ATTACHMENTS

COUNCIL MEMBERS' AGENDA BRIEFING

to be held at
the Council Chamber (Level 1), Civic Centre,
23 Dundebar Road, Wanneroo
on 08 July 2025 commencing at 6:00PM.

4 STRATEGIC LAND USE PLANNING & ENVIRONMENT

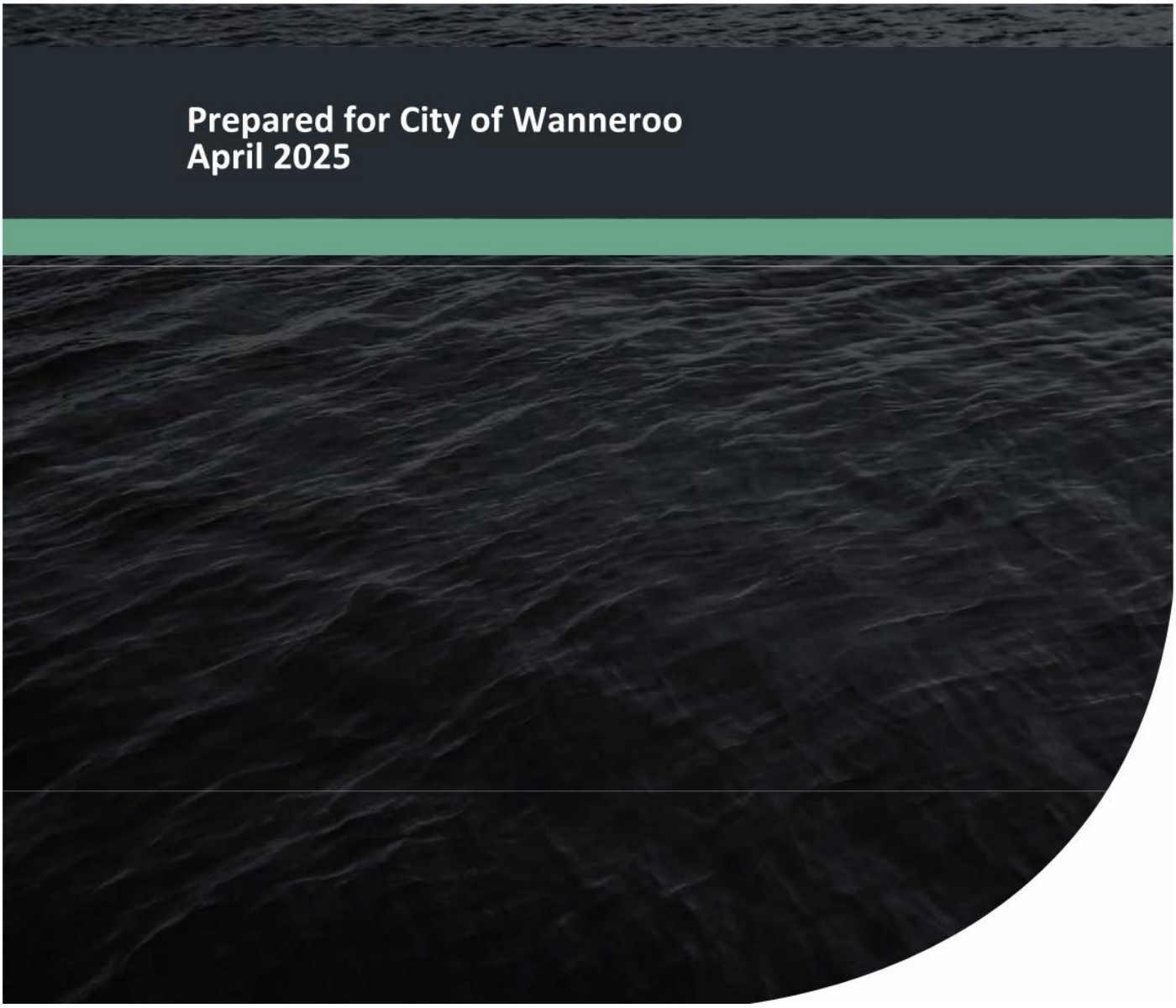
4.2 Southern Two Rocks Beach Access Foreshore Management Plan

Foreshore Management Plan

Southern Two Rocks Beach Access

Project No: EP19-132(03)

Prepared for City of Wanneroo
April 2025



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B	January 2025	Claire Rogers	CSR	Toni Burbidge	TB
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Executive Summary

The City of Wanneroo (the City) is proposing a new development to provide access to a section of beach and coastal foreshore reserve, which is currently formally unnamed but will be referred to in this document as the Southern Two Rocks Beach Access. The Access is located approximately 900 m south of the Two Rocks Marina, along Two Rocks Road in Two Rocks (hereafter referred to as the site). This infrastructure will enable the adjacent beach to function as a 'local beach' in accordance with the City's Coastal Management Plan and Local Planning Policy 4.21 – Coastal Assets.

The proposed development will consist of a vehicular access road and car park with associated infrastructure within the coastal foreshore reserve. Clearing of some native vegetation will be required to facilitate the development. Following construction, disturbed areas will be revegetated with native species in addition to an identified offset area. Details of the site, the conceptual design of the proposed development and foreshore restoration and management commitments are included in this plan.

The Foreshore Management Plan (FMP) is being prepared to support a development application for the proposed access and car park in accordance with the requirements of *State Planning Policy 2.6 State Coastal Planning Policy* (SPP 2.6) and various local planning policies (LPPs).

A Coastal Hazard Risk Management and Adaptation Plan (CHRMAP)(MP Rogers & Associates 2015; Cardno 2018) and Coastal Aquatic Risk Assessment (SLS WA 2019) have previously been developed. The CHRMAP outlines the City's current and future coastal hazard vulnerabilities; and identifies risks and adaptation management strategies to manage coastal vulnerability over the next 100 years.

This FMP outlines details of the statutory planning and policy context for the development and considers how the proposal meets those requirements, as well as the City of Wanneroo's Foreshore Management Plan Guidelines, LPP 4.13: Caves and Karstic Features, LPP 4.18 Earthworks and Sand Drift, and State Policy 2.8 Bushland Policy for the Perth Metropolitan Region.

Further studies including an unexploded ordinance survey and a geotechnical survey will be undertaken by other consultants to assist in informing the precise alignment for the access road and car park. The outcome of these studies will need to be considered in the final design of the development.

The City has received approval for a clearing permit from Department of Water and Environmental Regulation (DWER), