. • Eucalypt woodland/forest with Marri 20-40% projected foliage cover.
5	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> • Banksia woodlands with tree banksias >40%. Vegetation condition moderate due to weed invasion and some tree deaths.
6	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> • Banksia woodlands of key species (e.g. <i>B. attenuata</i>, <i>B. menziesii</i>) with projected foliage cover >60%. Vegetation condition good with low weed invasion and low tree death to indicate it is robust and unlikely to decline in the medium term.

Proteaceous plants include species such as *Banksia*, *Hakea* and *Grevillea*.

Appendix 5
Indicative fencing strategy



LEGEND: FENCING STRATEGY

- ▬▬▬▬▬▬ EXTENT OF LANDSCAPE WORKS
- ▬▬▬▬▬▬ TOW 3.50
BGL 2.80 RETAINING WALL WITH TOP OF WALL AND BOTTOM OF WALL HEIGHTS, ACTS AS PHYSICAL BARRIER
- ▬▬▬▬▬▬ 1.2m TALL CoW CONSERVATION FENCE, ACTS AS PHYSICAL BARRIER
- ▬▬▬▬▬▬ BALUSTRADE, ACTS AS PHYSICAL BARRIER
- ○ ○ ○ MORTARED LIMESTONE BOULDERS WITH STONE PITCHING TO STABILISE SLOPES OR ACT AS A PHYSICAL BARRIER
- ○ ○ ○ MORTARED GRANITE BOULDERS, ACT AS A PHYSICAL BARRIER
- ○ ○ ○ BOLLARDS: DO NOT ACT AS PHYSICAL BARRIER YET PREVENT VEHICLE ACCESS INTO OPEN SPACE
- ▬▬▬▬▬▬ NEW FOOTPATHS (NOTE WIDTHS AND MATERIALS VARY)

NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE FULL SET OF LANDSCAPE PLANS SUBMITTED FOR DA.

No.	REVISION	BY	DATE
D	UPDATED FENCING STRATEGY	KD	071217
C	FENCING STRATEGY DRAWING	KD	031017
B	DA SUBMISSION	KD	200717
A	FOR APPROVAL	SC	240217

FENCING STRATEGY SHEET 1

Project
CAPRICORN VILLAGE COASTAL NODE

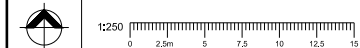
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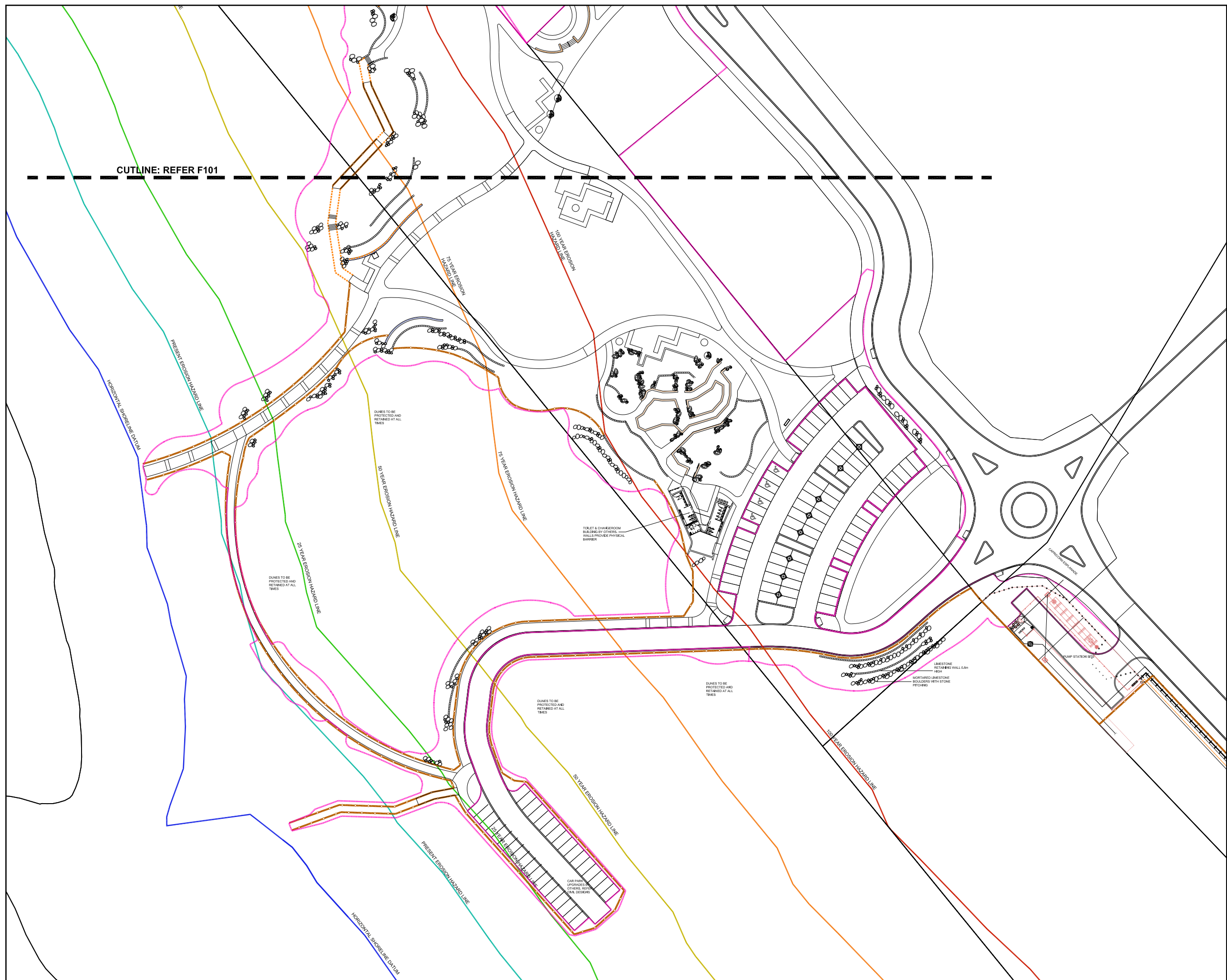
Project No.	Category	Drawing No.
B0494/CV/CN/F101		
Date	MARCH 2017	Revision
Scale	1:500 @ A1	D
Issue	APPROVAL	
Drawn	RMKD	Checked
		KD



LEGEND: FENCING STRATEGY

- EXTENT OF LANDSCAPE WORKS
- RETAINING WALL WITH TOP OF WALL AND BOTTOM OF WALL HEIGHTS, ACTS AS PHYSICAL BARRIER
- 1.2m TALL CoW CONSERVATION FENCE, ACTS AS PHYSICAL BARRIER
- BALUSTRADE, ACTS AS PHYSICAL BARRIER
- MORTARED LIMESTONE BOULDERS WITH STONE PITCHING TO STABILISE SLOPES OR ACT AS A PHYSICAL BARRIER
- MORTARED GRANITE BOULDERS, ACT AS A PHYSICAL BARRIER
- BOLLARDS: DO NOT ACT AS PHYSICAL BARRIER YET PREVENT VEHICLE ACCESS INTO OPEN SPACE
- NEW FOOTPATHS (NOTE WIDTHS AND MATERIALS VARY)

NOTE: THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE FULL SET OF LANDSCAPE PLANS SUBMITTED FOR DA.



No.	REVISION	BY	DATE
D	UPDATED FENCING STRATEGY	KD	071217
C	FENCING STRATEGY DRAWING	KD	031017
B	DA SUBMISSION	KD	200717
A	FOR APPROVAL	SC	240217

FENCING STRATEGY SHEET 2

Project
CAPRICORN VILLAGE
COASTAL NODE

Client
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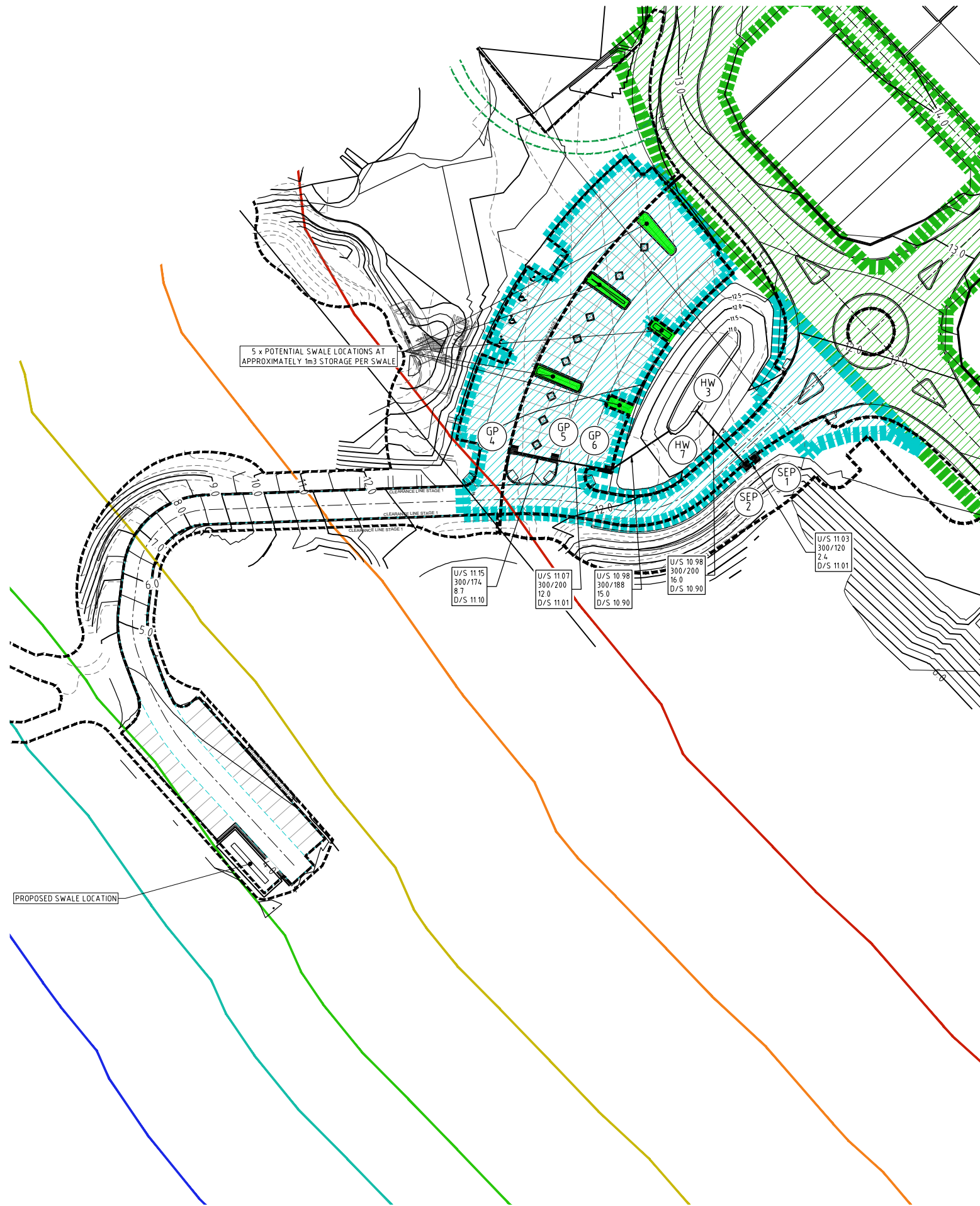


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Issue	APPROVAL	Checked KD
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Appendix 6
Stormwater drainage design



LEGEND

- EXISTING CONTOUR
- EPCAD DESIGN CONTOUR (1.0m)
- CW DESIGN CONTOUR (0.5m)
- CATCHMENT H
- CATCHMENT I
- PROPOSED DRAINAGE PIPE WITH JP, SEP, GP AND CGP
- PROPOSED SIDE ENTRY PIT, STANDARD GULLY PIT AND HEADWALL



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REV	DATE	DRN	CKD	APP	AMENDMENT	REV	DATE	DRN	CKD	APP	AMENDMENT
E	29.03.18	DPM			DRAINAGE PITS REPLACED WITH SWALE AT FORESHORE						
D	13.03.18	WBR			DRAINAGE INFORMATION ADDED						
C	30.11.17	DPM			ISSUED FOR INFORMATION						
B	30.11.17	DPM			AERIAL OVERLAY						
A	29.11.17	DPM			ISSUED FOR INFORMATION						

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CapricornVillage
JOINT VENTURE

CLIENT: CAPRICORN COASTAL NODE
PROJECT TITLE: DRAINAGE STRATEGY

APPROVED: **CHECK PRINT**
DESIGNED: MTW
SCALE: 12000

WAPC No. []
DRAWING No. 5745-CN01-SK29
REVISION: E

ORIGINAL SIZE A1

Appendix 7
Coastal Risk Assessment and
Recommendations: Capricorn Yanciep
Development



Coastal Risk Assessment and Recommendations

Capricorn Yanchep Development



SURF LIFE SAVING
WESTERN AUSTRALIA

Commercial-in-confidence

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1. Summary

DRAFT



1.1 Summary

The section of coastline backing the beach north of Yanchep Lagoon is being developed for housing as part of the Capricorn Joint Venture Project. The beach adjacent to the development is 1.25km long running north from the end of Yanchep Lagoon and is classified as Yanchep Beach (WA896) and Capricorn Beach (WA897) as identified in the Australian Beach Safety and Management Program (ABSAMP). The beaches are split by a groyne located towards the centre of the beach in lee of a small reef. There are currently formal beach access tracks which will be maintained or upgraded as part of the redevelopment. Additional facilities will be added in to support beach usage.

The objectives of the consultancy are as follows:

1. Undertake a coastal aquatic risk assessment of the beach adjacent to the Capricorn Development and assess its suitability as a recreational aquatic activity and swimming beach.
2. Conduct a review of existing signage to ensure signage is appropriate, to the required standard and reflects the nature of the risks present. Recommendations regarding the addition or relocation of signage will be provided in line with development plans.

In its current state the assessed areas are not heavily used for swimming activities with Yanchep Lagoon in the south more popular due to the provision of lifesaving services and facilities including a cafe, showers and sufficient parking. With the expected population growth in the area as development of housing continues it is likely beach usage at both Yanchep Beach and Capricorn Beach will increase.

SLSWA have assessed that this section of beach is suitable for continued usage for recreational aquatic activity, in particular Capricorn Beach north of the groyne. This section of beach is the preferred site for recreational activities due to the absence of rock/reef platforms which are evident along most of Yanchep Beach. This would be the preferred location for development of a coastal node with additional infrastructure including parking, cafes, showers etc. Recommended infrastructure to support safe aquatic recreation includes defined access tracks, designated emergency vehicle access points and a system of safety signage.

SLSWA completed a full audit of signage on this section of coast for the City of Wanneroo in 2014. As a result of the demolition of the Capricorn site and construction works some of this signage has been removed or damaged. Once access tracks and carparks are developed beach safety signage will need to be updated to suit the changed conditions.

This report contains findings and recommendations specific to current standards, guidelines and good practice regarding aquatic recreational risk management pertinent to the characteristics and designed applicative use of the assessed location. The report contains information specific to the Capricorn Development only.

A set of risk treatment options is proposed for the Capricorn Development. The following risk treatments are offered for consideration and are representative of the key recommendations tabled:

1. Access and Ongoing Maintenance (Section 4.2.4)
2. System of Safety Signage (4.2.5)
3. Systems of Supervision- Lifesaving Service Level Analysis (Section 4.2.6)
4. Existence of Emergency Action Plans (Section 4.2.7)
5. Education and Awareness Programs (Section 4.2.8)
6. Dune Vegetation Maintenance, Beach Scarping and Tunnelling (Section 4.2.9)
7. Monitor and Review (Section 4.2.10)

As a consequence of the continuing growth and changing usage patterns it is the view of SLSWA that the Land Manager should periodically review this aquatic risk assessment and treatment plan, in particular when a milestone development occurs or is imminent.

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1.2 SUMMARY OF PROPOSED KEY RISK TREATMENTS

1.2.1 Access and Ongoing Maintenance

There is currently a series of access points to both Yanchep and Capricorn Beach both informal and formal. As part of the development new access tracks will be developed, existing tracks will be upgraded for use and unnecessary or informal tracks closed. SLSWA recommend that wider emergency access for vehicles and other approved users to main beach areas be considered. Any hazards associated with access tracks and recreational areas should be removed where possible. Areas not suitable for swimming or recreational activities should have access restricted.

Ideally major access points provided should direct swimmers to the more 'friendly' areas for recreational swimming activities and patrolled areas. If this cannot be achieved other measures should be in place to direct swimmers to more suitable locations to recreate.

Please refer to Section 4.2.4 for more information on access infrastructure and ongoing maintenance.

1.2.2 System of Safety Signage

There is appropriate signage installed in most locations as per previous reports however some signage has been removed from areas where demolition or construction has occurred. There is also evidence of damaged signage and out of date temporary signage which should be removed in line with development.

Once access tracks, roads and carparks are developed or updated the appropriate signage should be installed.

Suitable future signage includes:

- Beach and aquatic safety signage,
- Location signage,
- Aquatic zoning signage,
- Signage relating to location of toilets/disabled access,
- Signage relating to location of nearest lifesaving service,
- Local government regulation signage,
- Environmental and conservation signage,
- Community information signage including safety, security and crime prevention.

Please refer to section 4.2.5 for more information on systems of safety signage.

1.2.3 System of Supervision – Lifesaving Service Level Analysis

Information of a general nature has been provided as a part of this report. While an assessment of service levels has been completed and is included for review purposes only, there are a number of other factors for the Land Manager to consider. The provision of a lifesaving service very much depends on the resource capabilities of the local community and the ability to implement basic infrastructure to support the delivery of a service.

Information provided in this report gives reference to a range of options relating to the provision of a lifesaving or surveillance service including:

- Activity Zoning
- Beach Camera Streams
- Operational, Storage and First Aid Facility
- Seasonal Lifesaving Service

Please refer to Section 4.2.6 for more information on systems of supervision.

1.2.4 Existence of Emergency Action Plans

The range of emergencies can vary between land and water, and from one location to the next. These can be the result of natural processes or human action, or a combination of these.

A well-planned and rehearsed Emergency Action Plan (EAP) for aquatic locations can greatly minimise the extent of injury and incapacitation if an incident does occur.

Please refer to Section 4.2.7 for more information on Emergency Action Plans.

1.2.5 Education and Awareness Programs

Education and awareness programs for residents, especially school aged children, and tourists alike are effective in mitigating risks at aquatic locations (see Appendix I for BeachSAFE Initiatives and Principles).

This section highlights and tables the SLSWA BeachSAFE Initiative in addressing awareness and education pertaining to improved safe coastal aquatic recreation. When consistently implemented it will assist to build the capacity of individuals and the local community to mitigate the risks of recreation and leisure in an aquatic environment.

The Land Manager should give strong consideration to actively investing in aquatic safety awareness and education programs to improve aquatic risk mitigation.

The Land Manager should also consider the development of a beach safety information booklet or similar; specific to the Yanchep area. This resource can be issued to residents within the Capricorn Development and visitors to enhance their awareness and understanding of behaviours that assist to make beaches a safer and more enjoyable place.

For more information on education and awareness programs please refer to Section 4.2.8.

1.2.6 Dune Vegetation Maintenance, Beach Scarping and Tunnelling

Parts of the Western Australian coast have been subject to beach erosion causing scarping of the beach and dunes, as a result of storm and swell events. This scarping can present a risk to the beachgoing public from the unstable nature of the face of the scarp. This section discusses some temporary measures for consideration to reduce the risk posed to the beach going public as a result of the erosion that was evidenced at Yanchep and Capricorn Beach.

Please refer to Section 4.2.9 for more information on foreshore degradation.

1.2.7 Monitoring and Review

Monitoring and review provides information on the extent to which risk treatment options are meeting their objectives, new hazards and risks being identified in a timely manner and evolving strategies being developed in line with community expectations.

Monitoring and review activity should not be limited to maintenance programs and should actively seek to record and analyse objective data relating to the how, why, what and when the beaches are being used, along with any incidents that occur so that objective decisions and medium to long term planned strategies can be developed by the land manager to assist in managing aquatic and recreational risk.

Please refer to Section 4.2.10 for more information on monitoring and review.

1.3 SUMMARY OF KEY RECOMMENDATIONS

1.3.1 RECOMMENDATION 1

Formal pedestrian access points and emergency vehicle access should be provided to the designated beach and recreational areas. Identified hazards specific to access tracks should be removed where appropriate. Access to unsuitable or hazardous areas should be restricted or removed.

1.3.2 RECOMMENDATION 2

The party responsible for implementing and maintaining access points and therefore communication of risk (i.e. safety signage) should implement an inspection regime to assess the installation, adequacy and visibility of in-situ aquatic and recreational safety signage. Records of the inspections and actions should be maintained.

1.3.3 RECOMMENDATION 3

The party responsible for implementing and maintaining aquatic safety signage should ensure the number of individual signs at any one location is maintained to a minimum, wherever possible. A single point of information for warning, regulation and information signage reduces confusion and visual pollution.

1.3.4 RECOMMENDATION 4

The party responsible for implementing and maintaining safety signs adopts and maintains emergency location signage identifiers, as shown in the National Aquatic and Recreational Signage and Style Manual (NARSSM).

These should be incorporated into any new safety signage in the Capricorn Development. This should be done in consultation with relevant emergency services agencies and the City of Wanneroo. A numbering system will need to be developed and adopted by the party responsible for maintaining access tracks and signs. Future municipal/residential developments need to be taken into account to avoid out of sync codes/location identifiers associated with future developments.

1.3.5 RECOMMENDATION 5

The party responsible for implementing and maintaining aquatic safety strategies should consider the installation of an operational, storage and first aid facility and associated surveillance station at Capricorn Beach. These facilities will provide a base for lifesaving services to operate as required.

1.3.6 RECOMMENDATION 6

The party responsible for implementing and maintaining aquatic safety strategies should develop, implement and review Emergency Action Plans (EAPs). This activity is to assure a planned and coordinated response to the range of potential and localised aquatic and recreation emergencies that may occur along the foreshore reserve.

The EAPs should take into account the difficulties in accessing locations, delay of response and the inherent risks of the locations.

1.3.7 RECOMMENDATION 7

The party responsible for implementing and maintaining aquatic safety strategies should, in association with other water safety and emergency response organisations, develop a planned and adequately resourced approach to improving long term awareness and education opportunities as they relate to safer aquatic recreation at Capricorn Yanchep.

1.3.8 RECOMMENDATION 8

Land Manager to consider an awareness program that develops a resident's safety booklet/flyer or similar to be distributed or promoted to new home owners, businesses and tourists in the Capricorn Yanchep Development.

This booklet should contain general beach safety information and messages in addition to safety information which is specific to the Yanchep area.

1.3.9 RECOMMENDATION 9

The party responsible for implementing and maintaining aquatic safety strategies should implement the use of Quick Reader (QR) codes on aquatic and recreational safety signage. Users of this technology are taken to safety information and in languages and translations that are relevant to their culture and language. The use of QR codes should form part of any aquatic awareness and education programs.

1.3.10 RECOMMENDATION 10

The party responsible for implementing and maintaining aquatic safety strategies to consider, and where practicable, implement engineered options to minimise the risks associated with dune and beach scarping and discourage access to these areas.

1.3.11 RECOMMENDATION 11

The party responsible for implementing and maintaining aquatic safety strategies should review and continue to enhance aquatic recreation public safety injury data and information collection. This should include the collation and analyses deemed necessary to underpin accurate risk assessment and effective risk treatment plans and actions.

2. Introduction, Scope & Context

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2.1 Introduction

In the 2015-2016 Season Western Australia had 20 drowning deaths, accounting for 15% of the national figure¹. The vast majority of these drownings occurred whilst boating (40%), wading/swimming (20%) and via rock/cliff related activities other than rock fishing (10%).

The vast majority of these fatal drowning deaths can be attributed to swimming/rip-currents and rock-fishing, with almost all occurring at unpatrolled locations/times, where no expert assistance is immediately available.

Accidental drowning deaths in the coastal aquatic environment can be accounted for through a number of causal factors known as the *drowning chain*.

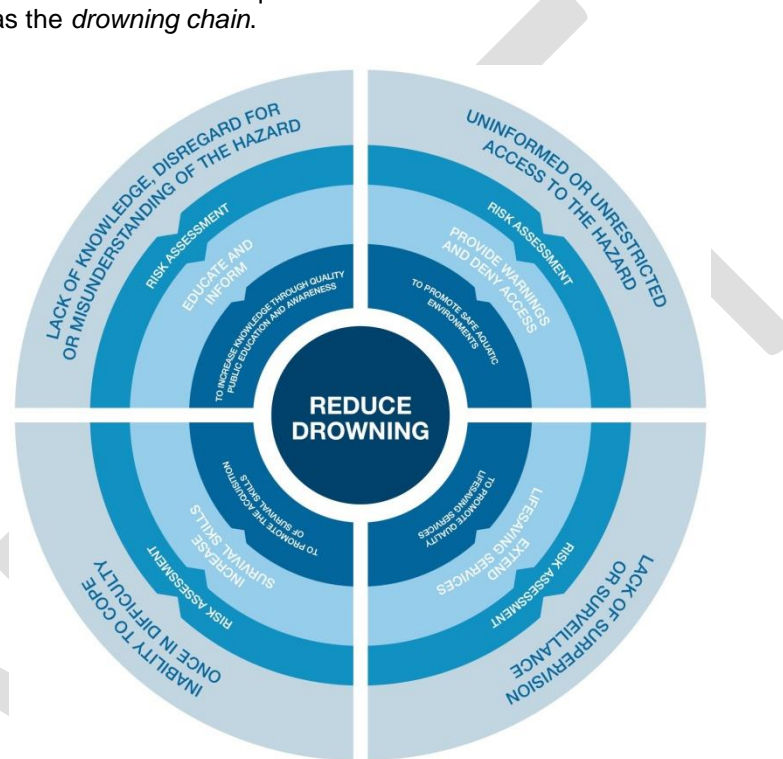


Figure 1: The International Life Saving Federation Drowning Chain (Source: ILSF Drowning Prevention Strategies, 2008)

Causal factors include:

- Lack of knowledge, disregard or misunderstanding of the hazard
- Uninformed or unrestricted access to the hazard
- Lack of supervision or surveillance
- Inability to cope once in difficulty.

Any of the above, either alone or in combination, could lead to a death by drowning. The strategies that have been identified to address the drowning chain include:

- Education and information
- Denial of access
- Improvement of infrastructure and/or provision of warnings

¹ Surf Life Surf Life Saving Australia (2016) National Coastal Safety Report 2016. SLISA: Sydney. Surf Life Saving Australia.



- Provision of supervision
- Acquisition of survival skills.

This report is a coastal public safety risk assessment and treatment plan specific to water safety related issues identified at the unpatrolled location of Yanchep Beach and Capricorn Beach.

This risk assessment and treatment plan has been prepared following an on-site risk assessment undertaken by SLSWA for Capricorn Village Joint Venture. The on-site assessments were based upon good practice risk management.

Both the on-site risk assessment and compilation of the risk assessment and treatment plan report have received contributions and input by SLSWA personnel including Mr Chris Peck, Ms Rachel Duczynski, Mr Matt du Plessis, Mr Simon Pepler and Ms Chrissie Skehan.

The assessment of risks and their potential treatments are detailed in the risk register and risk treatment plan section (Appendix C). Risks and the potential risk treatments are grouped into one table for ease of understanding.

The risk register and risk treatment plan is a tabular summary of risks identified by SLSWA and how to possibly best deal with them. It includes a list of **potential** risk treatments as identified by SLSWA and those risk treatments identified that are already in place.

The Overview of Principal Risk Treatments section details SLSWA's recommendations for a coordinated system of access control (Section 4.2.4) and safety signage (Section 4.2.5), which reflects current good practice. Although an effective risk treatment, signage should not be the only method used in minimizing the identified risks. Additional methods and recommendations for mitigating risk are also proposed in this section for consideration.

2.2 Scope and Context

The risk assessment is based on available information and conditions as observed during the site visit in February 2017 and previous site visits in May 2014.

This report provides treatment recommendations about how to improve risk and safety management in line with current industry aquatic risk management good practices, international standards and Australian water safety signage standards.

Risk treatments are guiding recommendations only and are representative of SLSWA's opinion in relation to safe aquatic recreation at Capricorn Yanchep.

The Land Manager, in consultation with all identified stakeholders, should determine which risk treatments are appropriate and can feasibly be implemented at this location.

2.3 Definition of Terms

The following is a summary of the definition of key terms used within this report.

ABSAMP, means the Australian Beach Safety and Management Program.

Emergency Action Plan, means a plan that outlines the procedures to be used in the event of an emergency.

Fringe, means the periods between the summer school holidays and both the spring and autumn school holidays, excluding the actual school holidays and Easter. The fringe season is usually characterised by periods of high level beach activity on weekends and public holidays and medium level beach activity on week days.

Hazard, means a potential to threaten human life, health, property or the environment.

Hazard symbols, means a graphical symbol used together with a safety colour and safety shape to form a safety sign.

Lifesaving Service, means an organised and structured service comprised of volunteer lifesavers and/or paid lifeguards and appropriate rescue and first aid equipment supported by a coordinated backup team.

Off peak, means the winter period generally from May through to August and which traditionally has low levels of beach activity.

Peak, means the spring, summer and autumn school holiday periods, and Easter where not included within the autumn school holiday period. The peak season is usually characterised by a high level of beach activity on all days.

Observation tower, means an elevated platform from which provides a lifesaver or lifeguard with an unobstructed view of an area of water and/or beach from either a seated or standing position.

Recreational waters, means those natural waters used not only swimming, windsurfing, and waterskiing, but also for boating and fishing.

Rescue, means to withdraw, remove, free, save or deliver from a state of exposure to a hazardous or potentially hazardous event.

Rescue watercraft, means a watercraft designed and used for rescue; in this instance the rescue of people.

Rip, (aka rip current) means channelled currents of water flowing away from shore, typically extending from the shoreline, through the surf zone, and past the line of breaking waves.

Risk Register, means a table summarising the identified risks, the location, why it has been identified as a risk, what current treatments are in place to lessen the risk and an overall hazard rating.

Risk Treatment Plan, means a table summarising how to deal with the identified risks, including a list of potential risk treatments, the risk treatments currently and any residual risk.

SLSC, means a Surf Life Saving Club from which seasonal volunteer based lifesaving services are provided.

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3. Assessment Methodology

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3.1 Site Identification

The survey area consists of two beaches as identified in the Australian Beach Safety and Management Program (ABSAMP) as Yanchep Beach (WA896) and Capricorn Beach (WA897). The 1.25km stretch of beach to be assessed runs from the end of Yanchep Lagoon, north past a groyne until a small rocky outcrop. The redevelopment of the area backing the beach will involve upgrading of existing tracks, addition of new tracks and development of a coastal node with associated facilities and infrastructure.

Yanchep Beach (WA896) begins on the northern side of the reef and continues north for 1km to the Capricorn Beach groyne, which is located in lee of a small reef. Waves average just over 1m along the beach and usually maintain a low tide terrace, which is cut by beach rips during and following periods of higher waves. There are sections of reef spaced intermittently along this section of beach in the surf zone.

The Yanchep Surf Life Saving Club is located at the southern end of the beach and patrols the lagoon.

Capricorn Beach (WA 897) extends for 1.25km from the groyne north until to a foreland attached calcarenite reef. Waves average around 1m and maintain a reflective to low tide terrace beach.

3.1.1 Swimming

Yanchep Lagoon is currently the most popular location for swimming activities. Recreation is promoted in this location through the provision of access tracks, lifesaving services (seasonal) and facilities including parking, café and showers. As housing in the area continues to grow and improved access is developed north of the lagoon, beach usage is likely to spread north along this section of beach.

Both Yanchep and Capricorn Beach are generally considered moderately hazardous under average conditions; however, this can change depending on the prevailing swell, wind direction and strength, tide position, time of the year and ultimately the fitness and capability of each individual beach user. There are sections of submerged rock/reef platforms in the wave zone along Yanchep Beach and two topographic rips in the area; one running from the northern end of Yanchep Lagoon and the other next to the Capricorn Groyne. Currents in these locations can be strong at times and prove hazardous to swimmers. The strong currents and wave action in the area can also cause additional rips to form along this section of beach.

3.1.2 Fishing

Fishing is a popular activity in Yanchep both from the beach and from rocks north of the lagoon and the Capricorn groyne. Fishing is not permitted between the red and yellow flags and spearfishing is prohibited at all times.

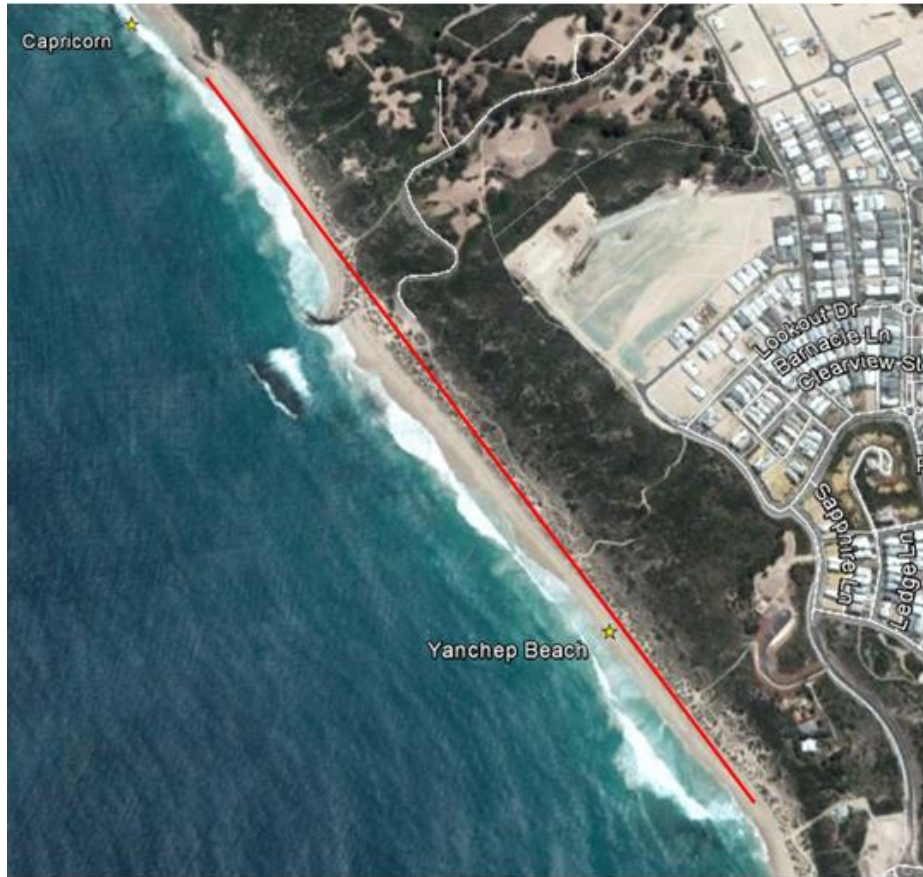


Figure 2: Overview of study area (Marked in red) (Google Earth).

More detailed images of the assessed areas can be found in Appendix C.

This report systematically progresses through the risk management steps with regard to the location outlined above.

3.2 Site Inspection

Site visits were completed on the following dates:

Location	Date
Yanchep Beach & Capricorn Beach	14 th February 2017

At no time during the inspection was the water entered. The inspection area was limited to the area outlined within the 'Site Identification' section of the report.

All inspections were performed from the land and along the edges of the water.

3.3 Hazard Identification and Risk Assessment

During the site inspection hazards were identified and assessed in terms of their individual risk to public safety (extreme, high, medium, low) using a risk assessment matrix (see Appendix A). The risk assessment matrix considers both the type of harm that could be sustained as a result of an individual



hazard and the likelihood of this harm actually occurring. The matrix is not specific to the Land Managers risk tolerances.

International Life Saving (ILS) endorses the Surf Life Saving Australia (SLSA) Aquatic Public Safety Risk Assessment program. The methodology is as follows:

1. Determine the minimum acceptable level of risks and potential injuries through completion of a risk assessment in accordance with recognised guidelines and standards.
2. Provide economically sustainable risk mitigation options
3. Review the status of aquatic safety and signage management
4. Evaluate the level of compliance or noncompliance with relevant regulations and standards
5. The assessment will include reference to:
 - a) The Australian Beach Safety and Management Program (ABSAMP),
 - b) The Australian Coastal Public Safety Guidelines,
 - c) Beaches of the Australian Coast-A guide to their nature, characteristics, surf and safety,
 - d) The National Aquatic and Recreation Signage Style manual,
 - e) Relevant standards including AS/NZS 2416:2010 Water Safety Signs and Beach Safety Flags (Parts 1, 2, 3) and AS/NZS ISO 31000:2009 Risk Management-Principles and Guidelines; and

3.4 Data Analysis

Data relevant to risk assessment has been considered in the production of this report. This includes:

- News and media information;
- SLSA Incident Reporting Database;
- National Coronial Information System;
- Coronial recommendations;
- Foreshore Concept Plan;
- Community profile data; and
- Formal and informal interviews with identified stakeholders.

All of these areas, factors and associated data have been taken into consideration within the risk register and risk treatment plans.

3.5 Beach Hazard Ratings and Overview

The hazards present at any given beach are very often determined by its geomorphology and the impact of water and weather conditions. Therefore it is important for land managers to understand the risks presented by these hazards. Since the late 1980s, Surf Life Saving Australia and the University of Sydney have partnered to identify the beach hazard ratings of every known beach in Australia.

The ABSAMP (Australian Beach Safety and Management Program) was developed by Professor Andrew Short from the University of Sydney Coastal Studies Unit in conjunction with Surf Life Saving Australia and the State Associations. The program has identified coastal hazards that affect bathers and rates the safety of the beach on a scale of one to ten, where one (1) is the least hazardous and ten (10) is the most hazardous.

The beach hazard ratings and definitions are provided in Table 1.

Table 1: ABSAMP Beach Hazard Ratings

Hazard Rating	Details
1 - 3	<u>Least Hazardous</u> : Low danger posed by water depth and/or weak currents; however, supervision still required, in particular for children and poor swimmers.
4 - 6	<u>Moderately Hazardous</u> : The level of hazard depends on wave and weather conditions, with the possibility of strong rips and currents posing a moderate risk.
7 - 8	<u>Highly Hazardous</u> : Experience in strong surf, rips and currents required, with beaches in this category considered dangerous.
9 - 10	<u>Extremely Hazardous</u> : Identifies beaches that are considered extremely dangerous due to strong rips and currents, and large breakers.

The beach hazard rating is calculated by determining the beach type and wave height. This can be done under either modal (average) or prevailing (current) conditions. The beach hazard rating is then calculated by using the following table:

Table 2: Beach hazard rating calculation matrices for wave dominate beaches.

Wave Height Beach Type	< 0.5 (m)	0.5 (m)	1.0 (m)	1.5 (m)	2.0 (m)	2.5 (m)	3.0 (m)	> 3.0 (m)
Dissipative	4	5	6	7	8	9	10	10
Long Shore Bar Trough	4	5	6	7	7	8	9	10
Rhythmic Bar Beach	4	5	6	6	7	8	9	10
Transverse Bar Rip	4	4	5	6	7	8	9	10
Low Tide Terrace	3	3	4	5	6	7	8	10
Reflective	2	3	4	5	6	7	8	10

It should be noted that the beach hazard ratings presented in this report relate to modal beach conditions and as such the hazard rating of a beach may increase when conditions alter e.g. with increasing wave height, winds, strong tides and high tide.

Furthermore, a hazard rating is also applied to an average person and therefore depending upon an individual's own skill, understanding and competence in relation to a certain area the hazard may in fact be greater or less.

The ABSAMP hazard ratings for the inspected areas are detailed within the next section of the report.

3.6 ABSAMP Beach Types and Ratings for Capricorn Yanchep

The ABSAMP hazard rating for the assessed beaches is listed in Table 3. The table provides an ABSAMP rating and descriptive label/name type for each location.

Table 3: ABSAMP Beach Hazard Rating

Location Name	ABSAMP no.	ABSAMP Rating	ABSAMP type
Yanchep Beach	WA 896	4	Transverse Bar and Rip/ Low Tide Terrace
Capricorn Beach	WA 897	5	Transverse Bar and Rip/ Low Tide Terrace

3.7 ABSAMP Beach Type Characteristic Overview and Hazards

Beach Type	Details
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Low Tide Terrace (LTT)</p>	<p><u>Low Tide Terrace</u></p> <p>Characteristics: Low Tide Terrace beaches are the lowest energy intermediate beach type and the most common intermediate type in Western Australia. These beaches occur on the open coast where the sand is fine to medium and wave height averages between 0.5m and 1m, and particularly where near shore reefs and headlands lower waves to less than 1m at the shore.</p> <p>Low Tide Terrace beaches are characterised by a moderately steep beach face, which is joined at the low tide level to an attached bar or terrace. The bar usually extends between 20m and 50m seaward and continues along shore, attached to the beach. Mid tide conditions result in water being returned seaward, both by reflection off the beach and via the mini rips, even if no rip channels are present. The rips are usually weak, ephemeral (short-lived) and shallow.</p> <p>Hazards: Low Tide Terrace beaches are the least hazardous of the intermediate beaches because of their characteristically low waves and shallow terrace. Changing wave and tide conditions produce a number of hazards to both swimmers and surfers. These are summarised:</p> <ul style="list-style-type: none"> • High tide: deep water close to shore; behaves like a reflective beach, • Low tide: waves may plunge heavily on the outer edge of the bar, with deep water beyond. Extreme care should be taken if body surfing or body boarding in plunging waves – the consequence is likely to be spinal injuries, • Mid tide: more gently breaking waves and waist deep water; weak mini rips return some water seaward, • Diving: care is required if diving into the surf as the water is usually shallow and can result in head/spinal injuries, • Higher waves: mini rips increase in strength and frequency, and may be variable in location; and • Oblique waves: rips and currents are skewed and may shift along the beach, causing a longshore and seaward drag <p><i>Summary:</i> Low Tide Terrace beaches are most hazardous at mid to high tide when waves exceed 1m and are oblique to shore, e.g. during summer when the winds are stronger.</p>



Beach Type	Details
<p>Transverse Bar and Rip (TBR)</p>	<p>Summary <u>Characteristics:</u> Consists of attached bars, rip troughs and undulating beach, 1.0 – 1.50m breakers, distinct rip troughs separated by attached bars every 150 – 300m. <u>Hazards:</u> Pronounced changes in depth and current between bars and rips, safest bathing is on the bars. <u>Beach Hazard Hints:</u> Bath on shallow sand bars adjacent to rips; however bathers can be washed off the bars into rips, inexperienced bathers may unknowingly enter rips.</p> <hr/> <p>Characteristics: Transverse Bar and Rip (TBR) are considered part of the intermediate beach type family. They are composed of fine to medium sand and exposed to waves averaging between 1.0 – 2.0m. TBR receive their name because as an individual walks along the beach they will see bars traverse or perpendicular to and attached to the beach, which are separated by deeper rip channels and currents. The bars and rips are usually regularly spaced with an average spacing of 350m. The surf zone in these areas range from 50 – 150m in width.</p> <p>Hazards: Transverse beaches are one of the main reasons WA beaches have surf. However, the good surf is also a hazard to the unwary swimmer and most drowning and rescues occur with this beach type. The shallow bars can tempt an individual into the surf, while lying to either side can be the deeper, more treacherous rip channels and currents.</p> <ul style="list-style-type: none"> • The centers of the attached bars are the best place to swim. They are shallow, furthest from the rip channels and the wave bores move towards the shore. • Rips are the cause of most surf rescues, so they are best avoided unless a very experienced surfer. • Rip feeder channels usually run along behind and to the sides of the bar, adjacent to the base of the beach. They carry water alongshore and deliver it to the seaward flowing rip current. • In the rip embayment, the feeder currents coverage and head out to sea. If the individual is not experienced these areas should be avoided, particularly if the water is moving and greater than waist depth. • Children wearing or on floats must be very wary of the feeder channel as they can drift from seemingly calm, shallow, inner feeder channel and be rapidly moved further out to sea. • The waves will break more heavily on the bar at low tide, often as a dangerous plunging wave or dumper. In the rip embayment the shore break will be stronger at high tide. • Higher waves that exceed 1.0-1.50m will cause wave breaking and rip currents to intensify. • Oblique waves that skew the bars and rips alongshore may make the identification of rips more difficult. • At low tide the rip currents are more confined to the rip channel and may intensify at low tide. • At high tide rip currents area weaker and may be partially replaced by a long shore current, even across the bar. <p>Summary: It is relatively safe on the bars during low to moderate waves, but individuals must be cautious of rips. Individuals are advised to stay on the bars and well away from the rips and side feeder currents.</p>



3.8 Communication and consultation

Communicating with stakeholders about risk perception and tolerance is the heart of the risk management process.

During the onsite visits for the assessment in February 2017, consultation with a number of stakeholders was undertaken to ensure the report process was transparent and to gain local knowledge, background and development plans for the areas inspected. Stakeholder feedback was collected from:

- Chris Peck, General Manager, SLSWA
- Chrissie Skehan, Health Promotion and Research Coordinator, SLSWA
- Matt du Plessis, Lifesaving Operations Coordinator, SLSWA
- Simon Peppler, Lifeguard Operations Officer, SLSWA
- Elizabeth Payne, Senior Consultant, Strategen Environmental

The process of communicating risk estimates from the assessment process to decision-makers and ultimately to the public, sometimes referred to as risk education, is only one part of the communication process.

However, in getting those affected by risk to accept risk mitigation measures, and in providing decision-makers and communities with the information they need to tolerate and deal with risks, there needs to be two-way communications that includes those affected by risk, the public, into the decision-making process.

There is a great opportunity to have this wealth of knowledge actively participate in the implementation of many of the potential risk treatment options. In particular it would be strongly recommended that the recommendations of this report are discussed on a regular basis at aquatic risk review meetings.

4. Risk Assessment Findings

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4.1 Action Planning Priority (Gross Risk)

4.1.1 Action Planning Priority Index

The action planning priority index can be viewed as the gross risk score for a beach. The index seeks to identify the risks associated with the broader aquatic environment under assessment, rather than specific hazards and risks present at a particular location or site. The majority of information detailed in this section of the report will be identified through pre-existing data (where available), with new data sourced where gaps are present or the data is not reliable.

The action planning priority index uses the following risk identification information (RII) - (where available):

1. Australian Beach Safety & Aquatic Management Program Rating (ABSAMP Rating),
2. Local Population Rating (LPR),
3. Human/Activity Interaction Rating (HAIR); and
4. Access Rating (AR).

4.1.1.1 Australian Beach Safety & Aquatic Management Program Rating (ABSAMP Rating)

The University of Sydney Coastal Studies Unit developed ABSAMP (Australian Beach Safety and Management Program) in conjunction with Surf Life Saving Australia and the State Associations. The program has identified hazards that affect bathers and rates the safety of the beach on a scale of one to ten, where one (1) is the least hazardous and ten (10) is the most hazardous (see appendix A for ABSAMP beach type characteristic overview). The scales are tabled below:

The scores below are based on the current state of the coastal zone during the peak summer season and should be revisited at regular intervals or in line with major development. With the predicted population increase the Capricorn Development will provide along with improved access and facilities the action planning priority rating can be expected to increase significantly once the development is completed.

Location Name	ABSAMP no.	ABSAMP Rating	ABSAMP type
Yanchep Beach	WA 896	4	Transverse Bar and Rip/ Low Tide Terrace
Capricorn Beach	WA 897	5	Transverse Bar and Rip/ Low Tide Terrace

4.1.1.2 Local Population Rating

The Local Population Rating (LPR) expands on the information obtained from the Facility Visitation Rating (RII part 2). This additional population rating identifies the population of residents and/or non-residents located within 2km's of a coastal location under assessment. The highest figure (resident or non-resident) will be recorded.

Population Rating	Qualifying Description (all staying/living within 2km of beach)
1	< 50 residents and/or < 20 non-residents (domestic or overseas tourists)
2	50 - 250 residents and/or 21 - 100 non-residents (domestic or overseas tourists)
3	250 - 1000 residents and/or 100 – 500 non-residents (domestic or overseas tourists)
4	1000 – 2500 residents and/or 500 – 1000 non-residents (domestic or overseas tourists)
5	2500 + residents and/or 1000 non-residents (domestic or overseas tourists)

Location	LPR Total
Yanchep Beach	5
Capricorn Beach	4

4.1.1.3 Human/Activity Interaction Rating

The Human/Activity Interaction Rating (HAIR) identifies any conflicts present at the aquatic environment between the number of people and activities taking place. Activities include both those in the water and those on the beach. A conflict may include a passive activity such as picnicking and ball games.

Population (in-water)		Conflicting activities		Population (on beach)		Conflicting activities	
100+	5	Persistent and dangerous	5	1000+	5	Persistent and dangerous	5
75-100	4	Persistent	4	750-1000	4	Persistent	4
50-75	3	Regular	3	500-750	3	Regular	3
25-50	2	Isolated conflicts	2	250-500	2	Isolated conflicts	2
1-25	1	No conflicts reported	1	1-250	1	No conflicts reported	1

Location	Population (in water)	Conflict	Population (on beach)	Conflict	HAIR Total
Yanchep Beach	2	1	1	1	5
Capricorn Beach	1	1	1	1	4

4.1.1.4 Access Rating

Beaches or coastal environments that have increased accessibility (i.e. near major roads, cities, public transport, car parks, boat ramps, maintained access paths etc.) increase the likelihood of users at that beach. This directly increases the level of risk of drowning and or injury and should be assessed as part of a wider risk assessment.

Access Rating	Qualifying Description
1	No identifiable access via road or track, no facilities, car parking or obvious access points
2	Access via un-maintained track with no facilities and/or via water access
3	Access via any form of track or walkway (either maintained or un-maintained) AND <u>any</u> provision of facilities or services including (but not limited to) public transport, shower, public toilet, payphone, kiosk, significant roadway, parking
4	Access via maintained tracks with clearly identified parking area AND/OR provision of basic facilities (i.e. public toilets, public shower/ wash down area) AND/OR within 10km of moderate sized town or city (population greater than 5,000)
5	Clearly evident, marked or signposted and maintained access points AND/OR within 10km of major town or city (population greater than 25,000) AND / OR car parking for 50 or more vehicles/boat trailers. Public transport provided within 250m of a beach access point

Location	Access Rating
Yanchep Beach	3
Capricorn	2

4.1.1.5 Action Planning Priority Score

The action planning priority score provides an indicator for the overall level of risk of the location. The scores range from 0 to 60. These scores can be used to prioritise the order in which risk treatments described in Section 4.2 of this report are implemented.

Location	ABSAMP X 2 (Out of 20)	Population Support X 2 (Out of 10)	Human Activity/ Interaction (Out of 20)	Access X 2 (Out of 10)	Total Score (Out of 60)
Yanchep Beach	8	10	5	6	29
Capricorn Beach	10	8	4	4	26

Scores of 40 or higher indicate a high overall level of risk. Where limited resources prohibit the implementation of all risk treatments recommended in this report, those beaches that have received a high action planning priority score should be treated first, then beaches with a medium score.

Priority	Priority location	Priority Action & Total Score	Comments
1	Yanchep Beach	29	There is sufficient beach access to this section of beach however there are currently no facilities or parking to encourage usage. Yanchep Lagoon is still the most popular beach in this region due to infrastructure and provision of lifesaving services.
2	Capricorn Beach	26	In its current state there no housing directly behind Capricorn Beach and access tracks are not easily identifiable so beach usage in this area is not significant. Priority to action will increase at both beaches with an increase in usage.

Key to Action Planning Priority

High 40+	Medium 31-40	Low 21-30	Very Low 0-20
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4.2 Overview of Principal Risk Treatments

4.2.1 Overview of Principal Risk Treatments

There are a range of risk treatment options that can be considered in the context of aquatic risk management. The selection of the most appropriate option involves balancing the financial, social and environmental impacts of implementing each against the benefits derived from each. These may include any combination of the following

- Spread (share) risk – insurance,
- Engineer (structural and technological) risk treatment – include modified practices,



- Regulatory and institutional – change through revised regulations and planning,
- Avoid – isolate the risk, move people away,
- Research to better understand; and
- Educate and inform stakeholders.

4.2.2 Hierarchy of risk treatments (controls)

In determining the most appropriate and cost effective option, it is important to consider the hierarchy of risk treatments (controls). The hierarchy is a sequence of options which offer a number of ways to approach the hazard control process.

- Hard controls deal with the tangible such as
 - Eliminate the hazard which in an aquatic context is often difficult to achieve,
 - Isolate the hazard which in an aquatic context can be difficult due to the dynamic nature of environmental and weather conditions,
 - Use engineering controls such as design of access paths, installation of appropriate signage, and revegetation; and
 - Use administrative controls such as supervision, emergency action plans, other documented policies, practices and procedures.
- Soft controls deal with human behaviour such as:
 - Awareness and education,
 - Community and individual capacity building: and
 - Use of effective leadership, management, trust, ethics, integrity, and building relationships

Outlined below are principal risk treatment solutions that expand upon those listed within the summary of proposed key risk treatments in Section 1.2 of this report. The solutions outlined endeavour to provide specific and detailed information relative to Capricorn Yanchep; however, due to the diverse nature of location characteristics, recommendations are at times generic in nature and may extend to risk mitigation at other locations.

The Land Manager should endeavour to adopt the most appropriate treatments specific to their organisations capabilities and resource limitations, and complete this in consultation with all relevant stakeholders.

4.2.3 Haddon's Matrix Applied to Capricorn Yanchep

William Haddon Jr developed a conceptual model, The Haddon Matrix, over 40 years ago. The matrix applies basic principles of public health management to the problem of traffic safety (Runyan, 1998). The framework can be applied to any source of injury.

Table 4 provides an overview of countermeasures for aquatic hazards, as assessed using Haddon's Matrix.

Table 4: An overview of countermeasures, as assessed using Haddon’s Matrix

	Host (Beach user)	Agent/Vehicle (Water, waves, rocks)	Physical Environment (Beach, rock platform)	Social Environment (Community norms, policies, rules)
Primary: Pre-Event (Prior to the beach user entering the water)	Education to choose appropriate locations and conditions Signage Weather warning systems Systems of supervision Dune vegetation maintenance; management of beach scarping and tunnelling	Activity Zoning Maintain access points	Restrict access Install safer access Maintenance programs Remove hazards	Regulate usage at times of heightened risk Cultural resistance to swimming at patrolled locations
Secondary: Event (Once the beach user has entered the water)	Provision of survival skills - education Swimming skill development Systems of supervision	Appropriate clothing/equipment Activity Zoning	Emergency Response Beacons/ Alarms/Phones	Use of PFDs while engaging in other aquatic activity (especially if inexperienced)
Tertiary: Post Event (Once the beach user is in difficulty and requires assistance)	Education to teach others how to assist or advise the patient CPR and first aid Basic rescue techniques Systems of supervision	Public Rescue Equipment	Emergency markers Install better access for emergency services Emergency alarm/alert devices/systems	Improve response of emergency services Prompt/timely notification of an emergency

4.2.4 Access and Ongoing Maintenance

The provision of access to the coast is a major contributor to the creation of risk in that access methods will guide people to an area and to any hazards that may be present. Access treatment, or otherwise, is a major contributor to managing coastal risk.

Currently there are six access tracks to the survey area (Yanchep and Capricorn Beach), most of these tracks are formalised on the road side however branch out in to multiple informal tracks towards the beach (Figure 3). In line with Foreshore Development Plans, additional tracks will be built, existing tracks will be maintained or upgraded and unnecessary tracks closed. All existing hazards associated with access tracks should be removed during redevelopment.



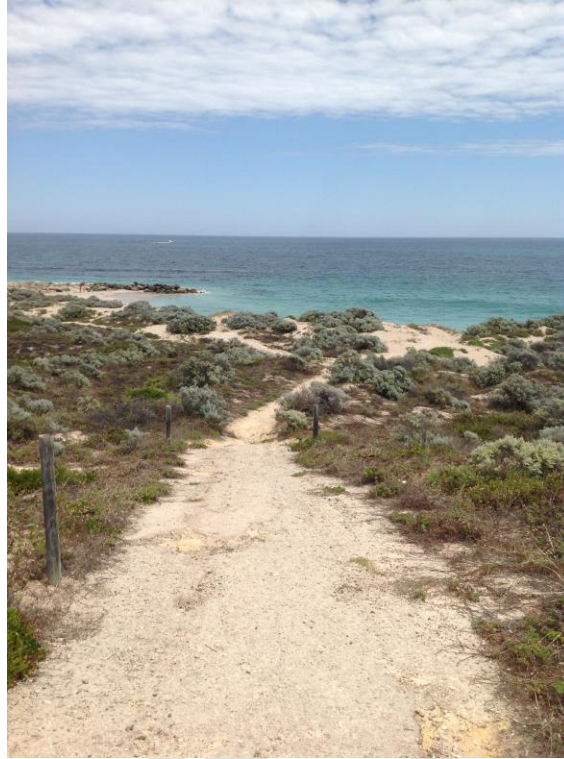


Figure 3: Example of a formal track to Capricorn Beach which branches out in to multiple informal tracks through the dunes.

SLSWA recommend that, along with pedestrian access paths, wider emergency access for vehicles and other approved users to main beach areas are considered.

To allow for potential roving patrols from Yanchep Beach SLSWA recommend the land manager consider the development of a sufficient vehicle access track between Yanchep Beach and Capricorn Beach, ideally behind the groyne (Figure 4). With the likely increase in usage of Capricorn Beach following development it would be beneficial to provide vehicle access to this section of beach allowing lifesaving services to conduct roving patrols of the area and respond to incidents as required. Provision of direct access between the two beaches in this location behind the groyne will help reduce response times in the event of an emergency.



Figure 4: State of the current pedestrian access track between Yanchep Beach and Capricorn Beach.

With the existence of public access infrastructure (defined and open access), and amenities comes the necessity to maintain existing infrastructure/capital works and further develop infrastructure to match that of the growing and changing community/stakeholders' needs. A key outcome of the implementation of access tracks and safety signage is the need for a periodic inspection, maintenance and replacement program. Common issues include sand drift, overgrown vegetation, degraded footings, damaged fencing graffiti and theft. Continual upkeep of defined access paths and associated barriers, including the grading of access paths and sweeping of stairs/steps will ensure continued usage of formal tracks and prevent the creation of additional hazards.

The responsible land manager should, once formal access pathways are developed, consider an infrastructure and capital works program as a priority. This may include:

- Removal of any identified informal and undefined access tracks,
- Erection of barriers to restrict and/or promote usage of the beach to certain areas only,
- Upkeep of defined access paths and associated barriers, including the grading of access paths and sweeping of stairs/steps,
- Maintain appropriate signage on entry to and along formal and defined access tracks,
- Remove unauthorised signage as it appears; including safety signage that does not conform to relevant standards or enhance safety,
- Improve conditions (grading or similar) and control (gates) of beach access tracks for emergency vehicles and other approved users,
- Development of an inspection schedule; and
- Recording of corrective and preventative actions taken.

Further information on individual access points, associated hazards and recommended controls can be found in Appendix D.

RECOMMENDATION 1

Formal pedestrian access points and emergency vehicle access should be provided to the designated beach and recreational areas. Identified hazards specific to access tracks should be removed where appropriate. Access to unsuitable or hazardous areas should be restricted or removed.

4.2.5 System of Safety Signage

A coordinated approach to signage, with strategically placed signs which are clearly visible, is a very important part of; and the first stage towards more effective aquatic risk management.

There is signage present at a majority of access tracks along this section of coastline in line with previous assessments completed for the City of Wanneroo. Due to demolition of the Club Capricorn site there has been some loss of signage from access tracks in this area. In some areas where construction has already commenced there are altered access tracks to those recorded in previous site visits. Once roads, carparks and associated access tracks are completed a signage schedule for these areas will need to be developed.

As the coastal zone is developed SLSWA recommend the land manager install informative and hazard signage at all access points, on entry roads, in carparks and at individual hazards. Emergency markers are also recommended on signage at each access track to aid emergency services in the case of an incident.

Examples of suitable future signs include:

- Beach and aquatic safety signage,
- Location signage,
- Aquatic zoning signage,
- Signage relating to location of toilets/disabled access,
- Signage relating to location of nearest lifesaving service,
- Local government regulation signage,
- Environmental and conservation signage,
- Community information signage including safety, security and crime prevention.

Below are examples of types of beach safety signage to be installed:



Level 3 - Open Access Sign or
Level 2 - Carpark Sign

Level 3 - Defined Access Sign

Level 4 - Individual Hazard and
Regulation Sign

As with access paths, a system of inspection and maintenance should be in place to ensure signage and buoys are not removed, damaged or obstructed from view.

For more detailed information on signage see Appendix F, G and H. Recommendations for types of signage to be installed have been provided (Appendix H) based on site visits and foreshore plans. Once a more detailed Foreshore Master Plan is finalised the type or placement of signage may need to be adjusted in line with Appendix G.

RECOMMENDATION 2

The party responsible for implementing and maintaining access points and therefore communication of risk (i.e. aquatic safety signage) should implement an inspection regime to assess the installation, adequacy and visibility of in-situ aquatic and recreational safety signage. Records of the inspections and actions should be maintained.

RECOMMENDATION 3

The party responsible for implementing and maintaining aquatic safety signage should ensure the number of individual signs at any one location is maintained to a minimum, wherever possible. A single point of information for warning, regulation and information signage reduces confusion and visual pollution.

RECOMMENDATION 4

The party responsible for implementing and maintaining safety signs adopts and maintains emergency location signage identifiers, as shown in the National Aquatic and Recreational Signage and Style Manual (NARSSM).

These should be incorporated into any new safety signage in the Capricorn Development. This should be done in line with in consultation with relevant emergency services agencies and the City of Wanneroo. A numbering system will need to be developed and adopted by the party responsible for maintaining beach access tracks and signs. Future municipal/residential developments need to be taken into account to avoid out of sync codes/location identifiers associated with future developments.



4.2.6 Systems of Supervision

LIFESAVING SERVICE LEVEL ANALYSIS

The following table identifies the calculated Lifesaving Service Level Scores for Yanchep and Capricorn Beach using the ABSAMP Beach Hazard Ratings; Visitation Levels; Frequency of Use; Residency of Visitors; Incident History; and Remoteness of Location to determine best practice lifesaving service levels, and for which the information was available. These scores are based on current usage of the area and during peak summer periods.

Note: These scores are calculated on the current state of the beach observed during the site assessment and other anecdotal knowledge of the area. Given the limited access and facilities, beach visitation rates are understandably low along with the calculated lifesaving service level score. As development in the area leads to better infrastructure in terms of access, parking, signage and facilities along with increased population, beach visitation rates will likely increase. The need for a lifesaving service will need to be reassessed at intervals or in line with milestone developments.

Table 5: Lifesaving Service Level scores

Yanchep Beach: Lifesaving Service Level Calculator

Dates	ABSAMP Rating	Visitation Rating	Frequency Rating	Residency Rating	Incident History Rating		Remoteness Rating	Total LSSL Score
					New	Existing		
Summer – 2016/2017	4	1	2	3	0	0	4	14

Capricorn Beach: Lifesaving Service Level Calculator

Dates	ABSAMP Rating	Visitation Rating	Frequency Rating	Residency Rating	Incident History Rating		Remoteness Rating	Total LSSL Score
					New	Existing		
Summer – 2016/2017	5	1	1	3	0	0	4	14

Detailed analysis of lifesaving service level scores for Fringe and Off-Peak seasons have not been assessed in this report as this was outside the scope of this assessment.

Lifesaving Service Level Score Descriptors

The following lifesaving service level descriptors provide the recommended lifesaving service level for the scores/rating as calculated in Table 5 above. The scores are not absolute and are to be used as a guide in determining the actual levels.

Table 6: Lifesaving Service Level scores

Rating	Lifesaving Service Level Description
<= 10	Warning Signage to Aquatic & Recreational Signage Style Guide standard
11-14	Emergency Beacons and/or Camera Surveillance or Swimming Enclosure (where applicable) Routine monitoring/surveillance patrols (land, sea, air) to also be considered
15-25	Lifesaving service = 2 x Lifeguard personnel during period assessed
26-30	Lifesaving service = 3 x Lifeguard personnel during period assessed
31 and >	Lifesaving service= more than 3 Lifeguard personnel during period assessed



Where the number of people in the patrolled area is over 1,000, the lifesaving service provider should increase the number of lifesaving personnel in line with the following table. Crowds can become in themselves hazardous as a result of difficulties of surveillance and heightened crowd interaction.

Table 7: Impact of beach attendance on lifesaving service levels

No. of People on Beach	No. of additional lifeguards
1,000 - 5,000	2
5,000 - 10,000	4
> 10,000	6

The Lifesaving Service Level score calculated in Table 5 is understandably low given the site is under development and with limited population in the area. At this stage SLSWA does not recommend the implementation of a lifesaving service at these beaches. As development in the area leads to better infrastructure in terms of access and facilities along with increased population, beach visitation rates will likely increase. The need for a lifesaving service will need to be reassessed at intervals or in line with milestone developments.

ACTIVITY ZONING

Activity zoning provides a beach management tool to isolate or separate activities that may be incompatible with the other activities or to isolate hazards or activities that are required to be contained to a particular area. Zoning of activities can be considered in lieu of direct lifesaving services establishing daily beach management plans and zones; however, compliance of the zoning may be much harder to enforce if persons of authority are not in-situ.

However, despite a direct lifesaving service not being in place the seasonal, temporary or permanent use of zoning should not be discounted by the Land Manager to assist in risk mitigation throughout the coastal reserve and beach areas.

There are two ways that zoning should be applied:

- a. Confining a particular aquatic activity to a specific location; and
- b. The segregation of activities that are a risk to other aquatic users.

The activities that are most commonly zoned include:

- Swimming,
- Surf boards (stand, stand up),
- Wind craft,
- Paddle craft,
- Fishing,
- Powercraft (including personal water craft [PWC] and water-skiing),

Primary zones for water-based recreation should include:

- Kite surfing
- Sailboarding
- Surfing
- Sub-aqua
- Fishing and/or spear fishing

- Water-skiing
- PWC

Consultation with the local community and local council is essential before putting any zoning in place.

OPERATIONAL, STORAGE, FIRST AID AND SURVEILLANCE FACILITY

Currently the beach visitation rates do not warrant the implementation of a lifesaving service (Table 5) however; in the future as beach access is improved and local population increases there will be greater need for a lifesaving service.

As the population grows in the area member numbers at Yanchep SLSC would be expected to increase. Increased members could allow for potential outpost facilities or roving patrols (paid and volunteer) to nearby beaches including Yanchep Beach and Capricorn Beach providing supervision at peak times.

To facilitate this is the future SLSWA recommend consideration be given to the installation of an operational, storage and first aid facility and associated surveillance station at Capricorn Beach as part of the coastal node providing a base for lifesavers/lifeguards to operate as required.

A base storage facility and associated surveillance station rather than a complete Surf Life Saving Club will allow remote surveillance and lifesaving service to be planned and implemented. The impetus for this recommendation is to provide a platform that will assist the community stakeholders to determine when greater beach management strategies are required to manage public safety at Yanchep and Capricorn Beach. As access to the beach is provided via roads, parking and beach access paths, these facilities will provide storage for key rescue and emergency care equipment allowing lifesaving and response services to be implemented. These may initially commence as a surveillance and response service only which could readily escalate to an on beach prevention and rescue service.

Typically, a lifesaving and surveillance facility (including permanent outposts) should have in summary the following form and function:

1. Have sufficient elevation that provides vision of the shoreline and ocean when streamed from an automated camera or when a trained lifesaver is insitu.
2. Provide for the secure storage of lifesaving, rescue and emergency care equipment:
 - i. Jet ski and trailer.
 - ii. SSVS (Side-by-Side Vehicles).
 - iii. 2 x Rescue Boards.
 - iv. 2 x Rescue Tubes.
 - v. First aid kit.
 - vi. Extraction Board.
 - vii. Oxygen Resuscitation equipment.
 - viii. Semi-automated Defibrillator.
 - ix. Communications equipment (handheld RF radios, tablets).
 - x. Beach hazard and warning signs.
 - xi. Emergency Response Point.
3. Provide for an area to enable first aid and prolonged pre-hospital care treatments.
4. Have sufficient GPO and electrical access to:
 - i. Re-charge equipment.
 - ii. Operate tablets and telecommunication devices.
 - iii. Operate temperature control equipment.
 - iv. Provide adequate illumination of spaces, with illumination relevant to the space required, including external to the facility.

5. Have appropriate telecommunication and data access within the building and to the highest point of the facility.
6. Have appropriate storage cabinets for:
 - i. Emergency care equipment and medical supplies.
 - ii. Storage of up to 100L of unleaded fuel.
7. Have appropriate access to water for maintenance of equipment, including a drainage space and wash down area.
8. Allow a one direction entry/exit into the storage space for plant and equipment.

RECOMMENDATION 5

The party responsible for implementing and maintaining aquatic safety strategies should consider the installation of an operational, storage and first aid facility and associated surveillance station at Capricorn Beach. These facilities will provide a base for lifesaving services to operate as required.

4.2.7 Existence of Coastal/Beach Emergency Action Plans

Emergencies can vary between land and water, and may be the result of natural processes or human action.

A well-planned and rehearsed aquatic recreational Emergency Action Plan (EAP) can greatly minimise the extent of injury and damage if an incident does occur.

The developed plans and associated procedures should give consideration to:

- The identification and response to emergencies,
- The nature and types of emergencies,
- Protocols in responding to each emergency,
- The competency and proficiency of responders,
- The type of plant and equipment required for each identified emergency,
- Emergency access to beach locations,
- Planned and scheduled training/practice opportunities; and
- Monitoring and review opportunities.

RECOMMENDATION 6

The party responsible for implementing and maintaining aquatic safety strategies should develop, implement and review Emergency Action Plans (EAPs). This activity is to assure a planned and coordinated response to the range of potential and localised aquatic and recreation emergencies that may occur along the foreshore reserve.

The EAPs should take into account the difficulties in accessing locations, delay of response and the inherent risks of the locations.

4.2.8 Education and Awareness Programs

In the suburbs surrounding Yanchep and Capricorn Beach, there is a substantial base of residents that are new arrivals to Australia, many of which have selected to live in an area promising a beach lifestyle. A high proportion of these new residents are from the United Kingdom, New Zealand and South Africa and are likely to have little to no beach knowledge, especially in regards to local hazards. This trend can be expected to continue in the Capricorn Yanchep Development (Table 8) offering a growing occurrence



where by many people frequently accessing the coast have poor water safety skills and minimal beach safety awareness.

Table 8: Birthplace of residents living in Yanchep-Eglinton-Alkimos in 2006 and 2011 [data source: Australian Bureau of Statistic, Census of Population and Housing 2006 and 2011].

Birthplace	2011		2006	
	Number	%	Number	%
Total overseas born	1,693	36.7	738	29.2
*Non-English speaking backgrounds	310	40.8	147	5.8
*Main English speaking countries	1,383	16.4	591	23.4
Australia	2,577	25.8	1,565	61.9
Not stated	338	17	226	8.9
Total Population	4,607	100.0	2,528	100.0

SLSWA recommend that the Land Manager consider the development of a resident's beach and aquatic safety booklet/flyer or web page with information specific to the Yanchep area. Strategies of this type could be provided and promoted to home owners in the area and assist in raising the awareness and improving education in the wider community on the potential hazards at their local beach.

Items covered in the handbook or flyer may include:

- Beach access,
- Hazards and warnings,
- Most 'friendly' part of the beach for swimming,
- Map showing beach zoning (swimming, fishing, surfing, no go areas),
- Parking and other facilities,
- Emergency information; and
- Lifesaving services.

SLSWA recommend that the Land Manager in consultation and cooperation with the City of Wanneroo, education institutions, learning centres and community groups within the Councils boundaries, develop a funded plan that leads to the delivery of programs that serve to improve and build resilience to drowning.

SLSWA recommend the key outcome of this program must be to increase;

1. Awareness of key aquatic safety messages and information portals, (i.e. BeachSAFE, SLSWA Twitter, Recfishwest)
2. Awareness of aquatic recreational risks and hazards,
3. Awareness of safety signage and the meaning of specific hazard symbols,
4. Awareness of beaches within the surrounding area that leads to knowledge of the appropriate areas to undertake aquatic recreation; and
5. Awareness of the need to build individual capability to recreate in an aquatic setting through participation in:
 - a. Learn to swim programs,
 - b. Swimming fitness programs, and



c. Surf activity and survival programs.

Existing programs should be regularly monitored and reviewed to confirm their effectiveness and ensure they are delivering the desired results.

A number of existing programs have been developed or are offered by various agencies, including Surf Life Saving WA that can assist the land manager to increase beach safety awareness and lifesaving skills within the community. These programs which are imbedded in the SLSWA **BeachSAFE Initiative** (Appendix I) include:

- **SurfBabies and SurfKids:** A six week program aimed at children from 2-7 years of age and their parents to increase awareness, confidence and safety at the beach.
- **Surf Survival:** An exciting educational program, teaching participants aged 7 to 15 years vital coastal recreation skills ranging from awareness of the oceans conditions right through to obtaining an accredited Surf Rescue Certificate. This is a six day school holiday program, adapted from Surf Life Saving Nippers Program.
- **Beach Activities:** A way to educate students on the important aspects of sun and beach safety, while increasing their skills and fitness in the water and on the beach. Important safety information is integrated into activities such as board riding, surf negotiation, swimming and beach games.
- **Life Skills for Life:** The program is an interactive two hour program designed to teach school children resuscitation and basic first aid.
- **Introduction to BeachSAFE:** An interactive program delivering the key messages that are fundamental to having fun and staying safe at the beach. This includes dangers at the beach, warning signs and meanings, surf environments, identification of lifesavers, wave types, rips, sea creatures, sun protection and safety at the beach.
- **Multicultural BeachSAFE Program:** This program is a beach safety and awareness program aimed at people from multicultural backgrounds. The program can be tailored to suit each groups needs and includes any combination of the Introduction to BeachSAFE, Beach Activities and Life Skills for Life programs using multilingual and culturally appropriate resources.
- **The Nippers Program:** Children aged 5 to 13 years participate in beach activities where they learn about beach safety, surf sports and the beach environment.
- **Indigenous Sports Program:** Aimed at educating indigenous students in rural communities by increasing their knowledge of beach safety and Basic first aid skills, through the Introduction to BeachSAFE Presentation and the Life Skills for Life program.
- **The SLSWA School Cadets:** Aims to engage secondary school aged children to participate in personal development and leadership, and aims to foster qualities of community responsibility and service in the way of coastal aquatic safety.
- **The Ocean Paddling – Be Safe Project:** Aims to provide a safety framework and guidelines aimed at the recreational paddler in how to safely participate in recreational paddling activities at the WA coast.

- The **Kite Boarding – Be Safe Project**: Aims to provide a safety framework and guidelines aimed at the recreational kite boarder in how to safely participate in recreational kite boarding activities at the WA coast.
- **Community Surf Rescue Certificate**: Provides participants with the skills and knowledge of basic prevention/rescue and surf awareness in order to be able to participate in aquatic activity and supervise others; and
- The **BeachSAFE website and app**: Information portals that target all beach users. People can find their nearest patrolled beach and check the associated hazards and recommended activities appropriate for that beach at any time. Other information is provided which allows beach users to make an informed decision about whether or not to recreate at the beach including; weather, UV index, patrol timetable, activities, beach hazard rating and beach facilities such as car parks and café's.

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Table 9: Example template of education and awareness program

Program	Target audience	Location	Delivery (Who)
School based safety programs	Lifesavers/Lifeguards/Instructors attending local LGA primary schools	All locations	SLSWA/Land Manager
Indigenous safety awareness program	Visit by local lifesavers/lifeguards to indigenous communities to provide beach safety information	All locations	SLSWA/Land Manager
Car park tickets	Use car parking ticketing to deliver key safety messages, e.g. <i>always swim between the red and yellow flags</i>	All locations	SLSWA/Land Manager
QR Codes	Use of QR codes on signage and other infrastructure to link to location based beach safety information	All locations	SLSWA
Media/Promotion	Use local media and promotional opportunities to deliver safety messages during the peak summer season, i.e. local newspapers, local radio, community publications and billboards Multi Media – Internet Social Media	All locations	SLSWA/ Land Manager
Nipper programs	Encourage local children to join local SLSCs and take part in Nipper activities.	All locations	SLSWA
Surf survival program	Promote SLSWAs surf survival program at local schools and to residents	All locations	SLSWA
Beach and ocean safety warnings	Media (e.g. Radio and TV), Internet, digital road signage, BeachSAFE, Digital information screens Edith Cowan University, SLSWA/Lifeguards on local TV news doing beach reports – also promotes safety, conditions and the profile/capabilities of lifeguards and lifesavers	All locations	SLSWA and Land Manager
Beach Safety Booklet/Flyer	Residents and Beach Visitors.	All locations	Land Manager/ SLSWA

QR Codes

There are many opportunities at present to make use of technology in innovative ways for education and awareness programs. One such opportunity is the use of smart phones to provide location based safety messaging. One method of delivering this would be to implement a system of Quick Response (QR) Codes (Figure 5). These codes can be included on signage and linked to specific safety information relating to the beach (Figure 6). The codes can be scanned by smart phones with freely available QR scanning applications installed, such as QR Reader on the iPhone. Below is an actual example of a QR code. This system would be relatively easy and cost effective to implement and would create opportunities for the media to increase public awareness of beach safety related issues. The Shire of Augusta-Margaret River, City of Rockingham and City of Busselton have successfully retro fitted QR Codes to existing signage at beach access points.

Appendix J tables the most popular languages (other than English) spoken at home by City of Wanneroo residents.



Figure 5: An example of a QR Code linked to beach safety information



Figure 6: Example of how QR codes can be incorporated into signage.



RECOMMENDATION 7

The Land Manager should consider an awareness program that develops a resident's beach safety booklet/flyer, web page or similar to be distributed or promoted to new home owners, businesses and tourists in the Capricorn Yanchep Development.

This booklet should generalised beach safety information and messages in addition to information which is specific to the Yanchep area.

RECOMMENDATION 8

The party responsible for implementing and maintaining aquatic safety strategies should implement the use of Quick Reader (QR) codes on aquatic and recreational safety signage. Users of this technology are taken to coastal aquatic safety information and in languages and translations that are relevant to their culture and language. The use of QR codes should form part of any aquatic awareness and education programs.

4.2.9 Dune Vegetation Maintenance, Beach Scarping and Tunnelling

Beaches are dynamic systems which undergo phases of accretion and erosion over time. These changes tend to occur seasonally, with erosion mostly over the winter months when there are increased storm events and higher swells. Accretion tends to be a much slower process, after a significant storm event it can take months or years for the beach to return to its original state. In many areas along the West Australian coast, coastal development and removal or damage to dune vegetation has resulted in dunes becoming unstable and more vulnerable to erosion. This is evident along the beaches in Yanchep, particularly at the various informal beach access tracks.

There was some erosion noted along the face of the dunes and near informal access points (Figure 7). Formalising access tracks and limiting access through to the dunes will prevent further erosion. Other than at these access points most of the dunes are stable and well vegetated and unlikely, at this stage, to pose any hazards in terms of erosion and sand collapse. As beach visitation rates increase the formalisation of paths and access restrictions to the dunes will become increasingly important. Revegetation of areas which are used as informal tracks will help to deter usage.



Figure 7: Example of dune erosion at an access track to Yanchep Beach.

Options to reduce the risk of tunnelling, sand collapse and falls in relation to erosion issues are limited. Some options may include:

- Individual hazard and/or temporary signage,
- Access restriction barriers (permanent or temporary);
- Dune revegetation works; and
- Periodic monitoring of specific locations where this has been identified as a potential risk.

RECOMMENDATION 9

The party responsible for implementing and maintaining aquatic safety strategies should consider, and where practicable, implement engineered options to minimise the risks associated with dune and beach scarping and discourage access to these areas.

4.2.10 Monitor and Review

Monitoring and review activity are an important part of risk mitigation to ensure that risk treatment options are meeting their objectives, new hazards and risks are identified and addressed in a timely manner and evolving strategies are in line with community expectations.

The responsible land manager should ensure there is a process of regular review of the effectiveness of any risk treatments implemented. This should include a process for the collection of data regarding any incidents affecting public safety.

RECOMMENDATION 10

The party responsible for implementing and maintaining aquatic safety strategies should review and continue to enhance aquatic recreation public safety injury data and information collection. This should include the collation and analyses deemed necessary to underpin accurate risk assessment and effective risk treatment plans and actions.

DRAFT



5. Actions Register

DRAFT



5.1 Implementation Priorities

This section provides an EXAMPLE only of the charting and recording of actions taken in implementing a consistent risk mitigation program. The actual implementation and records taken against actions is left to the Land Manager to confirm.

Priority 1

- Acceptance or otherwise of report recommendations to be completed by the Land Manager.
- Control measure implementation charts, to be completed and responsibilities assigned.
- Works programmes to be developed or re-affirmed from recommended control measure implementation charts, and in conjunction with relevant internal (or where appropriate) external stakeholder groups.
- High priority works to be commenced as soon as is practical.
- Communication with relevant stakeholders be maintained or increased.
- Risk monitoring practices and procedures are implemented with records retained.
- Enhanced data collection and collation procedures are implemented.
- Monitoring and review activity completed periodically and results documented.

Priority 2

Education and awareness;

- Education and awareness programs be identified, developed and implemented (development may be commenced earlier)

Risk Assessment Update;

- An updated risk assessment to be conducted and information collected to be collated with the inclusion of relevant and up to date data collected and collated in the intervening period.

The following chart is provided as **one example** of how the Land Manager could log and manage its aquatic risk management program.

Table 10: Control Measure Implementation

Hazard Description (Location)		Recommended Additional Controls/Treatment Plans	Refer to section	Priority			Person responsible for implementing control measures	Complete by date	Details of action taken (date completed)	Review date
Ref	H			M	L					
		Access and Signage: <ul style="list-style-type: none"> Access paths to be clearly defined. Appropriate safety signage be installed 	4.2.4 4.2.5							
		Remove/restrict access: Areas which are unsuitable for recreation or are vulnerable to erosion should have access restricted.	4.2.4							
		Maintain access and signage: Check for damage or obstruction of signage. Ensure access tracks are in good condition (e.g. no hazards, damage to fences/barriers, eroded footings, pathway obstruction).	4.2.4 4.2.5							
		Emergency Marker Sign: Identify each formal beach access track and provide each one with a unique identifier that can be posted onto access warning signs.	4.2.5							



Hazard Description (Location)		Recommended Additional Controls/Treatment Plans	Refer to section	Priority			Person responsible for implementing control measures	Complete by date	Details of action taken (date completed)	Review date
Ref	H			M	L					
		QR Codes: Implementation of QR codes and continued maintenance to ensure codes are functional and up to date.	4.2.9							
		Residents Booklet/Education: SLSWA recommend the consideration of a booklet/flyer/tool containing beach/aquatic safety information specific to the Yanchep Area to be distributed to new home owners in the area.	4.2.9							
		Lifesaving Service: SLSWA recommend installation of an operational, storage, first aid and surveillance facility at Capricorn Beach.	4.2.6							
		Emergency Action Plans: The land manager with the advice of a water safety emergency response organisation to develop an emergency action plan that specifically addresses the need to respond to emergencies that are likely to occur at Capricorn Yanchep.	4.2.8							



Ref	Hazard Description (Location)	Recommended Additional Controls/Treatment Plans	Refer to section	Priority			Person responsible for implementing control measures	Complete by date	Details of action taken (date completed)	Review date
	H			M	L					
		Foreshore Degradation: Monitoring and maintenance of the riverbanks and beach areas to ensure no additional hazards are created through the process of erosion/accretion.	4.2.9							
		Monitor and Review: Land Manager to enhance and review public safety and injury data.	4.2.10							



6. Documentation and Reference Material



The following documentation was provided by Strategen Environmental to assist in compilation of this report:

- Capricorn Village Foreshore Development Areas (DRAFT)

Other documentation and reference points include:

- SLSA Australian Coastal Public Safety Guidelines (2007) 1st Edition
- Australian Beach Safety and Management Program. SLSA and Dr. Andrew Short (University of NSW). Beaches of the Western Australia Coast: Eucla to Roebuck Bay (2005). University of Sydney Publications. SLSA Coastal Aquatic Risk Assessment Process
- AS/NZS 2416.1:2010 Water safety signs and beach safety flags - Specifications for water safety signs used in workplaces and public areas (ISO 20712-1:2008, MOD)
- AS/NZS 2416.3:2010 Water safety signs and beach safety flags - Guidance for use
- National Aquatic and Recreation Signage Style Guide; Third Edition (July 2006)
- AS/NZS 2416.3:2010 Water safety signs and beach safety flags - Guidance for use
- ISO 7010: 2011. Graphical symbols – Safety colours and safety signs – Registered safety signs
- Beach Safety and the Law: Australian Evidence. Wilkes. J (Ed). (2008)
- Google Earth: Datum reference points and images
- SLSA Australian Coastal Public Safety Guidelines (2007) 1st Edition
- SLSA – 34th Edition Public Safety and Aquatic Rescue
- SLSA Surfguard Database
- Australian Beach Safety and Management Program. SLSA and Dr. Andrew Short (University of NSW). Beaches of the Western Australia Coast: Eucla to Roebuck Bay (2005). University of Sydney Publications. SLSA Coastal Aquatic Risk Assessment Process
- National Coastal Safety Report 2012 (SLSA)
- National Aquatic and Recreation Signage Style Guide; Third Edition (July 2006)
- A Guide to Coastal Public Rescue Equipment. Version 1. 2007. Royal National Lifeboat Institute.
- BeachSAFE Initiative. Version 1. 2013. Surf Life Saving Western Australia.
- WA Coastal Safety Report 2013. Surf Life Saving Western Australia.
- Surf Life Saving Australia (2013) National Coastal Safety Report 2013. SLSA: Sydney.
- Nelson C & Wills S (2014). Public Rescue Equipment. Drowning: Prevention, Rescue, Treatment. Springer- Verlag, Berlin Heidelberg. pp 413-417.
- RNLI (2007). A Guide to Coastal Public Rescue Equipment. Version 1.
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- www.coastsafe.org.au
- www.ripcurrents.com.au
- www.beachsafe.org.au
- www.bom.gov.au



7. Appendices



APPENDIX A: Enterprise Wide Risk Ranking Tool



ENTERPRISE-WIDE RISK MANAGEMENT – RISK RANKING TOOL

IMPACT TABLE

DESCRIPTOR	PEOPLE (Social) Due to SLSA Culpability or Negligence	PROPERTY & FINANCIAL Property loss; Increased expenses; lost revenue	ENVIRONMENTAL (Environment) e.g. Dune and Back beach; Creeks; Lagoons; Bushland; Air; Vegetation; Wildlife	REPUTATION (Governance) Social; Ethical; Heritage; Cultural; Leadership
Extreme	Death or total permanent disability	> \$1 million; Massive financial loss	Catastrophic event (e.g. habitat destruction) with national significance (e.g. endangered species) attracting national media attention	Wholesale resignation of Board Members and Senior Management Major State or National media coverage 1,000+ complaints Financial loss or fraud > \$100,000
High	Critical injury resulting in long-term partial disability	> \$100,000 - \$1 Million; Major financial loss	Major event (e.g. creek contamination, chemical spill, > 20lt oil spill) with regional impact (e.g. lake, lagoon, creek) requiring external emergency agency clean up support	External Agency Inquiry with adverse finding Significant regional media coverage 50 – 1,000 complaints Financial loss or fraud > \$50,000 < \$100,000
Medium	Very serious injury, e.g. broken arm, leg, wrist, etc which could result in hospitalisation and/or greater than 7 days off work	> \$10,000 - \$100,000; High financial rate	Major event (e.g. 10 - 20lt oil spill) with localised impact (e.g. street, precinct)	External Agency request for clarification Regional & suburban media coverage 20 – 50 complaints Financial loss or fraud > \$5,000 < \$50,000
Minor	Minor injury, e.g. strain, sprain, gash, etc resulting in between 1-7 days off work	> \$1,000 - \$10,000; Minor financial loss	Minor event (e.g. < 10lt oil spill) with localised impact (e.g. street, precinct)	Suburban media coverage 10 – 20 complaints Financial loss or fraud > \$1,000 < \$5,000
Insignificant	Minor injury, e.g. cuts, abrasions, etc requiring first-aid and/or resulting in less than 1 day off work	< \$1,000; Low financial loss	Negligible event (e.g. noise pollution) with localised impact (e.g. street, precinct)	Media enquiry / Letter to the Editor 0 – 10 complaints Financial loss or fraud < \$1,000

LIKELIHOOD TABLE

DESCRIPTOR	DESCRIPTION
Almost Certain	<ul style="list-style-type: none"> Will probably occur more than once 100% chance of occurrence Common or Frequent Occurrence Is expected to occur in most circumstances
Likely	<ul style="list-style-type: none"> High probability that will occur at least once 1 in 10 chance of occurrence (10%) Likely to occur or "has happened to us a number of times in the past" Might occur in a 2-3 year timeframe
Possible	<ul style="list-style-type: none"> Reasonable likelihood that could occur more than once 1 in 100 chance of occurrence (1%) Could occur or "I've heard of it happening elsewhere" Might occur in a 5 year timeframe
Unlikely	<ul style="list-style-type: none"> May occur once or less 1 in 1000 chance of occurrence (0.1%) Not likely to occur Might occur in a 10 year timeframe
Rare	<ul style="list-style-type: none"> May occur in exceptional circumstances Practically impossible 1 in 10,000 chance of occurrence (0.01%) Could happen but probably never will

RISK SCORE MATRIX*

		IMPACT				
		1. INSIGNIFICANT	2. MINOR	3. MEDIUM	4. HIGH	5. EXTREME
LIKELIHOOD	5. ALMOST CERTAIN	M5	H10	H15	E20	E25
	4. LIKELY	L4	M8	H12	E16	E20
	3. POSSIBLE	L3	M6	H9	H12	E15
	2. UNLIKELY	L2	L4	M6	H8	H10
	1. RARE	L1	L2	L3	M4	M5

RISK LEVEL	ACTION YOU SHOULD TAKE
EXTREME – (E15-E25)	Consider discontinuing - Immediate correction required
HIGH – (H8-H15)	Immediate corrective action required
MODERATE – (M4-M8)	Attention needed - correction required
LOW – (L1-L4)	Perhaps acceptable as is

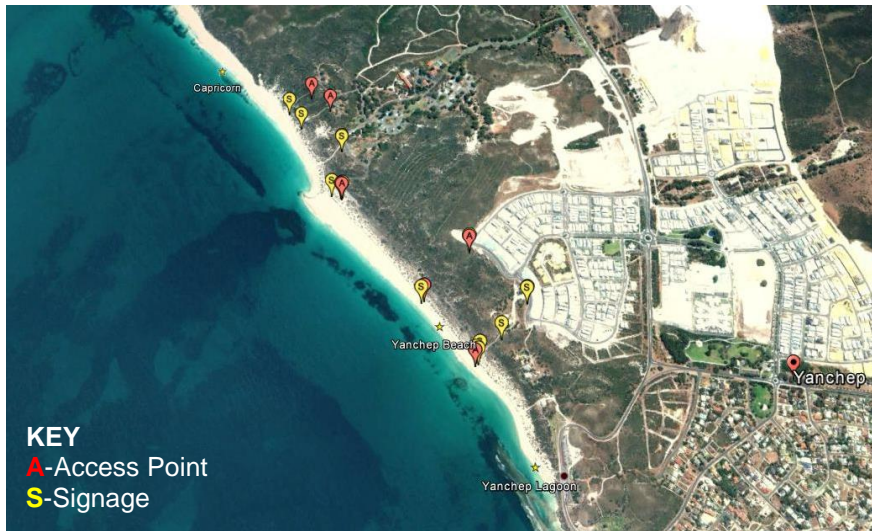
* Risk Score Matrix consistent with ISO 31000: Risk Management



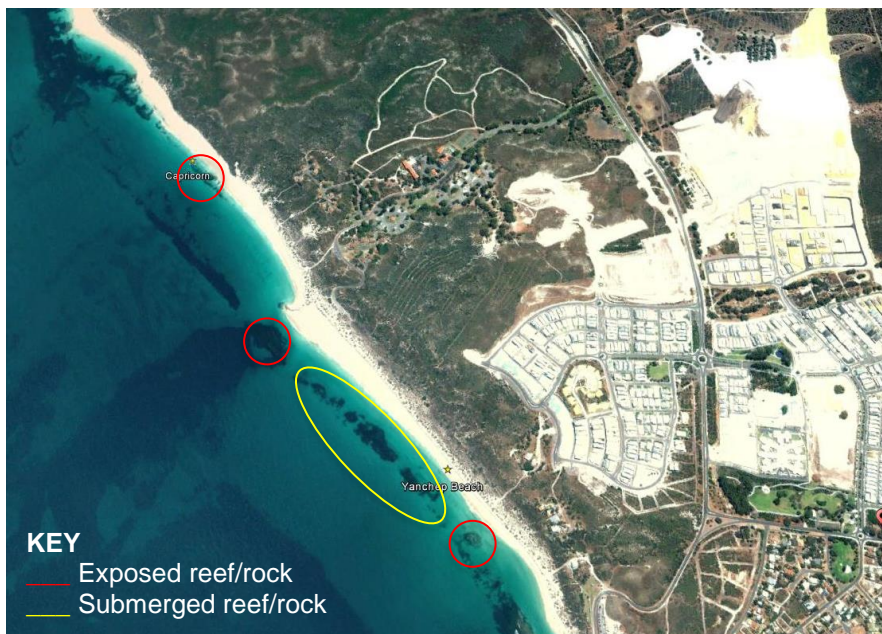
Appendix B: Assessment Area



B1: Image showing current access tracks and signage in the survey area [Google Earth]



B2: Image showing reef/rock platforms present at Yanchep Beach [Google Earth]





B3: Image showing sections of reef along Yanchep Beach. Also note the rips evident along this section of beach.





Appendix C: Risk Register* and Risk Treatment Plan**



C1 Risk Register and Risk Treatment Plan – Yanchep Beach

Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment Plans	Action Priority & Residual Risk Level
				C	L	Risk Level				
1 (26984)	Uneven surfaces		Slips, trips, falls	Minor	Possible	Medium	Beach Users	semi-cleared pedestrian track	Create a clear access track between Yanchep and Capricorn Beach for Surf Lifesaving and Emergency vehicles.	Low
2 (26983)	Groyne Waves overwashing Uneven Surfaces/Holes		Slips, trips, falls Broken bones Head injury	Extreme	Possible	Extreme	Fisherman Children Elderly	Level 4 - Individual Hazard Sign	Individual Hazard Sign Discourage Usage Routine inspection/maintenance	High





Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment	Action Priority & Residual
				Extreme	Possible	Extreme				
3(26994)	Waves		Drowning Death Non-fatal Drowning	Extreme	Possible	Extreme	Surfcraft users Weak swimmers Children	'How to Escape a Rip' Signage Beach Safety Signage Patrolled during the peak summer season	Awareness/Education Program Emergency Action Plans	High
4(26990)	Submerged Reef		Head Injury Spinal Injury Cuts and Abrasions	High	Possible	Extreme	Surfcraft users Swimmers	Beach Safety Signage Patrolled during the peak summer season	Awareness/Education Program Emergency Action Plans	High




Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment	Action Priority & Residual
				Medium	Possible	High				
5(26995)	Snakes	N/A	Poisonous Bite Minor injuries/First Aid	Medium	Possible	High	Beach users	Beach Safety Signage Semi-formal access tracks Fencing	Formalise access tracks through to the beach to restrict access to dunes Install fence/barrier Awareness/Education Program Emergency Action Plans	Low
6(26992)	Rips	N/A	Drowning death Non-fatal drowning	Extreme	Possible	Extreme	Weak swimmers Children Elderly	Beach Safety Signage 'How to escapes a rip' signage Patrolled during peak summer season	Awareness/Education Program Emergency Action Plans	High




Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment	Action Priority & Residual
				Minor	Possible	Medium				
7(26982)	Damaged fence			Minor	Possible	Medium	Beach Users	-	Repair damaged fencing	Low
8(26980)	Dune erosion		Environmental damage	Medium	Likely	High	-	Semi-formalised access tracks	Formalise access right through to the beach Install fencing Informational Signage	Medium





Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment	Action Priority & Residual
				Minor	Possible	Medium				
9(26981)	Uneven footpath		Slips, trips, falls	Minor	Possible	Medium	Beach Users Elderly	-	Upgrade access track	Low
10(26993)	Shore Dump	N/A	Non-fatal Drowning Fatal Drowning Spinal Injury	Extreme	Possible	Extreme	Weak swimmers Elderly Children Surfcraft users	Beach Safety Signage Patrolled during the peak summer season	Awareness/Education Program Emergency Action Plans	High



Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment	Action Priority & Residual
				Extreme	Possible	Extreme				
11(26989)	Submerged Reef		Head injuries Spinal Injuries Cuts and abrasions	Extreme	Possible	Extreme	Surfcraft Users Snorkelers	Beach Safety Signage Patrolled during the peak summer season	Awareness/Education Program Emergency Action Plans	High



C2 Risk Register and Risk Treatment Plan – Capricorn Beach

Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment Plans	Action Priority & Residual Risk Level
				C	L	Risk Level				
1 (26986)	Beach rock		Slips, trips, falls Cuts and abrasions	Minor	Possible	Medium	Beach Users	Nearest access track is 130m south	Maintain access tracks in current locations Install beach safety signage on new/updated tracks	Low
2 (26987)	Submerged Reef		Head injury Spinal Injury Cuts and abrasion Slips, trips, falls Minor injuries/First Aid	Extreme	Possible	Extreme	Beach Users Swimmers Surf craft users	Level 3 – Open Access Sign and Defined Access Sign	Maintain and/or update signage in line with development Education and Awareness Programs Emergency Action Plans	High




Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment	Action Priority & Residual
				Extreme	Possible	Extreme				
3(26997)	Waves	N/A	Drowning Death Non-fatal Drowning	Extreme	Possible	Extreme	Surfcraft users Swimmers	Beach Safety Signage	Education and Awareness Programs Emergency Action Plans	High
4(26998)	Shore Dump	N/A	Non-fatal Drowning Fatal Drowning Spinal Injury	Extreme	Possible	Extreme	Swimmers Elderly Children Surf craft users	Beach Safety Signage Patrolled during the peak summer season	Education and Awareness Programs Emergency Action Plans	High



Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment	Action Priority & Residual
				Extreme	Possible	Extreme				
5(26991)	Rips	N/A	Drowning death Non-fatal drowning	Extreme	Possible	Extreme	Weak swimmers Children Elderly	Beach Safety Signage	Maintain and/or update signage in line with development Install rip informational signage Education and Awareness Programs Emergency Action Plans	High
6(26996)	Snakes	N/A	Minor injuries/First Aid Poisonous Bite	Medium	Possible	High	Beach Users	Beach Safety Signage	Formalise access tracks through to the beach Install fences to restrict access to dunes	Low



Ref	Hazard Description	Photo	Risk(s)	Risk Matrix's			Risk Groups	Existing Controls/Treatment Plans	Recommended Additional Controls/Treatment	Action Priority & Residual
				Extreme	Possible	Extreme				
7(26985)	Submerged rocks		Head Injury Spinal Injury Slips, trips falls	Extreme	Possible	Extreme	Fisherman Swimmers	-	Install Beach Safety Signage Education and Awareness Programs Emergency Action Plans	High






Appendix D: Access Schedule




Note: GPS Datum is WGS 84. Additionally, the GPS device used was an iPad 3 with a margin error of ± 5.0 metres.



D1: Access – Yanchep Beach




Access Reference	Photo	Access Location Description	GPS Position	Current Access Risk Treatment	Proposed Risk Treatment for Access	Type	Hazards
1(8363)		Access track south of Capricorn groyne Formal access on roadside however multiple tracks have been created through the dunes	-31.540661, 115.617287	Warning signage from carpark	Installation of beach safety signage Formalise Access Tracks	Open access	No formal access track No safety signage in place
2(8362)		Formal access from carpark south of Capricorn groyne	-31.540678, 115.617325	Warning Signage	Installation of beach safety signage	Formal Access	No safety signage in place Access not formalised through to the beach
3(8359)		Formal Beach Access from Capricorn Esplanade	-31.542482, 115.621841	Level 3 Open Access Sign (road side) Level 3 Defined Access Sign (beach side)	Maintain access track and signage	Formal Access	Access not formalised through to the beach



Access Reference	Photo	Access Location Description	GPS Position	Current Access Risk Treatment	Proposed Risk Treatment for Access	Type	Hazards
4(8361)		Beach Access from Capricorn Esplanade	-31.543989, 115.620178	Level 3 Defined Access Sign	Formalise Access Track all the way through to the beach	Formal Access	Access not formalised through to the beach
5(8360)		Gated vehicle access to the newly constructed car park Access restricted at time of site visit	-31.544081, 115.623787	Access restricted due to carpark upgrade works	Maintain beach safety signage	Vehicle Access Gate	Uneven surfaces Shared vehicle and pedestrian access
6(8358)		Formal access, uneven ramp on beach end. Out of date and signage that has fallen over.	-31.545992, 115.621849	Level 3 Defined Access Sign (both ends of track) 'How to escape a rip' signage 'Dog Prohibited' signage	Fix damaged fencing and signage Formalise access track all the way through to the beach	Formal access	Uneven ramp on beach end of access track Damaged fencing Signage on beach end on the ground



D2: Access – Yanchep Beach

Access Reference	Photo	Access Location Description	GPS Position	Current Access Risk Treatment	Proposed Risk Treatment for Access	Type	Hazards
1(8365)		Formal at top informal at bottom	-31.537235, 115.616234	Signage located mid-way through dunes	Formalise access tracks Install Beach Safety Signage	Formal Access	Multiple 'goat tracks' thorough the dunes Environmental Damage Access path hard to identify from the beach
2(8366)		Access from previous Club Capricorn Resort Access is formal at the top of the track an informal towards the beach	-31.537678, 115.616936	Signage located mid-way through dunes	Access to be closed shown in Foreshore development plans	Formal Access	Multiple 'goat tracks' thorough the dunes Environmental Damage Access path hard to identify from the beach
3(8364)		Access is defined from the carpark however informal towards the beach end. No fencing and informal tracks branching off.	-31.539047, 115.617348	Level 3 Open Access Signage	Maintain/update signage in line with development	Formal Access	Formalise access track through to the beach Install fencing







Appendix E: Facilities Audit

Assessed Locations:

- 1 Yanchep Beach
- 2 Capricorn



E1 Yanchep Beach

FACILITY TYPE	PHOTO	GPS POSITION		FACILITY DESCRIPTION
		LAT	LONG	
Car Park		-31.540646	115.617325	Carpark located in previous Club Capricorn Resort site. Will be updated in line with Foreshore Development Plans
Lookout		-31.543350	115.621123	Lookout located along the beach access track to Yanchep Beach
Lookout		-31.545349	115.622406	Lookout located along the beach access track to Yanchep Beach
Car Park		-31.544832	115.623095	Not yet accessible to vehicles. Under construction

E2 Capricorn Beach

Note: The area backing Capricorn Beach, previously Club Capricorn Resort has been demolished and in its current state there are no facilities present.



Appendix F: Existing Signage

Assessed Locations:

- 1 Yanchep Beach
- 2 Capricorn


F1 Yanchep Beach

SIGN TYPE	SIGN DESCRIPTION	PHOTO	GPS POSITION	
			LAT	LONG
Level 4 - Individual Hazard Sign	Individual hazard sign located on southern side of Capricorn groyne		-31.540560	115.616959
Informational signage	Temporary signage		-31.540634	115.617355
Level 3 - Open Access Sign	Located on southern side of access track		-31.542437	115.621849



<p>Level 4 - Individual Hazard Sign</p>	<p>Locate don beach end of access track</p>		<p>-31.544041</p>	<p>115.620079</p>
<p>Level 3 - Open Access Sign</p>	<p>Sign located gated vehicle access road from Capricorn Esplanade</p>		<p>-31.544107</p>	<p>115.623772</p>
<p>Level 3 - Defined Access Sign</p>	<p>Located on southern side of access track</p>		<p>-31.545189</p>	<p>115.622810</p>
<p>Dog beach signage</p>	<p>Sign on ground. Not visible from access track.</p>		<p>-31.545742</p>	<p>115.622025</p>



<p>Informational signage</p>	<p>Located on north side of the track at beach end. Temporary signage is out of date.</p>		<p>-31.545885</p>	<p>115.621902</p>
<p>Level 3 - Defined Access Sign</p>	<p>Sign has been knocked over. Sign was upside down and not visible from the access track.</p>		<p>-31.545944</p>	<p>115.621956</p>



F2 Capricorn

SIGN TYPE	SIGN DESCRIPTION	PHOTO	GPS POSITION	
			LAT	LONG
Level 3 - Defined Access Sign	Located mid-way through dunes		-31.537739	115.615402
Level 4 - Individual Hazard Sign	Located mid-way through dunes		-31.538254	115.615852
Level 3 - Open Access Sign	Sign is falling over. Temporary signage is out of date.		-31.539083	115.617348



Appendix G: General Information: Aquatic Recreation Safety Signage

The following points are presented for consideration, in terms of a signage system:

- Safety Signs as recommended in this report should follow the ***National Aquatic and Recreational Signage Style Manual***, 3rd Edition, July 2006 and ***AS/NZS 2416:2010 Water Safety Signs and Beach Safety Flags*** (Parts 1, 2, 3).
- Warning signs should be of consistent design, i.e. EITHER the triangular shape (as referenced in AS/NZS 2416:2010) or diamond shaped. The standard is clear on this point (AS/NZS 2416:2010, Appendix ZZ1 Warning Sign Shape). SLSWA recommend that warning signs enclosures use the diamond shape for consistency with other coastal locations in Australia and Western Australia.
- Signage layout consists of the following sections, listed in hierarchical order:
 - a. Location name and emergency marker (if applicable) or street address
 - b. Hazards and warnings within the designated area
 - c. Safety information or general location/area details
 - d. Regulations (Local Laws)
 - e. Facility/Land Manager
- The importance of effectively placing risk management and safety signage in a public reserve cannot be underestimated. Location, height and existing visual distractions are major factors that contribute to the effectiveness of a sign when installed.
- Carpark signs should be sited central to the car parking area, as visitors drive in. The signs should be placed where parked vehicles will not obscure the sign.
- Open access signs should be spaced at regular intervals.
- Defined access signs should be sited as close as practical to the access point, or other appropriate location, and need to be consistently applied where possible, e.g. on the left hand side of a track entrance.
- Repetitive and/or unnecessary information and signs should be removed in order to effectively capture the attention of visitors, improve overall visual amenity and avoid confusion as a result of too many signs. Any secondary signage that is present at a location should not compete for attention and should be re-located as appropriate so as not to impact on the recognition of the safety orientated primary risk management for signage.

Access and Signage Schedule – Recommendations for all signs

All signage should incorporate the following information:



- **General Information** – for example, the location and direction of the nearest patrolled location,
- **Regulations** – As required by City of Perth ordinances,
- **Facility Manager** – If desired, the signs can incorporate the Land Manager logo.

Temporary Signage

Temporary individual hazard signs may be used where a hazard is localised and which has been identified at a level of risk that warrants a sign be posted, and is not permanent in nature.

Emergency Location Indicators/Markers

Numbering of access tracks aids location of the incident in the case of an emergency. Before any system of numbering is implemented consideration should be given to surrounding signage already in place and potential additional signage to avoid out of sync codes or location identifiers.



Emergency Vehicle Access to the Location

Those tracks that are used for emergency vehicles should be identified by appropriate signage at the nearest contact with the roadway. These signs should have an emergency location indicator/marker in accordance with the recommendations contained within this report and numbering scheme approved by the relevant emergency service providers.

Distance to closest Lifesaving Service Patrolled Area

The following signage should be used to direct the coastal users to permanent lifesaving services such as that provided by the four volunteer surf lifesaving clubs.



Where multiple signs are positioned at a location they will compete for the attention of visitors. More signs at a location not only create visual pollution, but may reduce the likelihood of any messages being understood. For this reason *A/NZS 2416:2010 Water Safety Signs and beach Safety Flags – Part 3 – Guidance for use*, provides options for the consolidation of signage onto a single multiple symbol sign. The use of such signs, in conjunction with the removal of any unnecessary signage, can reduce the overall number of signs used at a location and therefore reduce visual pollution. Most importantly, however, consolidation of signage may increase the likelihood of the messages on the signs being sighted by visitors and also may increase comprehension.

The recommended signage is, in the opinion of SLSWA, in compliance with both the Australian and International standards for Water Safety Signs and Beach Safety Flags and also mirrors the style guidance in the National Aquatic Recreational Signage Style Manual.



Appendix H: Proposed Signage




























Note: The following signage tables provide recommendations for signage that should be installed throughout the Capricorn Yanchep Development and are based on site visits and the Foreshore Development Plans provided by Strategen Environmental and are a guide only.






Once a finalised Foreshore Concept Plan has been provided with greater detail on access paths a full detail of proposed signage with types of signage and exact locations can be completed.



Table H1

<p>Example Only</p> 	<p>Location Identification:</p> <p>Beach Name:</p> <p>Site Reference:</p> <p>Sign Type:</p> <p>GPS Location:</p> <p>Location Description and Siting:</p>	<p>In case of emergency dial '000'</p> <p>Level 3 Open Access Sign</p> <p>Sign to be placed at the top of beach access tracks.</p> <p>Suitable for wider (vehicle) access tracks.</p>																								
<p>Hazards and Warnings:</p> <table border="0"> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>No Lifesaving Service</td> <td>Dangerous Current</td> <td>Submerged Rocks</td> <td>Shallow Water</td> <td>Dumping waves</td> <td>Snakes</td> </tr> <tr> <td>NARSSM</td> <td>AS/NSZ: 2416.1</td> <td>AS/NZS: 2416.1</td> <td>AS/NZS: 2416.1</td> <td>AS/NZS: 2416.1</td> <td>AS/NZ: 2416.1</td> </tr> <tr> <td>WS 15</td> <td>WSW015</td> <td>WSW007</td> <td>WSW006</td> <td>WSW023</td> <td>WSW013</td> </tr> </table>									No Lifesaving Service	Dangerous Current	Submerged Rocks	Shallow Water	Dumping waves	Snakes	NARSSM	AS/NSZ: 2416.1	AS/NZS: 2416.1	AS/NZS: 2416.1	AS/NZS: 2416.1	AS/NZ: 2416.1	WS 15	WSW015	WSW007	WSW006	WSW023	WSW013
																										
No Lifesaving Service	Dangerous Current	Submerged Rocks	Shallow Water	Dumping waves	Snakes																					
NARSSM	AS/NSZ: 2416.1	AS/NZS: 2416.1	AS/NZS: 2416.1	AS/NZS: 2416.1	AS/NZ: 2416.1																					
WS 15	WSW015	WSW007	WSW006	WSW023	WSW013																					
<p>Information:</p> <table border="0"> <tr> <td>  </td> <td> <p>Yanchep Lagoon is patrolled only when red and yellow flags are displayed. *Xkm South. Refer www.beachsafe.org.au or www.wanneroo.wa.gov.au.</p> </td> <td>  </td> </tr> <tr> <td>NARRSSM</td> <td></td> <td>Keep children under supervision at all times</td> </tr> <tr> <td>IS, 1</td> <td></td> <td>AS/NZS 2416.1</td> </tr> <tr> <td></td> <td>*Approximate assessment</td> <td>WSW002</td> </tr> </table>				<p>Yanchep Lagoon is patrolled only when red and yellow flags are displayed. *Xkm South. Refer www.beachsafe.org.au or www.wanneroo.wa.gov.au.</p>		NARRSSM		Keep children under supervision at all times	IS, 1		AS/NZS 2416.1		*Approximate assessment	WSW002												
	<p>Yanchep Lagoon is patrolled only when red and yellow flags are displayed. *Xkm South. Refer www.beachsafe.org.au or www.wanneroo.wa.gov.au.</p>																									
NARRSSM		Keep children under supervision at all times																								
IS, 1		AS/NZS 2416.1																								
	*Approximate assessment	WSW002																								
<p>Regulations:</p>																										



				
No Dogs	No Vehicles	No Motorbikes/Quad bikes	No Littering	No camping
ISO 7010	NARSSM	NARSSM	NARSSM	NARSSM
PO21	RS 03	RS 04	RS, 10	RS 43

General Notes on location:










1. Directional arrow for Lifesaving Service required
2. Remove all other signs and consolidate into single sign board.

Reference:






1. AS/NZS: 2416.1. 2010. Water safety signs and beach safety flags. Specifications for water safety signs used in workplaces and public areas (ISO 20712-1: 2008 MOD)
 - a. Where available use symbols in diamond enclosure from this standard.
2. AS/NZS: 2416.3. 2010. Water safety signs and beach safety flags. Guidance for use
 - a. Where available use symbols in diamond enclosure from this standard.
3. National Aquatic and Recreational Style Guide Manual (Version 3. July 2006).
 - a. Use this manual to guide the development of the sign style.



Table H2

<p>Example Only</p> 	<p>Location Identification:</p> <p>Beach Name:</p> <p>Site Reference:</p> <p>Sign Type:</p> <p>GPS Location:</p> <p>Location Description and Siting:</p>	<p>In case of emergency dial '000'</p> <p>Level 2 Carpark Sign</p> <p>Sign should be placed on the access road into carparks where most visible.</p>			
<p>Hazards and Warnings:</p>					
 <p>No Lifesaving Service</p> <p>NARSSM WS 15</p>	 <p>Dangerous Current</p> <p>AS/NSZ: 2416.1 WSW015</p>	 <p>Submerged Rocks</p> <p>AS/NZS: 2416.1 WSW007</p>	 <p>Shallow Water</p> <p>AS/NZS: 2416.1 WSW006</p>	 <p>Dumping waves</p> <p>AS/NZS: 2416.1 WSW023</p>	 <p>Snakes</p> <p>AS/NZ: 2416.1 WSW013</p>
<p>Information:</p>					
 <p>NARRSSM IS, 1</p>	<p>Yanchep Lagoon is patrolled only when red and yellow flags are displayed. *Xkm South. Refer www.beachsafe.org.au or www.wanneroo.wa.gov.au.</p> <p>*Approximate assessment</p>	 <p>Keep children under supervision at all times AS/NZS 2416.1 WSW002</p>			
<p>Regulations:</p>					



				
No Dogs	No Vehicles	No Motorbikes/Quad bikes	No Littering	No camping
ISO 7010	NARSSM	NARSSM	NARSSM	NARSSM
PO21	RS 03	RS 04	RS, 10	RS 43

General Notes on location:










3. Place sign on the left side of the main access path
4. Directional arrow for Lifesaving Service required
5. Remove all other signs and consolidate into single sign board.

Reference:





4. AS/NZS: 2416.1. 2010. Water safety signs and beach safety flags. Specifications for water safety signs used in workplaces and public areas (ISO 20712-1: 2008 MOD)
 - a. Where available use symbols in diamond enclosure from this standard.
5. AS/NZS: 2416.3. 2010. Water safety signs and beach safety flags. Guidance for use
 - a. Where available use symbols in diamond enclosure from this standard.
6. National Aquatic and Recreational Style Guide Manual (Version 3. July 2006).
 - a. Use this manual to guide the development of the sign style.



Table H3

<p>Example Only</p> 	<p>Location Identification:</p> <p>Beach Name:</p> <p>Site Reference:</p> <p>Sign Type:</p> <p>GPS Location:</p> <p>Location Description and Siting:</p>	<p>In case of emergency dial '000'</p> <p>Defined Access Level 3</p> <p>Sign to be placed at the top of access tracks.</p> <p>For use where access to the reserve is controlled via a narrow pathway.</p>			
<p>Hazards and Warnings:</p>					
 <p>No Lifesaving Service</p> <p>NARSSM WS 15</p>	 <p>Dangerous Current</p> <p>AS/NZ: 2416.1 WSW015</p>	 <p>Submerged Rocks</p> <p>AS/NZ: 2416.1 WSW007</p>	 <p>Shallow Water</p> <p>AS/NZS: 2416.1 WSW006</p>	 <p>Dumping waves</p> <p>AS/NZ: 2416.1 WSW 023</p>	 <p>Unstable Cliffs</p> <p>NARSSM WS 34</p>
<p>Information:</p>					
 <p>NARSSM IS, 1</p>	<p>Yanchep Lagoon is patrolled only when red and yellow flags are displayed. *X km South. Refer www.beachsafe.org.au or www.wanneroo.wa.gov.au.</p> <p>*Approximate assessment</p>	 <p>Keep children under supervision at all times</p> <p>AS/NZS 2416.1 WSW002</p>			
<p>Regulations:</p>					



			
No Littering NARSSM RS, 10	No Trail bikes NARSSM RS, 4	No Dogs ISO 7010 PO 21	No Horses NARSSM RS, 17
<p>General Notes on location:</p> <ol style="list-style-type: none"> 1. Place sign on the left of the main access path to beach. 2. Directional arrow required for Lifesaving Service information 3. Remove all other signs and consolidate into single sign board. <p>References:</p> <ol style="list-style-type: none"> 2. AS/NZS: 2416.1. 2010. Water safety signs and beach safety flags. Specifications for water safety signs used in workplaces and public areas (ISO 20712-1: 2008 MOD) <ol style="list-style-type: none"> a. Where available use symbols in diamond enclosure from this standard. 3. ISO 7010: 2011. Graphical symbols – Safety colours and safety signs – Registered safety signs 4. National Aquatic and Recreational Style Guide Manual (Version 3. July 2006). <ol style="list-style-type: none"> a. Use this manual to guide the development of the sign style. 			



Appendix I: The BeachSAFE Initiative and Principles

The BeachSAFE Initiative is a comprehensive and holistic approach to building capacity within the WA community so people can recreate safely on the coast. It incorporates a range of community education, awareness and promotional programs which are based upon four key coastal safety principles, which are integral to staying safe when recreating at the beach. These are:

- S** Supervision
- A** Aquatic Education
- F** First Aid & CPR Training
- E** Emergency Preparedness

The Initiative is driven by research and evidence based practices, is guided by local and national frameworks and targets high risk demographics in order to reduce the number of coastal drowning deaths in WA.

BeachSAFE Coastal Aquatic Safety Initiative

The BeachSAFE Initiative was developed in 2013 by Surf Life Saving WA (SLSWA) in response to the increasing number of coastal drowning deaths occurring at beaches in Western Australia. Tragically, during the 2012/13 year a record 17 people lost their lives [1].

Research shows that there has been a 42% increase in the annual coastal drowning rate and a 176% increase in the number of preventative actions performed by surf lifesavers and lifeguards over the last 6 years. With a rapidly increasing population fuelled by migration and immigration; urban sprawl; improved public transport; and a greater range of coastal recreational options than ever before, more people are recreating on the coast, yet fewer of them have the skills to do so safely.

The Initiative is SLSWA's holistic approach to addressing this disturbing trend. It recognises the need for targeting high risk groups, locations and recreational pursuits. While the initiative is a state wide approach to mitigating coastal risk it has been developed to be scalable and adaptable to local community needs and outcomes.

The Objectives of the BeachSAFE Initiative are:

- Increase parents and carer's awareness and knowledge of how to keep children aged 0-4 years safe around aquatic environments,
- Increase the general community's awareness and knowledge of how to be safe around aquatic environments
- Increase the general community's confidence and skill set to provide First Aid and CPR in aquatic related incidents; and
- Reduce risk taking behaviour in and around aquatic environments in young people

The benefits of the BeachSAFE Initiative include:

- A reduction in the number of fatal and non-fatal drowning incidents involving children aged 0-4 years,
- A reduction in the number of fatal and non-fatal drowning incidents in the general community,
- Reduced severity of aquatic related injuries,
- Reduced risk taking behaviour in young people recreating in aquatic environments; and
- A reduction in the financial burden on the community associated with drowning related hospitalisations, years of life lost and disability adjusted life years.

The Initiative is comprised of 3 core components which collectively provide a sustainable approach to coastal drowning prevention.

These are:

1. The BeachSAFE Framework.
2. The BeachSAFE Principles:
 - Supervision
 - Aquatic Education
 - First Aid and CPR Training
 - Emergency Preparedness
3. The BeachSAFE Program Suite.

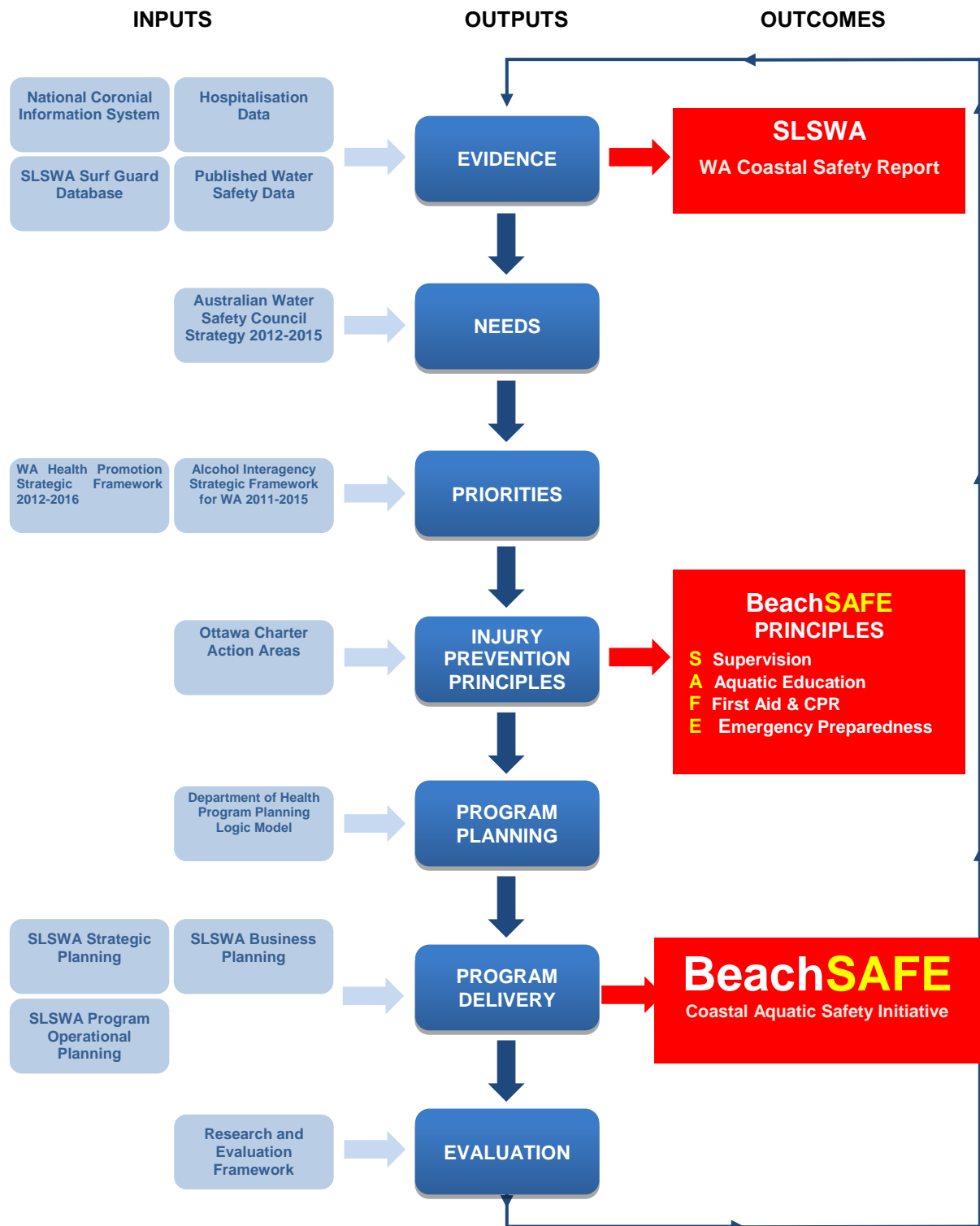
The BeachSAFE Framework

The BeachSAFE Initiative has been designed to integrate with and contribute to the National Water Safety Strategy set by the Australian Water Safety Council [2]. The Initiative is research based and identifies priority areas so resources are allocated where they are needed most. Regular analysis and review ensures its effectiveness is measured to ensure it remains relevant with future needs and priorities.

The BeachSAFE Framework uses the latest research, local and national frameworks, and evaluation methods to produce outputs to guide decision making and planning in order to produce drowning prevention outcomes for WA.



Figure 1.0 BeachSAFE Framework



The four BeachSAFE Principles represent the fundamental principles that are common to safe recreation in all aquatic recreational activities. In terms of drowning risk, they represent the highest priorities for reducing drowning deaths in WA. The principles are presented in a simple, memorable and relevant safety message and acronym; BeachSAFE. Each and every program in the BeachSAFE Initiative aligns to one or more of the SAFE principles and delivers consistent messaging for maximum recall and message awareness.

The SAFE Principles are a product of the BeachSAFE Framework and therefore align with and contribute to the Australian Water Safety Strategy 2012-2015 and the frameworks of key Western Australian stakeholder organisations. .

The SAFE principles are:

S

Supervision

Supervision is a key contributing factor to reducing the risk of drowning at coastal locations and is an established aquatic injury prevention strategy. Supervision reduces the severity of injury as well as reducing the overall risk of drowning. Without supervision, many more drowning incidents would result in permanent incapacitation and death, particularly in young children.

Whilst surf lifesavers perform an invaluable supervision service to the public, Australia has more than 30,000km of coastline, of which only 3% is patrolled by lifesavers and lifeguards.

While many parents believe they adequately supervise their child in aquatic environments, 25% reported that they would watch from the sand rather than being in the water with their child.

At coastal locations the importance of active supervision is magnified compared to other aquatic environments due to several factors:

- Access to the coast is unrestricted,
- The coast is a dynamic and unpredictable environment with significant inherent risks,
- Supervision requirements on the coast cannot be enforced,
- The majority of beaches do not have lifesaving supervision services ,
- The majority of supervision services rely on volunteer workforces; and
- Limited restrictions apply to the type of patron recreation that may occur on coast, for example surfing, swimming, boating etc.

For these reasons SLSWA advocates that when on the coast the community should strive to:

- Only recreate between the red and yellow patrol flags, and if not possible be prepared for any emergencies,
- Always ensure that children of all ages are accompanied and supervised by a competent adult,
- Never recreate alone; and
- Choose to recreate at locations that match their aquatic capacity.
-

A

Aquatic Education



Programs that increase the capacity of the community in relation to aquatic pursuits are at the core of the BeachSAFE Initiative.

According to the Pricewaterhouse Coopers Report 'What is the economic contribution of Surf Life Saving in Australia' (2011), 5% of people rescued by Surf Life Saving services would have resulted in a drowning death, and a further 3% would have resulted in permanent incapacitation. Based on these figures, SLSWA lifesaving services between 2008-09 and 2012-13 were able to:

- Prevent 293 people from drowning at WA beaches
- save 176 people from permanent incapacitation, and
- save the economy over \$1.45 billion

SLSWA strongly advocates all members of the community to learn to swim, as this primary skill is applicable to all aquatic pursuits in all aquatic environments. There are many excellent learn to swim programs providing this to the community.

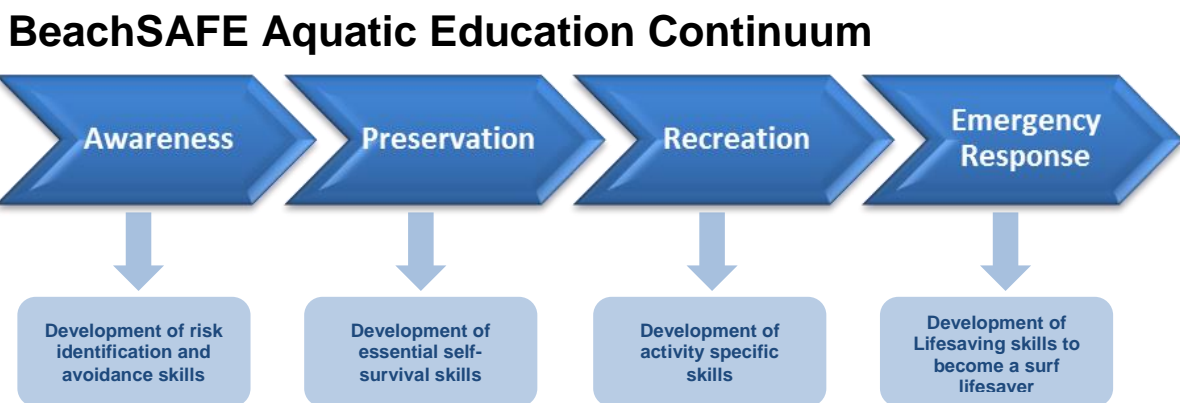
However, learning to swim is only one part of aquatic education equation. The coast is a dynamic environment with constantly changing risks that are generally hidden to the casual observer. Therefore, whilst swimming capability is a key component of safe coastal recreation, unfortunately many competent swimmers drown along the Western Australian coast every year as they lack the additional surf knowledge and skills that are required for safe coastal recreation. For this reason BeachSAFE Programs focus on developing those skills that are unique and essential to SAFE coastal aquatic recreation.

BeachSAFE programs cater to participants of all skill levels and provide theoretical and practical surf environment training on:

- Environmental assessments, risk identification and risk avoidance,
- Safe recreation practices for a range of activities such as swimming, surfing, paddling, kite boarding and rock fishing,
- Skill and fitness training; and
- Survival and rescue techniques.

In the same manner that a participant may progress through a learn to swim program from beginner to advanced level, participants also progress through the BeachSAFE Aquatic Education Continuum from beginner to Bronze Medallion qualified surf lifesaver - at which stage they form a vital and voluntary contribution to the Western Australian community's emergency management capacity.

Figure 2.0 BeachSAFE Aquatic Education Continuum



Each season over 8,000 children are enrolled in surf clubs, where they are progressively taught to be



BeachSAFE and later encouraged to become surf lifesavers where they contribute their time and expertise to increasing WA's emergency management capacity.

Of course, not all members of the community have the desire or determination to become surf lifesavers or, for a variety of reasons, do not have the opportunity to join a surf club.

For this reason it is essential the community has access to a range of tailored programs to the broader community that are delivered outside the club based system.

Programs range from public awareness campaigns such as our '*Swim between the flags – If we can't see you we can't save you*' campaign which encourages people to swim only in patrolled areas (areas that are risk assessed and supervised) through to emergency response programs including the '*Community Surf Rescue Certificate*,' where on average 1,600 participants per year are trained and equipped with the skills required to supervise others and assist in emergency situations on the coast.

Awareness programs are also offered to community members with specific recreational requirements through the 'Be Safe' range of programs including ocean paddling, kite surfing and rock fishing.

Last year SLSWA provided over 3.8 million people with coastal safety messages through community programs, First Aid and CPR training and through rescues and preventative actions performed at patrolled locations on the coast.

F

First Aid &
CPR Training

Early response First Aid and CPR are often the difference between life and death in an emergency situation.

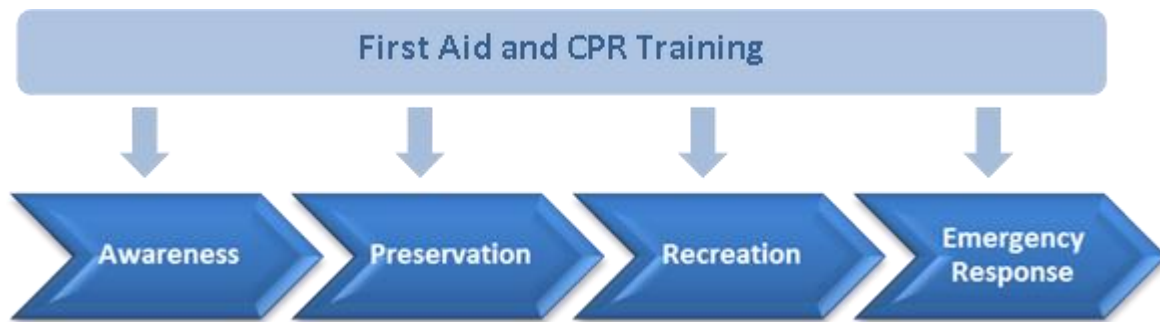
Drowning is the leading cause of aquatic related unintentional mortality. However, fatal drowning may be averted through the immediate restoration of oxygen through the administration of emergency Cardiopulmonary Resuscitation (CPR).

Surf Life Saving Western Australia is a leading provider of accredited First Aid and CPR Training to the WA community and provides a vast array of training programs through 30 Surf Life Saving centres in WA. Over half of the 18,500 surf lifesaving members in Western Australia have completed some form of First Aid and CPR training, and last year an additional 14,700 West Australians completed an accredited training course through SLSWA, taking these skills into their homes, communities, workplaces and beyond.

Further, over 5,000 school children per year participate in the Life Skills for Life program which, in addition to providing surf awareness education, provides hands on instruction in basic CPR to students aged 11 to 12 years and provides take home resources for utilisation in the home environment. Over 30,000 students have participated in this program to date.

It is important to note that these vital lifesaving skills are also incorporated in our aquatic education programs at all stages of the continuum.

Figure 3.0 Integration of First Aid Training in the BeachSAFE Aquatic Education Continuum



First Aid and CPR Training programs are a vital component of the BeachSAFE Initiative. Increased participation in these programs will lead to increased community capacity to respond to and avert life threatening situations.



Emergency Preparedness



Emergency Preparedness is acknowledgement and acceptance of the fact that sometimes, despite the best training, planning and preparation, things can and do go wrong in coastal aquatic environments. It involves ensuring the appropriate equipment and processes are in place to lessen their impact and improve chance of survival.

Emergency Preparedness is a part of Emergency Management which is the discipline of dealing with and avoiding emergency situations, and may be represented as consisting of five distinct phases:

Emergency Management Model:

1. **Prevention:** Permanent protection or isolation from risks
2. **Mitigation:** Risk assessment and training to avoid unnecessary risks
3. **Preparedness:** Equipment and procedures for use when emergency situations occur
4. **Response:** Search, rescue and support activities
5. **Recovery** Commence once the immediate threat to human life has subsided and aim to return a degree of regularity.

Given the unpredictable and dynamic nature of coastal aquatic environments, the underlying principles of Emergency Preparedness are encompassed in all the aquatic education programs within the BeachSAFE Program Suite. In addition, specific emergency preparedness provisions for popular and dangerous coastal recreation activities are included, highlighting the importance and effectiveness of certain techniques in specific situations.

Unfortunately, many people choose not to swim at patrolled locations, or participate in aquatic activities that are not possible 'between the flags'. In partnership with stakeholder groups, SLSWA has developed the 'Be Safe' range of programs to build awareness and practice of emergency preparedness behaviours for particular high risk recreation pursuits which do not occur within patrolled locations. Focusing on safe practices, appropriate preparation techniques, emergency clothing and equipment, and applicable education and training programs, the 'Be Safe' programs aim to lessen the impact of unplanned events when they occur.

Each BeachSAFE Principle outlined above was designed through evidence based research and has been identified as the priority areas to reduce coastal drowning deaths in WA.

BeachSAFE Program Suite

The BeachSAFE Program Suite is a set of programs that have been developed by SLSWA to deliver the four key BeachSAFE Principles of Supervision, Aquatic Education, First Aid and CPR, and Emergency Preparedness.

All programs are evidence based, and aim to increase the community's knowledge, awareness or skills to recreate safely on the coast.

The Suite offers three levels of prevention programs:

Primary prevention: A range of programs for the WA society and coastal land managers. These programs influence the safety experience of the WA coastline for all beachgoers.



- Secondary prevention:** A range of programs for target groups within the community and other organisations. These include settings such as schools, workplaces, Surf Life Saving Clubs, recreational sport and activity associations and other community groups.
- Tertiary prevention:** A range of SLSWA Surf Life Saving services that aim to prevent individuals from drowning or acquiring injury on the coast.

The BeachSAFE Program Suite has been developed through the BeachSAFE Framework and is aligned to the four key BeachSAFE Principles. The programs are evaluated and reviewed in order to maintain relevance with current and emerging drowning trends.

SLSWA works in partnership with a range of government and non-government organisations to deliver these programs including:

Government

- Department of Sport and Recreation
- Department of Premier and Cabinet
- Department of Fire and Emergency Services
- Department of Health
- Department of Parks and Wildlife
- Heathway
- WA Office of the Coroner
- Local Government Authorities
- Australian Sports Commission
- Water Police
- Department of Fisheries

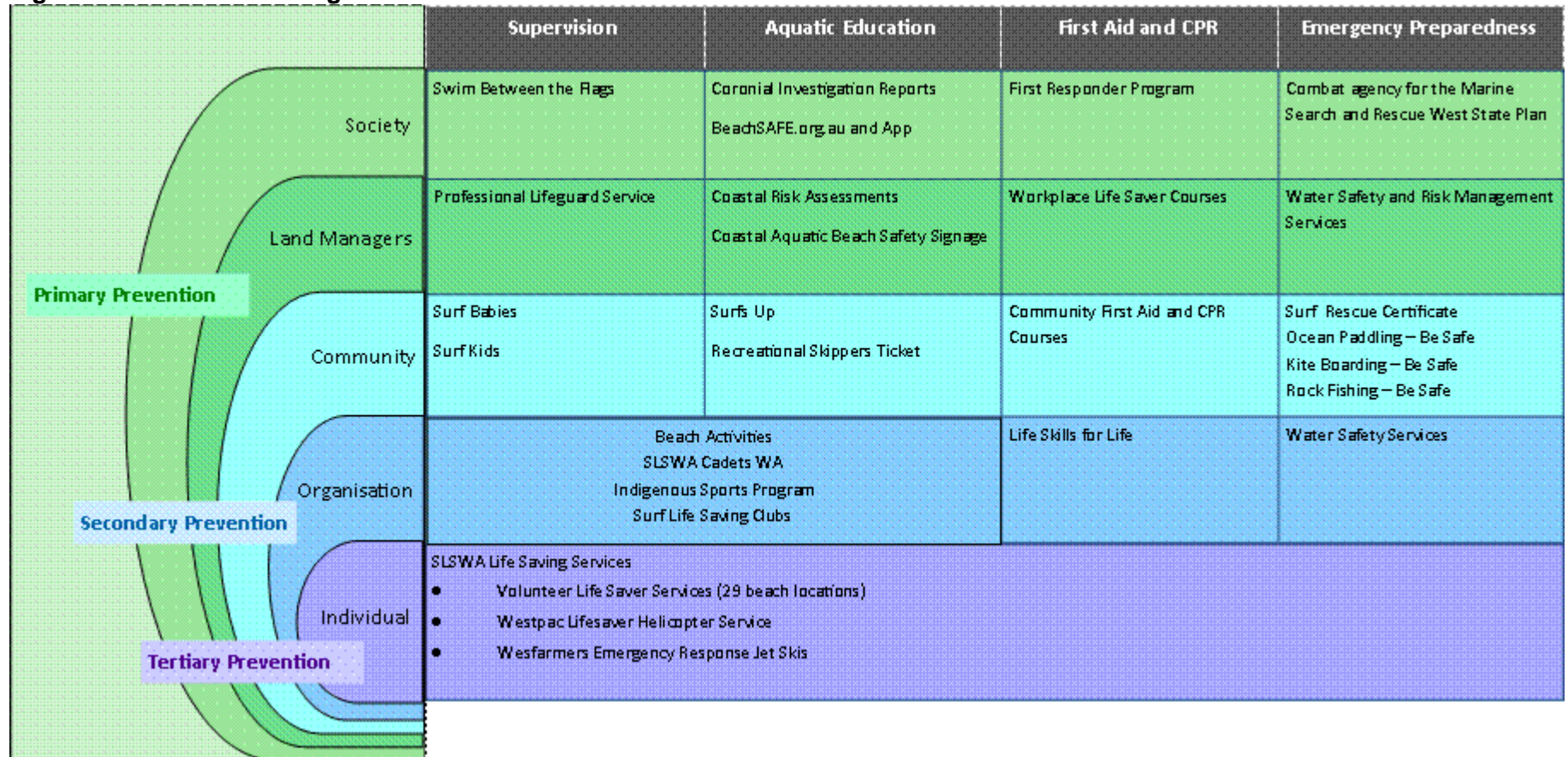
Non-Government

- DHL
- Woodside
- Westpac
- Telstra
- Wesfarmers
- Fogarty Foundation
- Fremantle Port Authority
- Rec Fish West
- Lottery West
- Injury Control Council of WA
- The Sunday Times
- Lavan Legal
- Metro Motors
- Rival
- Crowe Horwath
- Canoeing WA
- WA Kite Surfing Association
- Volunteer Marine Response Agency
- Catholic Education Office of WA



The following figure contains the BeachSAFE Program Suite outlining the three levels of prevention and the program alignment to the four key BeachSAFE Principles.

Figure 4.0 BeachSAFE Program Suites



Appendix J: Language Spoken at Home – ranked by size.

I1: Language spoken at home (City of Wanneroo Residents) – ranked by size in 2006 and 2011.

[Source: Australian Bureau of Statistics, Census of Population and Housing 2006 and 2011.]

Language (Excludes English)	2011		2006		Change Change 2006 to 2011
	Number	%	Number	%	
Vietnamese	4,133	2.7	3,391	3.1	+742
Afrikaans	1,916	1.3	394	0.4	+1,522
Italian	1,627	1.1	1,556	1.4	+71
Macedonian	1,503	1.0	1,287	1.2	+216
Arabic	1,490	1.0	863	0.8	+627
Gujarati	985	0.6	200	0.2	+785
Filipino/Tagalog	850	0.6	290	0.3	+560
Persian/Dari	795	0.5	377	0.3	+418
Spanish	775	0.5	572	0.5	+203
Cantonese	704	0.5	572	0.5	+132
Mandarin	685	0.5	360	0.3	+325
Serbian	595	0.4	484	0.4	+111
Burmese	583	0.4	423	0.4	+160
Romanian	580	0.4	445	0.4	+135
Polish	576	0.4	477	0.4	+99
German	509	0.3	386	0.3	+123
Dinka	484	0.3	128	0.1	+356
French	450	0.3	263	0.2	+187
Malay	448	0.3	386	0.3	+62
Croatian	393	0.3	349	0.3	+44
Greek	339	0.2	324	0.3	+15
Dutch	306	0.2	236	0.2	+70
Khmer	296	0.2	226	0.2	+70
Bosnian	273	0.2	243	0.2	+30
Punjabi	268	0.2	88	0.1	+180
Thai	254	0.2	126	0.1	+128
Hindi	246	0.2	74	0.1	+172
Indonesian	245	0.2	131	0.1	+114
Karen	217	0.1	66	0.1	+151
Maori (New Zealand)	185	0.1	74	0.1	+111
Portuguese	185	0.1	104	0.1	+81
Tamil	179	0.1	102	0.1	+77
Non-verbal so described	173	0.1	167	0.2	+6
Japanese	158	0.1	60	0.1	+98



Appendix 8
Capricorn Village Joint Venture: North
Yanchep Coastal Erosion Hazard Review

Our reference: K1437:CRD:Letter 17054 Rev 2
Enquiries: Clint Doak, direct line: 9254 6613

7 May 2018

Capricorn Village Joint Venture
C/- Acumen Development Solutions
18 Lyall Street
SOUTH PERTH WA 6151
Attn: Mr Jarrod Rendell

Dear Jarrod

**CAPRICORN VILLAGE JOINT VENTURE
NORTH YANCHEP COASTAL EROSION HAZARD REVIEW – 2017**

M P Rogers & Associates Pty Ltd (MRA) has previously completed a review of the required coastal erosion hazard allowances for the North Yanchep development areas. The outcomes of these assessments were outlined in the following reports.

- *North Yanchep Coastal Setback Assessment* – MRA Report R337 Rev 2 completed for the Capricorn Village Joint Venture (CVJV) in January 2013.
- *North Yanchep – North of Groyne Assessment of Setback* – MRA Report R340 Rev 2 completed for the CVJV in July 2014.

These assessments were completed in accordance with the requirements of State Planning Policy 2.6 – the State Coastal Planning Policy. However, it is noted that the most recent amendment to SPP2.6 occurred in July 2013. This amendment therefore post-dates the completion of the *North Yanchep Coastal Setback Assessment* (MRA Report R337 Rev 2) which was completed in January 2013.

Nevertheless, as noted within the *North Yanchep Coastal Setback Assessment*, a draft version of the proposed 2013 revision of SPP2.6 was available at that time. An assessment of the coastal setback (now termed the “coastal erosion hazard allowance”) was therefore made in accordance with the proposed amendments to the policy. These proposed amendments have subsequently been adopted as policy, therefore meaning that the assessment presented within that report was consistent with the requirements of the 2013 version of SPP2.6.

Despite being consistent with the requirements of the 2013 version of SPP2.6 with regard to the assessment methodology, both reports used shoreline movement information up to and including the year 2012. As a result, the shoreline information presented within the reports is approximately 5 years old and should be reviewed. Furthermore, coastal hazard assessments have been completed for the area as part of the City of Wanneroo’s CHRMAP Part 1 works (as presented in MRA Report R607 Rev 0: *CHRMAP Part 1 – Coastal Vulnerability Study and Hazard Mapping*) which provides further information relevant to the assessment.

To complete the update of the coastal hazard lines, aerial imagery from February 2017 has been sourced and reviewed against previously noted shoreline movement trends. The review of the shoreline movement information was completed for the entire tertiary sediment cell (cell 30a), as required by SPP2.6.

In accordance with the requirements of the City of Wanneroo, the revised coastal hazard lines presented within this letter cover the full extent of tertiary Sediment Cell 30a, Zones 2 and 3 (as defined within CHRMAP Part 1). Details of these updated assessments are provided hereafter.

Revised Coastal Hazard Assessment – North of the Capricorn Village Groyne

Assessment of the shoreline position in 2017 shows a continuation of the trends observed prior to 2012. Essentially, the shoreline north of the Capricorn Village groyne has accreted markedly since 1965. As a result the allowance for long term shoreline movement (S2) that were made remain appropriate. Likewise, the allowances for severe storm erosion (S1) and coastal recession due to sea level rise (S3) also remain appropriate.

Revised Coastal Hazard Assessment – South of the Capricorn Village Groyne

Assessment of the shoreline position in 2017 for the shoreline south of the Capricorn Village groyne also shows a continuation of the trends observed prior to 2012. The shoreline immediately south of the Capricorn Village groyne has accreted markedly since 1965, however the extent of ongoing accretion reduces with distance south. In fact, since 1996 the shoreline just south of the Mary Lindsay Homestead (chainage 1,200 m in report R337 Rev 2) shows an erosion trend of around 0.3 m/year. This trend is consistent with the shoreline movement noted within the CHRMAP Part 1 works. As a result the allowances for long term shoreline movement (S2) will need to vary across the shoreline.

A long term shoreline movement allowance (S2) of 0 m/year will be appropriate for the shoreline from the Capricorn Village groyne extending south 600 m (report R337 Rev 2 chainages 1,500 to 2,100 m). From this location the S2 allowance will need to transition to 0.3 m/year at a location around 900 m south of the groyne (report R337 Rev 2 chainage 1,200 m). This allowance will also be required for the remainder of the shoreline down to around chainage 800 m where the shoreline becomes rocky. From this point south the required allowances are entirely consistent with those made within the CHRMAP Part 1.

Consideration of the severe storm erosion (S1) and coastal recession due to sea level rise (S3) allowances suggests that the values outlined in report R337 Rev 2 and the CHRMAP Part 1 remain appropriate for this area.

Revised Coastal Hazard Assessment Allowances

Total coastal erosion hazard allowances for a variety of planning horizons are provided in Table 1 for Zones 2 and 3 of Sediment Cell 30a. These allowances are measured in a landward direction from the Horizontal Shoreline Datum (HSD) which has been updated based on the 2017 information. A plan showing the location of the coastal erosion hazard lines is included as Attachment 1.

Table 1 Coastal Erosion Hazard Allowance for Zones 2 and 3 of Sediment Cell 30a

Chainage (m)	Tertiary Sediment Cell & Zone	Erosion Allowance (m)																	
		2017		25 Years (2042)				50 Years (2067)				75 Years (2092)				100 Years (2117)			
		S1	S2	S3	FOS	Total	S2	S3	FOS	Total	S2	S3	FOS	Total	S2	S3	FOS	Total	
200-400	30a Zone 3	Rocky Coast																	
500		24	0	13	5	42	0	35	10	69	0	64	15	103	0	90	20	134	
600-800		Rocky Coast																	
900-1,200	30a Zone 2	28	7.5	13	5	53.5	15	35	10	88	22.5	64	15	130	30	90	20	168	
1,500-2,100		28	0	13	5	46	0	35	10	73	0	64	15	107	0	90	20	138	
2,200-2,500		21	0	13	5	39	0	35	10	66	0	64	15	100	0	90	20	131	

Concluding Comments

It is noted that the locations of the coastal hazard lines presented in Attachment 1 are slightly different to the lines that were prepared for the City of Wanneroo as part of their CHRMAP Part 1 works (as presented in MRA Report R607 Rev 0: *CHRMAP Part 1 – Coastal Vulnerability Study and Hazard Mapping*). The reasons for this difference are outlined below.

- The CHRMAP Part 1 works used data up to and including 2015. This investigation for the CVJV has used data up to and including 2017. Some small differences in the location of the shoreline between 2015 and 2017 are noted (generally up to 2-3 m) and will affect the locations of the coastal hazard lines.
- The CHRMAP Part 1 works required consideration of different timeframes, including a 105 year planning horizon to 2120. As a result the S3 Allowance for sea level rise was slightly bigger than required for this CVJV study (due to the extended planning horizon of 105 years versus 100 years). Furthermore, the Allowance for Uncertainty was also 1 m greater given the extended planning horizon.

Given the above, even though the basis of each of the erosion allowances determined for these site are identical between the CHRMAP Part 1 and the CVJV studies (i.e. the S1 allowance and S2 allowances are identical and the S3 allowance is based on the same sea level rise projection), the locations of the coastal hazard lines are slightly different. Despite these differences it is important to recognise that coastal erosion hazard lines determined within this letter and presented on the attached plan are the most appropriate coastal hazard lines to be used to guide coastal planning for these locations. This is due to the fact that they make use of the most recently available information and also consider a planning horizon of 100 years, as required in SPP2.6.

We trust the above and attached information provides a sufficient level of detail for you at this time. Please do not hesitate to contact the undersigned should you require any further information.

Yours sincerely

for and on behalf of
[m p rogers & associates pl](#)

Legend

- 2017 Horizontal Shoreline Datum
- Rock Shoreline
- Present (2017) Erosion Hazard Line
- 25 year (2042) Erosion Hazard Line
- 50 year (2067) Erosion Hazard Line
- 75 year (2092) Erosion Hazard Line
- 100 year (2117) Erosion Hazard Line

Notes

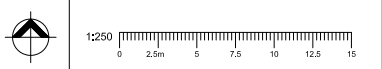
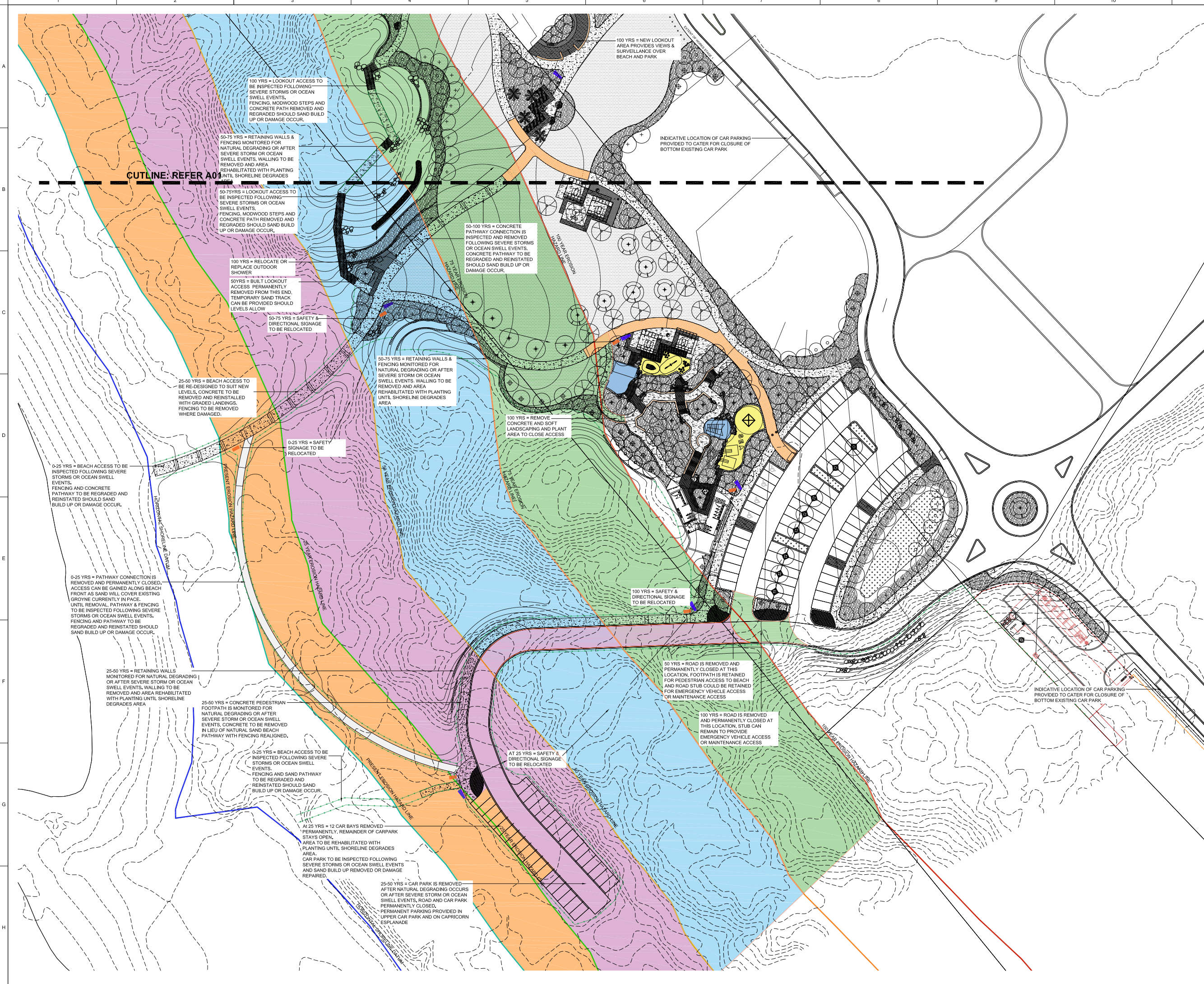
1. Aerial photograph taken February 2017.
2. Coastal Erosion Hazard Lines based on the outcomes of MRA Reports R337 Rev 2, R340 Rev 2, R607 Rev 1 and MRA Letter 17054 Rev 2 dated 7 May 2018.



AT CORRECT SCALE THIS IS 100 mm



Appendix 9
Coastal node adaptation plan



- LEGEND**
- 0-25 YEAR ADAPTATION AREA
 - 25-50 YEAR ADAPTATION AREA
 - 50-75 YEAR ADAPTATION AREA
 - 75-100 YEAR ADAPTATION AREA
 - MATURE TRANSPLANT SOURCED FROM SITE
 - PHOENIX CANARIENSIS TRANSPLANTS
 - 1000 LITRE TREES
 - 500 LITRE TREES
 - 200 LITRE TREES
 - 100 LITRE TREES
 - 90 LITRE FEATURE SHRUBS
 - 45 LITRE TREES
 - 5 LITRE TREES (NON IRRIGATED)
 - ESTABLISHMENT IRRIGATED SHRUB PLANTING (2YRS)
 - PERMANENT IRRIGATED ROLL ON TURF
 - D DIRECTIONAL SIGNAGE TO BE RELOCATED OR REPLACED
 - S CITY OF WANNEROO BEACH SAFETY SIGNAGE TO BE RELOCATED OR REPLACED
 - 1.2m TALL CoW CONSERVATION FENCE TO BE RELOCATED OR REPLACED
 - MODWOOD DECKS TO BE RELOCATED OR REPLACED
 - TOW 3.50 BGL 2.80 RECON LIMESTONE RETAINING WALL WITH TOP WALL AND BOTTOM OF WALL HEIGHTS
 - TOW 3.50 BGL 2.80 GRANITE CLAD BLOCK RETAINING WALL WITH TOP OF WALL & BOTTOM OF WALL HEIGHTS
 - EXISTING CONTOURS
 - PROPOSED CONTOURS
 - PROPOSED LOCATION OF POLE LIGHTS, TO BE REMOVED AND REPLACED IN DETERMINED SAFE LOCATION OUTSIDE OF COASTAL HAZARD AREA

No.	REVISION	BY	DATE
A	FOR APPROVAL	KD	06/03/18

ADAPTATION PLAN 2

Project
CAPRICORN VILLAGE COASTAL NODE

Client
ACUMEN



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Date	MARCH 2018	Revision
Scale	1:500 @ A1	A
Issue	APPROVAL	Checked KD
Drawn	RM/KD	

Appendix 10
Coastal node and POS landscape plans
(concept plans subject to future
approvals)

CAPRICORN VILLAGE COASTAL NODE POS LANDSCAPE & IRRIGATION WORKS

(Contract No B0494/CV/CN/L)

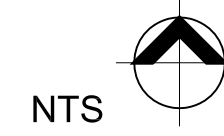
for
ACUMEN

MARCH 2018

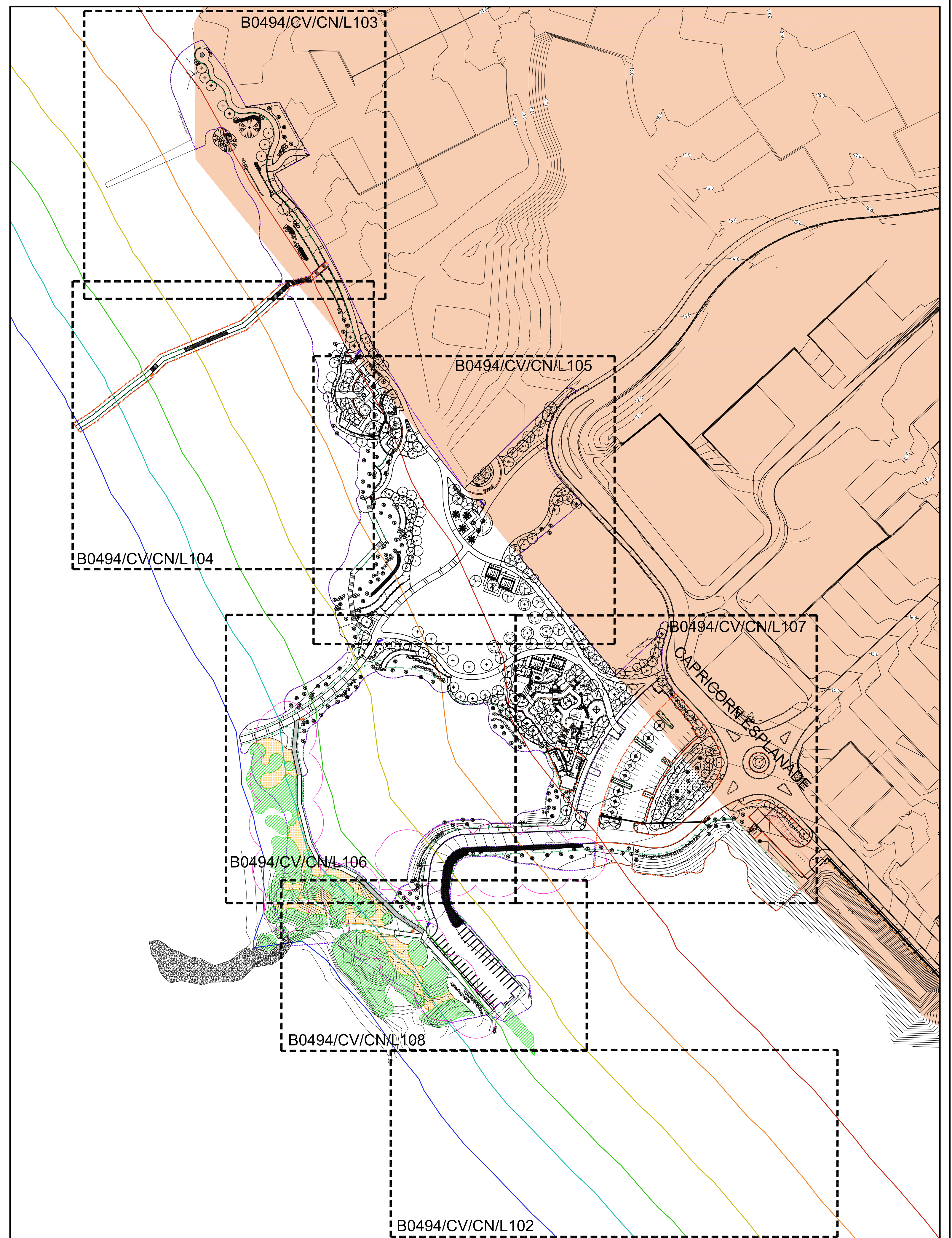
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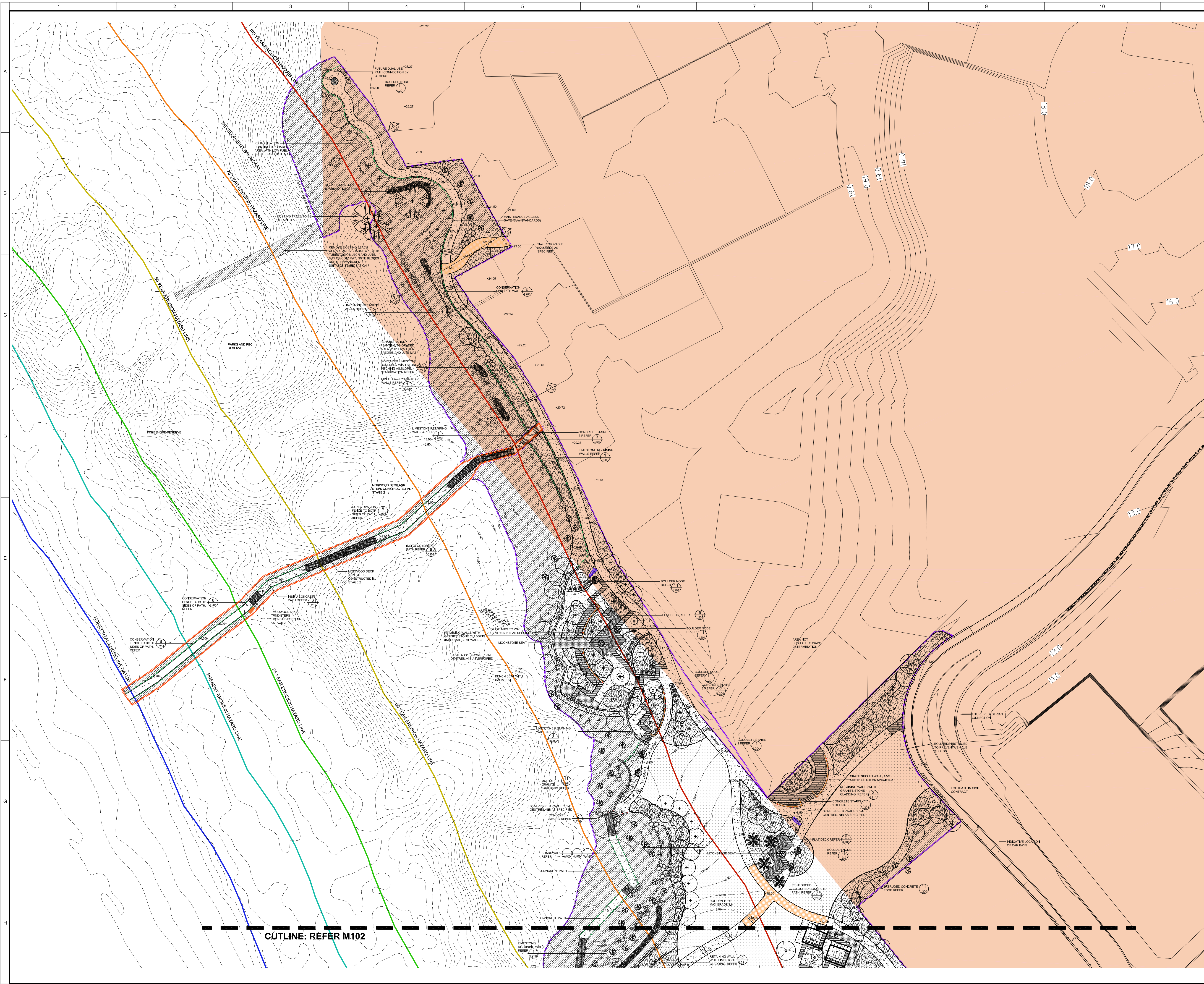
EPCAD
DRAWING SCHEDULE

EPCAD PTY LTD



Drawing No.	Title
PLANS 100 SERIES	
B0494/CV/CN/L-C-SH	COVER SHEET
B0494/CV/CN/L101	LANDSCAPE MASTERPLAN 01
B0494/CV/CN/L102	LANDSCAPE MASTERPLAN 02
B0494/CV/CN/L103	LEVELS, KEY AND PLANTING PLAN SHEET 1 OF 6
B0494/CV/CN/L104	LEVELS, KEY AND PLANTING PLAN SHEET 2 OF 6
B0494/CV/CN/L105	LEVELS, KEY AND PLANTING PLAN SHEET 3 OF 6
B0494/CV/CN/L106	LEVELS, KEY AND PLANTING PLAN SHEET 4 OF 6
B0494/CV/CN/L107	LEVELS, KEY AND PLANTING PLAN SHEET 5 OF 6
B0494/CV/CN/L108	LEVELS, KEY AND PLANTING PLAN SHEET 6 OF 6
DETAILS 200 SERIES	
B0494/CV/CN/L200	GENERAL DETAILS SHEET 1
B0494/CV/CN/L201	GENERAL DETAILS SHEET 2
B0494/CV/CN/L202	BALUSTRADE DETAILS
B0494/CV/CN/L203	FLAT DECK DETAILS SHEET 1
B0494/CV/CN/L204	STAIR DETAILS SHEET 1
B0494/CV/CN/L205	SEA STACK STEPS
B0494/CV/CN/L206	SITE SECTIONS
B0494/CV/CN/L207	BOARDWALK DETAILS SHEET 1
B0494/CV/CN/L208	BOARDWALK DETAILS SHEET 2
B0494/CV/CN/L209	BOARDWALK DETAILS SHEET 3
B0494/CV/CN/L210	SITE SECTIONS
B0494/CV/CN/L211	FURNITURE AND WALL DETAILS
SHADE STRUCTURES 300 SERIES	
B0494/CV/CN/L301	SHADE STRUCTURE SHEET 1
B0494/CV/CN/L302	SHADE STRUCTURE SHEET 2
B0494/CV/CN/L303	SHADE STRUCTURE SHEET 3
PLAY DETAILS 400 SERIES	
B0494/CV/CN/L400	PLAY AREA DETAIL PLAN
B0494/CV/CN/L401	PLAY AREA SECTIONS
B0494/CV/CN/L402	PLAY AREA DETAILS





LEGEND

- EXTENT OF WORKS STAGE 1
- EXTENT OF WORKS STAGE 2
- MATURE TRANSPLANT SOURCED FROM SITE
- PHOENIX CANARIENSIS TRANSPLANTS
- 1000 LITRE TREES
- 500 LITRE TREES
- 200 LITRE TREES
- 100 LITRE TREES
- 90 LITRE FEATURE SHRUBS
- 45 LITRE TREES
- 5 LITRE TREES (NON IRRIGATED)
- ESTABLISHMENT IRRIGATED SHRUB PLANTING (2YRS)
- NON IRRIGATED TUBESTOCK PLANTING
- PERMANENT IRRIGATED ROLL ON TURF
- REVISION CLOUD HIGHLIGHTS DESIGN CHANGE FROM ORIGINAL DA SUBMISSION
- AREA NOT SUBJECT TO WAPC DETERMINATION
- EXISTING FORE DUNE VEGETATION TO BE RETAINED & PROTECTED

No.	REVISION	BY	DATE
F	FMP REVEG REMOVED	KD	070818
E	ADDRESSING CoW COMMENTS	KD	260618
D	DA SUBMISSION 3	BW	150218
C	DA SUBMISSION 2	KD	291117
B	DA SUBMISSION	KD	200717
A	FOR APPROVAL	SC	240217

LANDSCAPE MASTER PLAN 01

Project
CAPRICORN VILLAGE COASTAL NODE

Client
ACUMEN

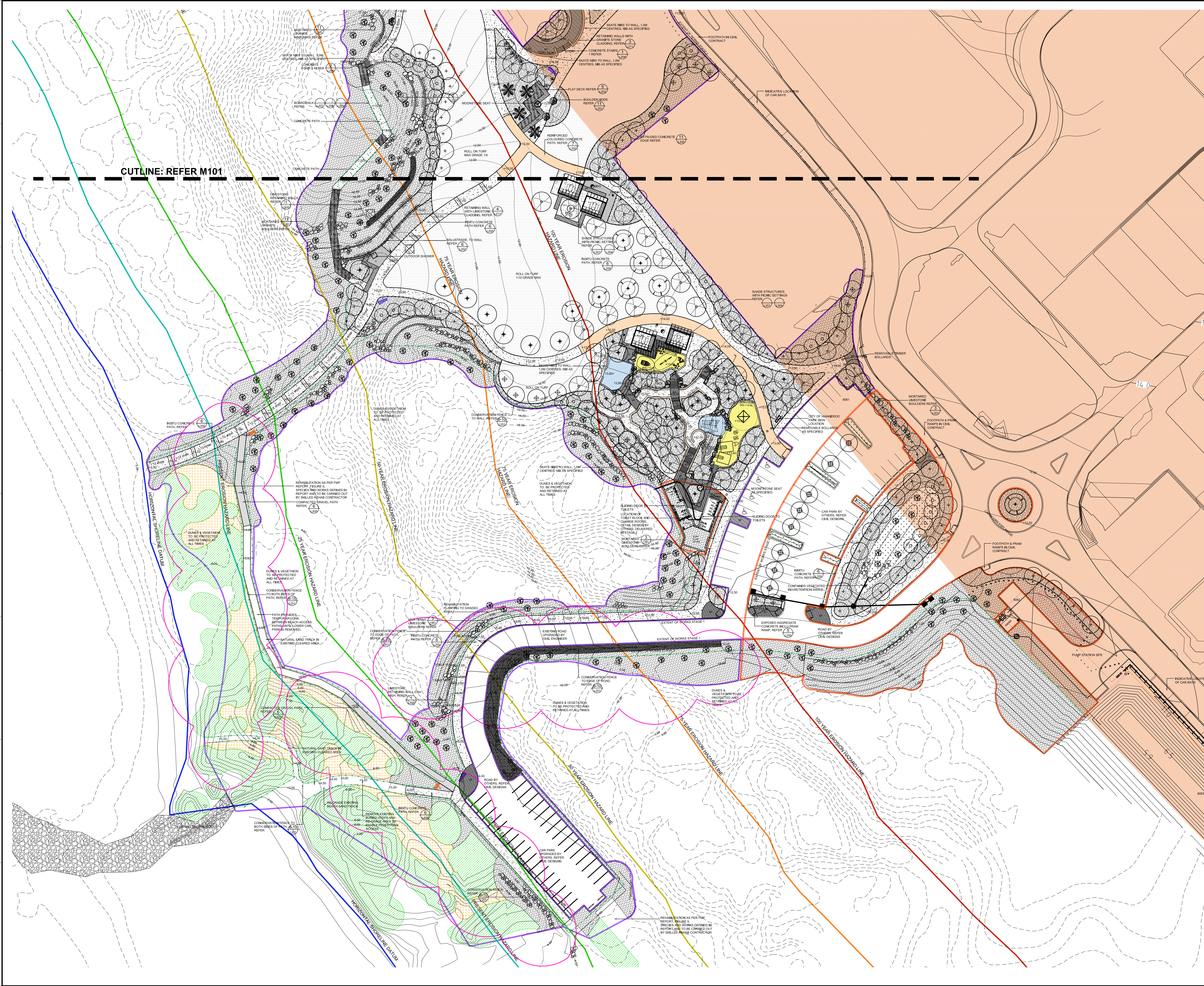


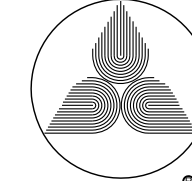

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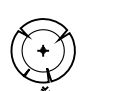

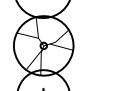
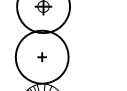
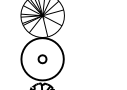
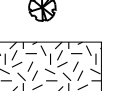

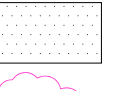


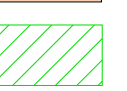




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Scale	1:500 @ A1	F
Issue	APPROVAL	Checked
Drawn	RMKD	KD

CUTLINE: REFER M102





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- LEGEND**
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 - EXTENT OF WORKS STAGE 2
 -  MATURE TRANSPLANT SOURCED FROM SITE
 -  PHOENIX CANARIENSIS TRANSPLANTS
 -  1000 LITRE TREES
 -  500 LITRE TREES
 -  200 LITRE TREES
 -  100 LITRE TREES
 -  90 LITRE FEATURE SHRUBS
 -  45 LITRE TREES
 -  5 LITRE TREES (NON IRRIGATED)
 -  ESTABLISHMENT IRRIGATED SHRUB PLANTING (2YRS)
 -  NON IRRIGATED TUBESTOCK PLANTING
 -  PERMANENT IRRIGATED ROLL ON TURF
 -  REVISION CLOUD HIGHLIGHTS DESIGN CHANGE FROM ORIGINAL DA SUBMISSION
 -  AREA NOT SUBJECT TO WAPC DETERMINATION
 -  EXISTING FORE DUNE VEGETATION TO BE RETAINED & PROTECTED

No.	REVISION	BY	DATE
F	FMP REVEG REMOVED	KD	070818
E	ADDRESSING COW COMMENTS	KD	260618
D	DA SUBMISSION 3	BW	150218
C	DA SUBMISSION 2	KD	291117
B	DA SUBMISSION	KD	200717
A	FOR APPROVAL	SC	240217

Title
LANDSCAPE MASTER PLAN 02

Project
CAPRICORN VILLAGE COASTAL NODE

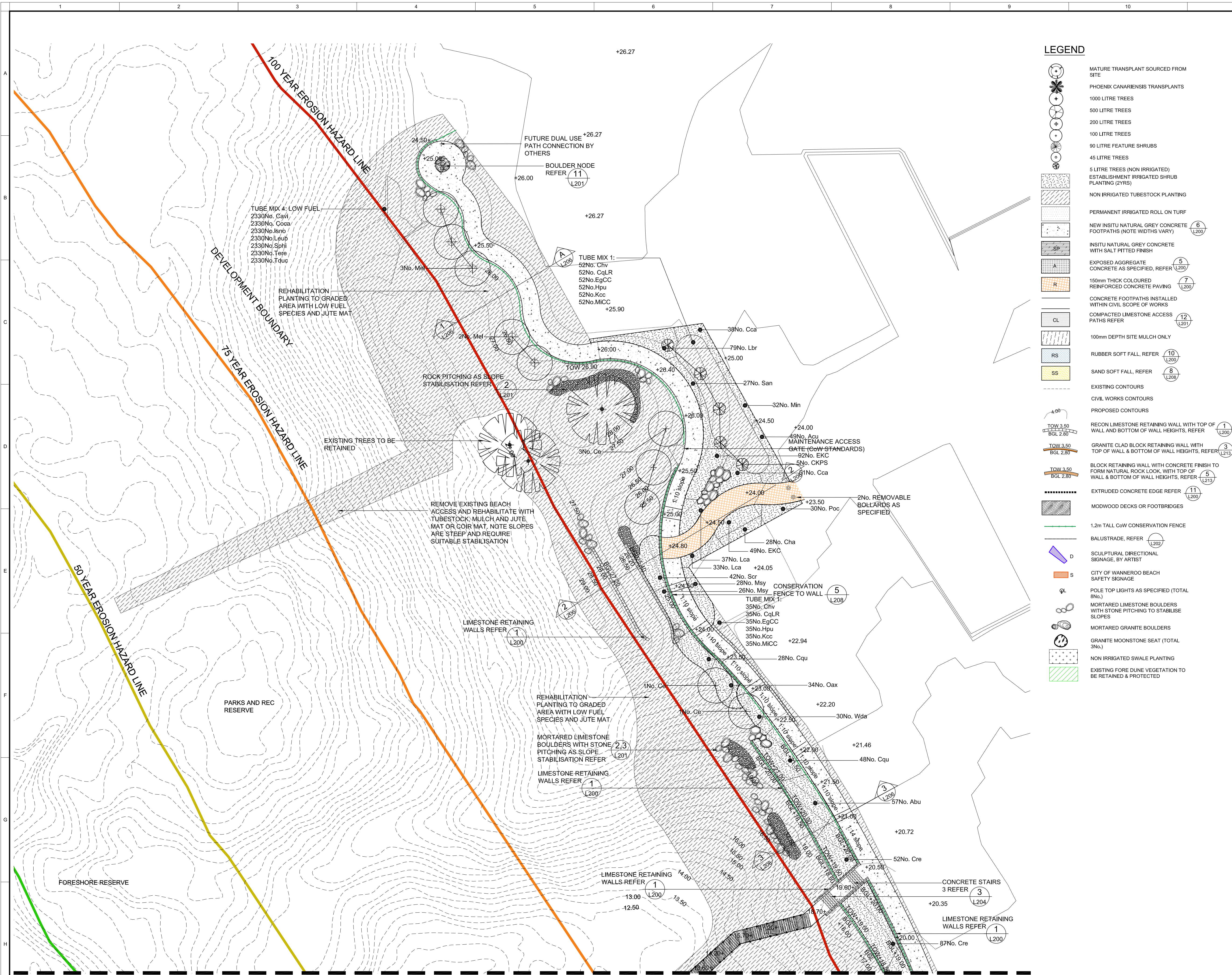
Client
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Issue	APPROVAL	Checked
Drawn	RMKD	Checked
		KD



LEGEND

- MATURE TRANSPLANT SOURCED FROM SITE
- PHOENIX CANARIENSIS TRANSPLANTS
- 1000 LITRE TREES
- 500 LITRE TREES
- 200 LITRE TREES
- 100 LITRE TREES
- 90 LITRE FEATURE SHRUBS
- 45 LITRE TREES
- 5 LITRE TREES (NON IRRIGATED)
- ESTABLISHMENT IRRIGATED SHRUB PLANTING (2YRS)
- NON IRRIGATED TUBESTOCK PLANTING
- PERMANENT IRRIGATED ROLL ON TURF
- NEW INSITU NATURAL GREY CONCRETE FOOTPATHS (NOTE WIDTHS VARY)
- INSITU NATURAL GREY CONCRETE WITH SALT PITTED FINISH
- EXPOSED AGGREGATE CONCRETE AS SPECIFIED, REFER L200
- 150mm THICK COLOURED REINFORCED CONCRETE PAVING L200
- CONCRETE FOOTPATHS INSTALLED WITHIN CIVIL SCOPE OF WORKS
- COMPACTED LIMESTONE ACCESS PATHS REFER L201
- 100mm DEPTH SITE MULCH ONLY
- RUBBER SOFT FALL, REFER L200
- SAND SOFT FALL, REFER L208
- EXISTING CONTOURS
- CIVIL WORKS CONTOURS
- PROPOSED CONTOURS
- RECON LIMESTONE RETAINING WALL WITH TOP OF WALL AND BOTTOM OF WALL HEIGHTS, REFER L200
- GRANITE CLAD BLOCK RETAINING WALL WITH TOP OF WALL & BOTTOM OF WALL HEIGHTS, REFER L213
- BLOCK RETAINING WALL WITH CONCRETE FINISH TO FORM NATURAL ROCK LOOK, WITH TOP OF WALL & BOTTOM OF WALL HEIGHTS, REFER L213
- EXTRUDED CONCRETE EDGE REFER L200
- MODWOOD DECKS OR FOOTBRIDGES
- 1.2m TALL CoW CONSERVATION FENCE
- BALUSTRADE, REFER L202
- SCULPTURAL DIRECTIONAL SIGNAGE, BY ARTIST
- CITY OF WANNEROO BEACH SAFETY SIGNAGE
- POLE TOP LIGHTS AS SPECIFIED (TOTAL 8No.)
- MORTARED LIMESTONE BOULDERS WITH STONE PITCHING TO STABILISE SLOPES
- MORTARED GRANITE BOULDERS
- GRANITE MOONSTONE SEAT (TOTAL 3No.)
- NON IRRIGATED SWALE PLANTING
- EXISTING FORE DUNE VEGETATION TO BE RETAINED & PROTECTED

AILA[®]

1:250
0 2.5m 5 7.5 10 12.5 15

GENERAL NOTES:

THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER EPCAD CONTRACT DRAWINGS AND SPECIFICATION.

FOR ENGINEERING DETAILS AND SERVICES INFORMATION PLEASE REFER TO COSSILL AND WEBLEY DRAWINGS.

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.

THE CONTRACTOR SHALL REPORT ANY DISCREPANCIES OR CLASHES WITH EXISTING SERVICES.

ALL SETTING OUT TO BE AGREED ON SITE WITH THE LANDSCAPE ARCHITECT.

ALL EXISTING SERVICES ON SITE TO REMAIN UNTOUCHED AND PROTECTED DURING THE COURSE OF THE WORKS. ANY DAMAGE TO EXISTING ROADS AND PAVEMENTS TO BE REPAIRED AT THE EXPENSE OF THE CONTRACTOR.

EXISTING ROADS AND FOOTPATHS TO BE KEPT CLEAR OF OBSTRUCTION AND KEPT CLEAN AT ALL TIMES.

TRAFFIC MANAGEMENT TO THE SATISFACTION OF THE RELEVANT AUTHORITY TO BE IMPLEMENTED WHERE REQUIRED.

ALL TREE PLANTING TO BE AS PER THE UTILITY PROVIDERS CODE OF PRACTICE.

ALL GRASS SLOPES TO BE NO MORE THAN 1 IN 6. ALL SHRUBS BED GRADES TO BE NO MORE THAN 1 IN 4.

ALL WORKS MUST BE INSTALLED TO MEET LOCAL AUTHORITY STANDARDS. LOCAL AUTHORITY STANDARDS TAKE PRECEDENCE OVER DETAIL DRAWINGS.

UNLESS INDICATED ALL SUBDIVISION FOOTPATHS ARE TO BE INSTALLED BY OTHERS.

No.	REVISION	BY	DATE
F	FMP REVEG REMOVED	KD	070818
E	ADDRESSING CoW COMMENTS	KD	260618
D	DA SUBMISSION 3	BW	150218
C	DA SUBMISSION 2	KD	291117
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No.	REVISION	BY	DATE
F	FMP REVEG REMOVED	KD	070818
E	ADDRESSING CoW COMMENTS	KD	260618
D	DA SUBMISSION 3	BW	150218
C	DA SUBMISSION 2	KD	291117
B	DA SUBMISSION 1	KD	200717
A	FOR APPROVAL	SC	240217

LEVELS, KEY AND PLANTING PLAN SHEET 1 OF 6

Project: **CAPRICORN VILLAGE COASTAL NODE**

Client: **ACUMEN**

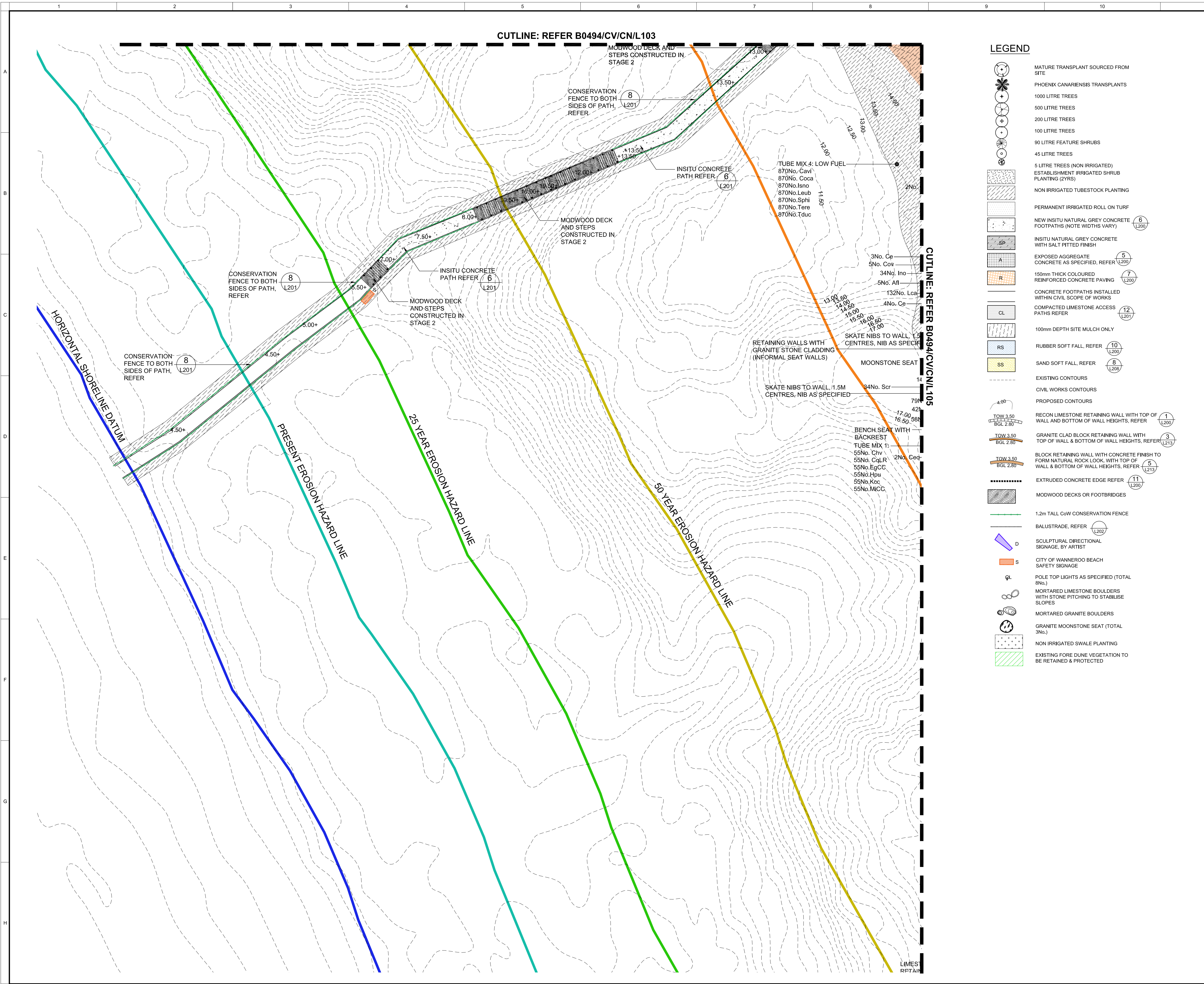


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Date	MARCH 2017	Revision
Scale	1:250 @ A1	F
Issue	APPROVAL	Checked KD
Drawn	RMKD	

CUTLINE: REFER B0494/CV/CN/L104



CUTLINE: REFER B0494/CV/CN/L103

MODWOOD DECK AND STEPS CONSTRUCTED IN STAGE 2

CONSERVATION FENCE TO BOTH SIDES OF PATH, REFER (8) L201

INSITU CONCRETE PATH REFER (6) L201

MODWOOD DECK AND STEPS CONSTRUCTED IN STAGE 2

INSITU CONCRETE PATH REFER (6) L201

MODWOOD DECK AND STEPS CONSTRUCTED IN STAGE 2

CONSERVATION FENCE TO BOTH SIDES OF PATH, REFER (8) L201

CONSERVATION FENCE TO BOTH SIDES OF PATH, REFER (8) L201

HORIZONTAL SHORELINE DATUM

PRESENT EROSION HAZARD LINE

25 YEAR EROSION HAZARD LINE

50 YEAR EROSION HAZARD LINE

TUBE MIX 4: LOW FUEL
870No. Cavi
870No. Coca
870No. Isno
870No. Leub
870No. Sphi
870No. Tere
870No. Tdud

RETAINING WALLS WITH GRANITE STONE CLADDING (INFORMAL SEAT WALLS)

SKATE NIBS TO WALL, 1.5M CENTRES, NIB AS SPECIFIED

MOONSTONE SEAT

BENCH SEAT WITH BACKREST TUBE MIX 1:

55No. Chv
55No. CqLR
55No. EgCC
55No. Hbu
55No. Koc
55No. MICC

CUTLINE: REFER B0494/CV/CN/L105

LEGEND

- MATURE TRANSPLANT SOURCED FROM SITE
- PHOENIX CANARIENSIS TRANSPLANTS
- 1000 LITRE TREES
- 500 LITRE TREES
- 200 LITRE TREES
- 100 LITRE TREES
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- INSITU NATURAL GREY CONCRETE WITH SALT PITTED FINISH
- EXPOSED AGGREGATE CONCRETE AS SPECIFIED, REFER (5) L200
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1:250
0 2.5m 5 7.5 10 12.5 15

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No.	REVISION	BY	DATE
F	FMP REVEG REMOVED	KD	070818
E	ADDRESSING CoW COMMENTS	KD	260618
D	DA SUBMISSION 3	BW	150218
C	DA SUBMISSION 2	KD	291117
B	DA SUBMISSION	KD	200717
A	FOR APPROVAL	SC	240217

Title	Level	Key	Planting
LEVELS, KEY AND PLANTING PLAN			
SHEET 2 OF 6			

Project: CAPRICORN VILLAGE COASTAL NODE
Client: ACUMEN

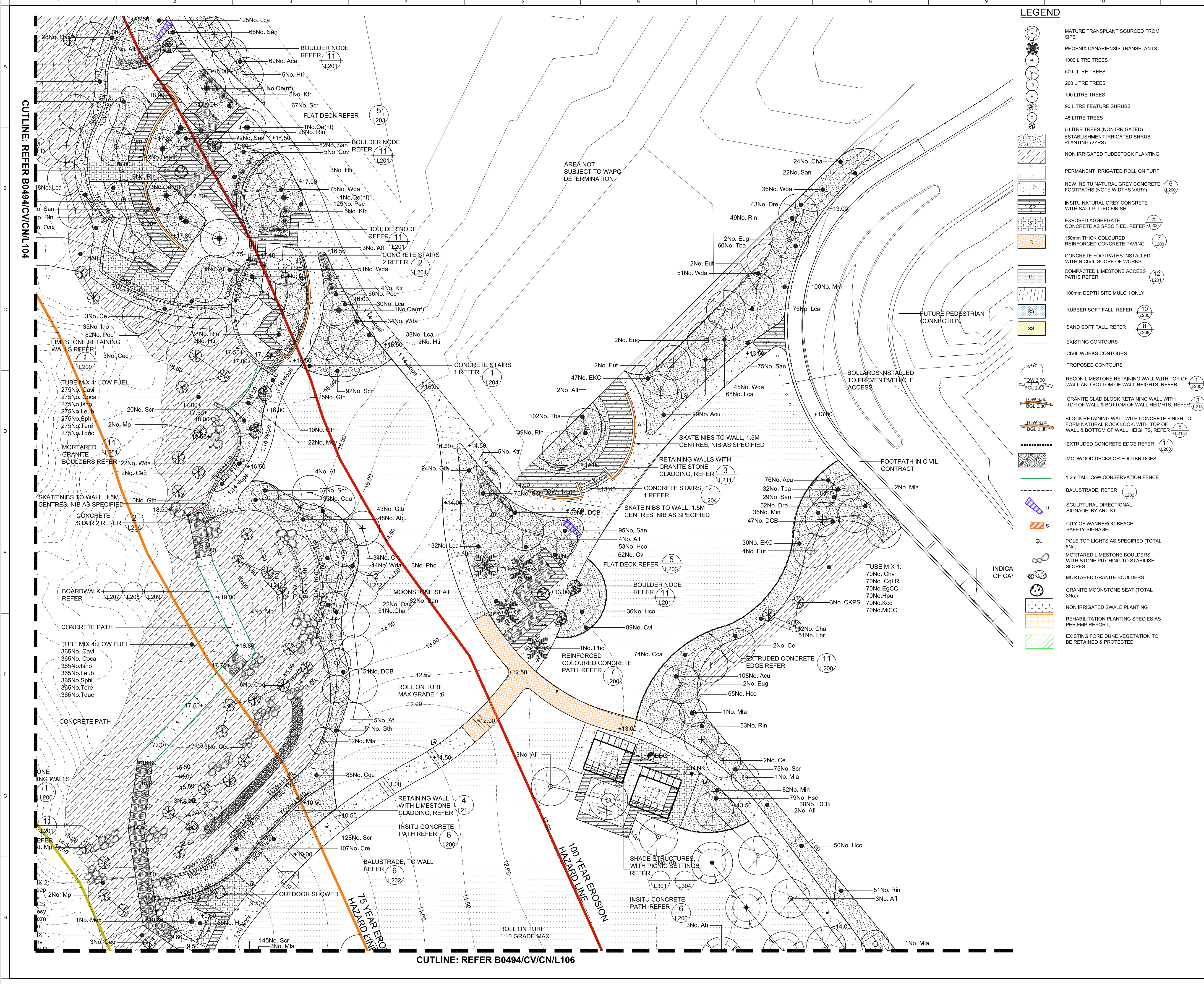


EPCAD Pty Ltd
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Project No. Category Drawing No.
B0494/CV/CN/L104

Date MARCH 2017 Revision
Scale 1:250 @ A1
Issue APPROVAL
Drawn RMKD Checked KD



LEGEND

- MATURE TRANSPLANT SOURCED FROM SITE
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No.	REVISION	BY	DATE
E	ADDRESSING CoW COMMENTS	KD	260618
D	DA SUBMISSION 3	BW	150218
C	DA SUBMISSION 2	KD	291117
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A	FOR APPROVAL	SC	240217

LEVELS, KEY AND PLANTING PLAN SHEET 3 OF 6

Project: CAPRICORN VILLAGE COASTAL NODE

Client: ACUMEN

EPCAD Pty Ltd
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Project No. Category Drawing No.

B0494/CV/CN/L105

Date: MARCH 2017 Revision: E

Scale: 1:250 @ A1 Issue: APPROVAL Drawn: RMKD Checked: KD

CUTLINE: REFER B0494/CV/CN/L104

CUTLINE: REFER B0494/CV/CN/L106

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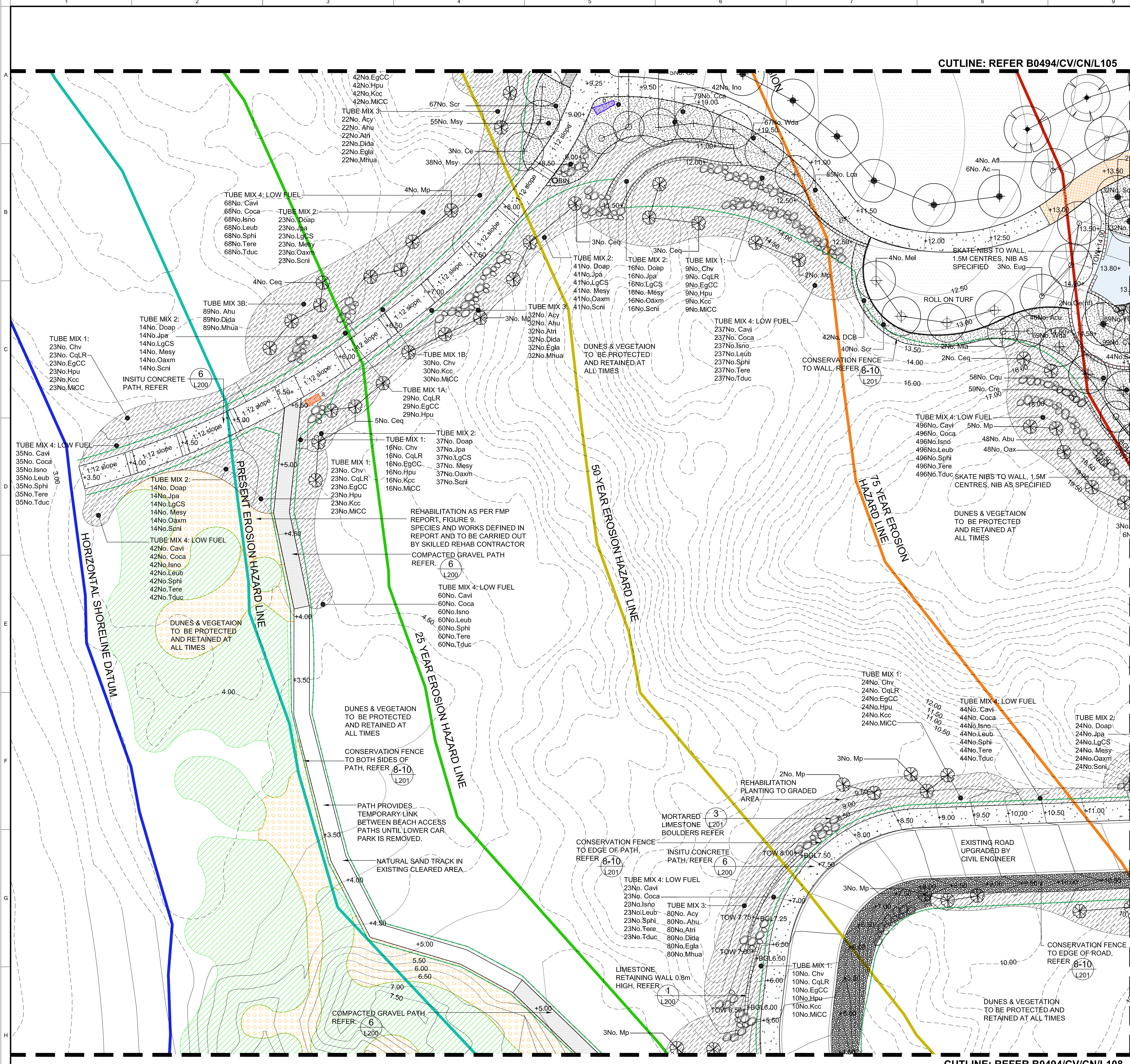
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E	ADDRESSING CoW COMMENTS	KD		260618
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LEVELS, KEY AND PLANTING PLAN SHEET 4 OF 6

Project: CAPRICORN VILLAGE COASTAL NODE

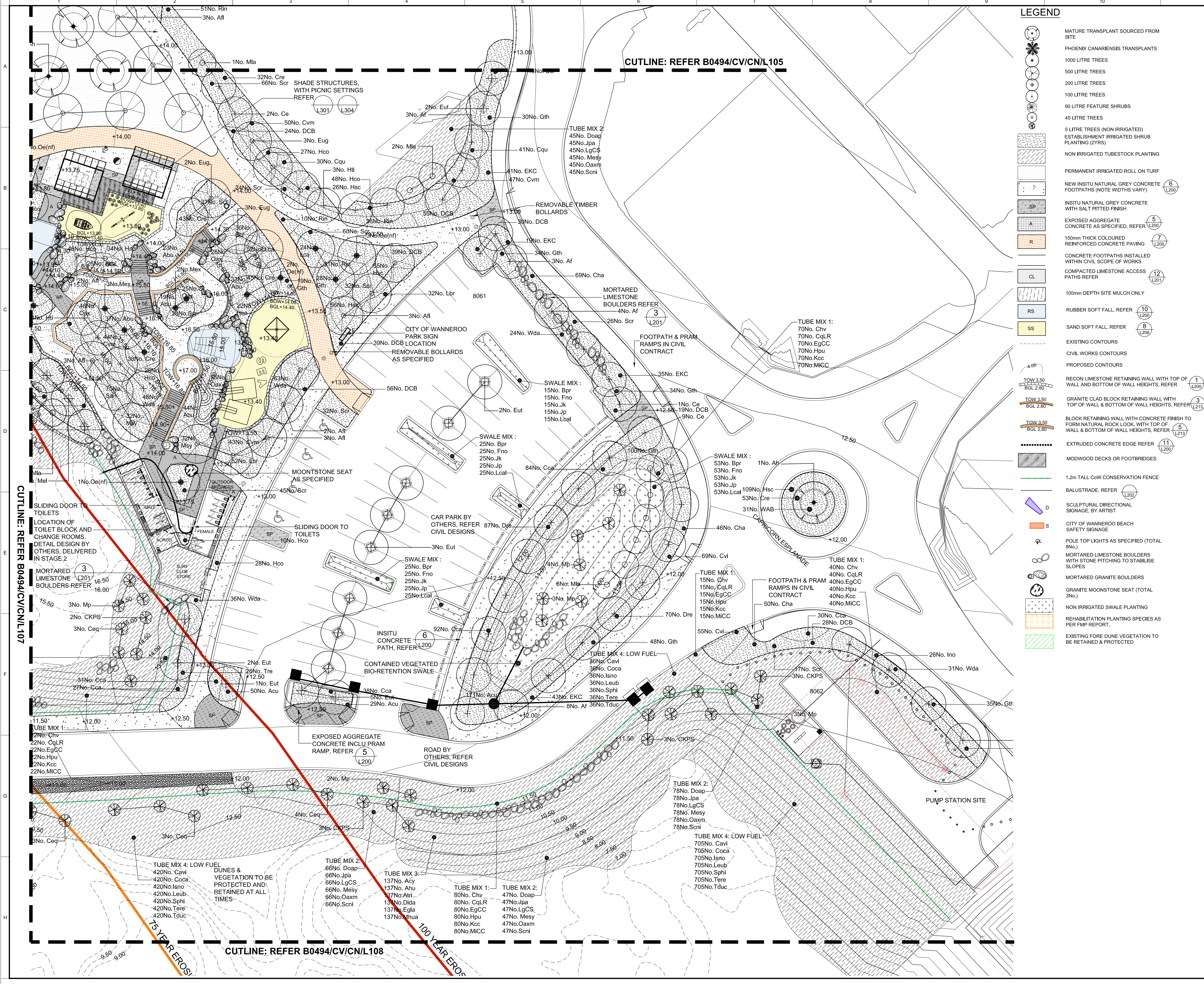
Client: ACUMEN



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Project No.	Category	Drawing No.
B0494/CV/CN/L106		
Date: MARCH 2017	Revision:	
Scale: 1:250 @ A1	Issue:	APPROVAL
Drawn: RMKD	Checked: KD	



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1:250

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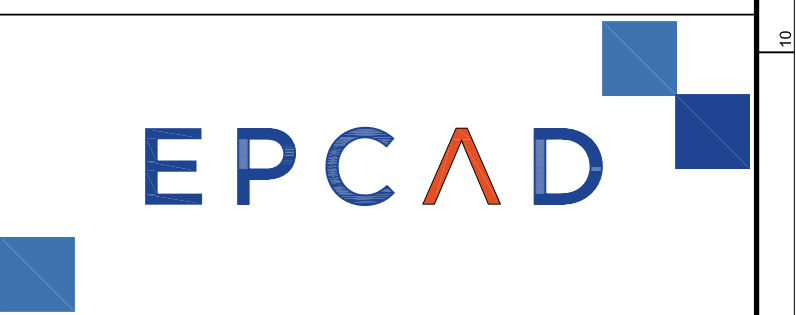
No.	REVISION	BY	DATE
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E	ADDRESSING CoW COMMENTS	KD	26/06/18
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LEVELS, KEY AND PLANTING PLAN SHEET 5 OF 6

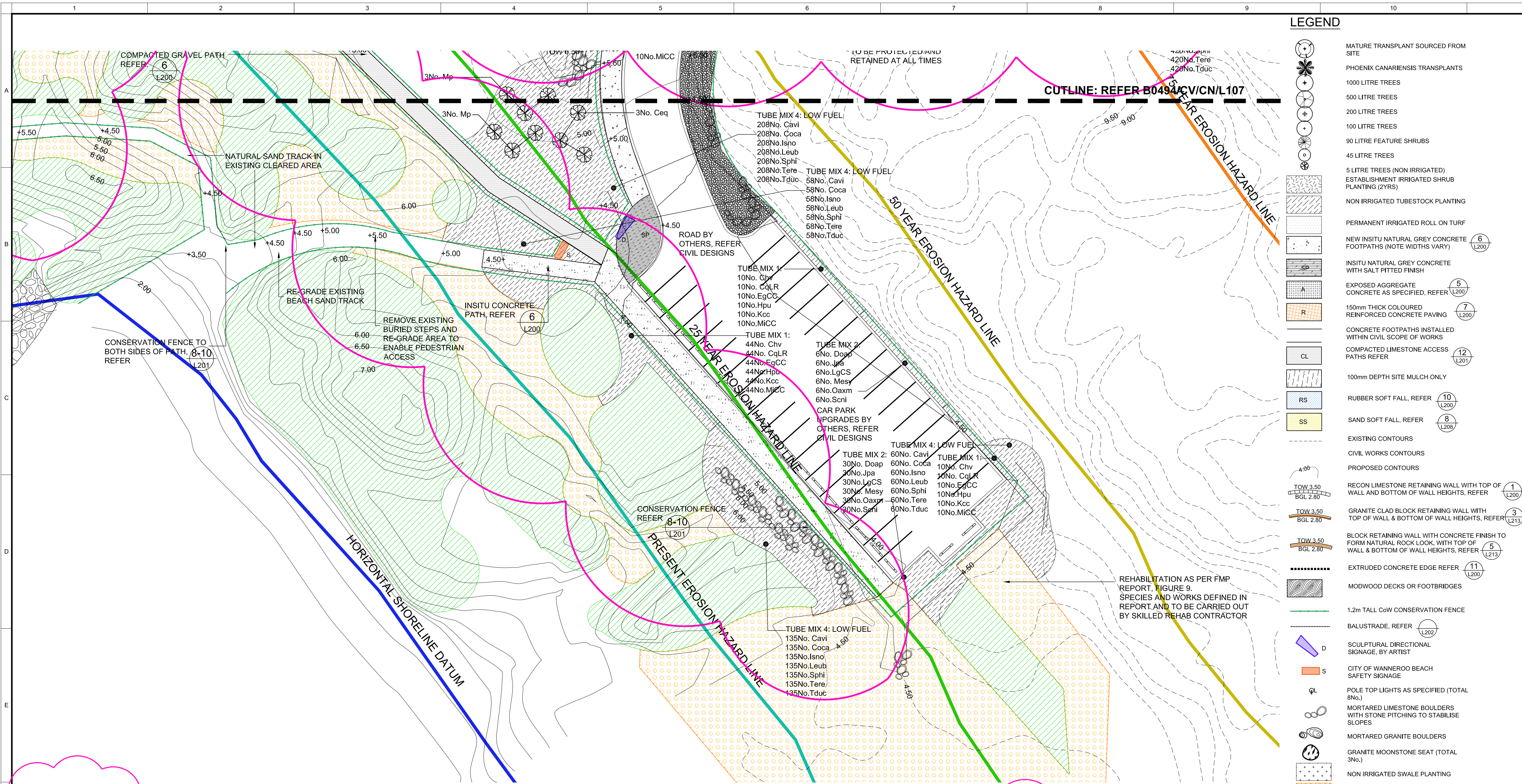
Project: **CAPRICORN VILLAGE COASTAL NODE**

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Project No.	Category	Drawing No.
B0494/CV/CN/L107		
Date: MARCH 2017	Revision:	
Scale: 1:250 @ A1		
Issue: APPROVAL		
Drawn: RMKD	Checked: KD	



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PLANT SCHEDULE

TREES	SIZE	QTY
Ac Araucaria columnaris *	1000L	6
Afl Agonis flexuosa	500L	41
Af Agonis flexuosa	100L	31
Ah Araucaria heterophylla *	TRANS	7
Ce Casuarina equisetifolia	100L	39
Ceq Casuarina equisetifolia	5L	54
CKPS Callistemon 'Kings Park Special'	5L	22
Eug Eucalyptus gomphocephala	500L	17
Eut Eucalyptus utilis	200L	23
Hli Hibiscus tiliaceus	100L	20
Mex Metrosideros excelsa *	1000L	6
Mel Melaleuca lanceolata	200L	17
Mia Melaleuca lanceolata	45L	32
Mp Melaleuca preissiana	5L	56
Oe(nf) Olea europaea (non fruiting)	1000L	19
Phc Phoenix canariensis*	TRANS	4

PLANT SCHEDULE

SHRUBS	SIZE	CENTRES	QTY
Abu Alyxia buxifolia	200mm	750mm	398
Acu Adenanthos cuneatus Coral Carpet	130mm	550mm	766
Cca Conostylis candicans	130mm	550mm	544
Cha Chamelaucium uncinatum beach ball	200mm	750mm	350
Cqu Calothamnus quadrifidus	200mm	750mm	361
Cre Coprosma repens	200mm	700mm	550
Cov Crassula ovata	90 Litre	as shown	10
Cvi Carprobotrus virescens	130mm	550mm	374
Cvm Callistemon viminalis	200mm	750mm	184
DCB Dianella cassia Blue	130mm	700mm	527
Dre Dianella revoluta Little Rev	130mm	550mm	252
EKC Eremophila Kalbarri Carpet	130mm	750mm	481
Gth Grevillea thelemianiana	130mm	700mm	491
Hco Hardenbergia comptoniana	200mm	700mm	492
Hsc Hibbertia scandens	130mm	550mm	428
Ino Isolepis nodosa	130mm	700mm	137
Ktr Kalanchoe tricolour	90 Litre	as shown	19
Lbr Leucophyta brownii	200mm	700mm	214
Lca Lepidosperma calcicola	130mm	550mm	1048
Min Myoporum insulare coastal carpet	200mm	550mm	249
Msy Melaleuca systema	130mm	700mm	233

PLANT SCHEDULE

SHRUBS CONTINUED	SIZE	CENTRES	QTY
Oax Olearia axillaris	200mm	700mm	342
Poc Patersonia occidentalis	200mm	550mm	303
Rin Rhabdolepis indica	130mm	700mm	435
San Scaevola anchusifolia	130mm	550mm	704
Scr Scaevola crassifolia	130mm	700mm	1347
Tba Thryptomene baeckencea flat	200mm	550mm	194
Tre Templetonia retusa	200mm	700mm	26
Wda Westringea dampieri	130mm	700mm	809

TUBESTOCK 1- GROUNDCOVERS

SPECIES	SIZE	CENTRES	QTY
Chv Chorizema varium	tubestock	550mm	680
CqLR Calothamnus quadrifidus 'Little Ripper'	tubestock	550mm	679
EgCC Eremophila glabra 'Carramar Carpet'	tubestock	550mm	679
Kcc Kennedia coccinea	tubestock	550mm	680
MICC Myoporum insulare 'Coastal Carpet'	tubestock	550mm	680
Hpu Hemiandra pungens	tubestock	550mm	679

LITTORAL MIX

SPECIES	SIZE	CENTRES	QTY
Bpr Baumea preissii	tubestock	500mm	118
Fno Ficinia nodosa	tubestock	500mm	118
Jk Juncus kraussii	tubestock	500mm	118
Jp Juncus pallidus	tubestock	500mm	118
Lcal Lepidosperma calcicola	tubestock	500mm	118

TUBESTOCK 2- SHRUBS

SPECIES	SIZE	CENTRES	QTY
Doap Dodonaea aptera	tubestock	600mm	462
Jpa Juncus pallidus	tubestock	600mm	462
LgCS Lepidosperma gladiatum 'Coastal Sedge'	tubestock	600mm	462
Mesy Melaleuca systema	tubestock	600mm	462
Oaxm Olearia axillaris mini	tubestock	600mm	462
Scni Scaevola nitida	tubestock	600mm	462

TUBESTOCK 3- TALL SHRUBS

SPECIES	SIZE	CENTRES	QTY
Acy Acacia cyclops	tubestock	650mm	271
Ahu Allocasuarina humilis	tubestock	650mm	360
Atri Atriplex cinera	tubestock	650mm	271
Dida Diplolaena dampieri	tubestock	650mm	360
Egla Eremophila glabra	tubestock	650mm	271
Mhue Melaleuca huegii	tubestock	650mm	360

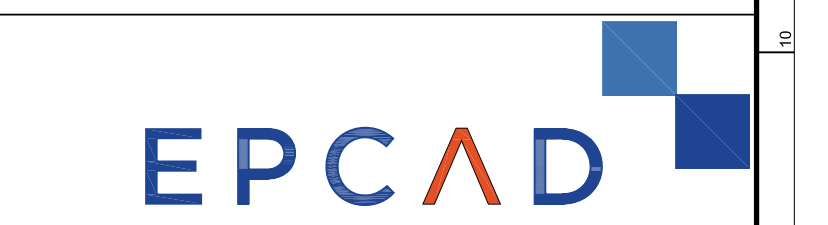
TUBESTOCK 4: LOW FUEL SPECIES

SPECIES	SIZE	CENTRES	QTY
Cavi Carprobotrus virescens	tubestock	700mm	6467
Coca Conostylis candicans	tubestock	700mm	6467
Isno Isolepis nodosa	tubestock	700mm	6467
Leub Leucophyta brownii	tubestock	700mm	6467
Sphi Scaevola anchusifolia	tubestock	700mm	6467
Tere Templetonia retusa	tubestock	700mm	6467
Tduc Tetragonia decumbens	tubestock	700mm	6467

No.	REVISION	BY	DATE
F	STONE PITCHING TO ROADSIDE SWALE	KD	120718
E	ADDRESSING CoW COMMENTS	KD	260618
D	DA SUBMISSION 3	BW	150218
C	DA SUBMISSION 2	KD	291117
B	DA SUBMISSION	KD	200717
A	FOR APPROVAL	SC	240217

LEVELS, KEY AND PLANTING PLAN SHEET 6 OF 6

Project: CAPRICORN VILLAGE COASTAL NODE
 Client: ACUMEN



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Project No.	Category	Drawing No.
B0494/CV/CN/L108		
Date	MARCH 2017	Revision
Scale	1:250 @ A1	F
Issue	APPROVAL	Checked
Drawn	RMKD	Checked
		KD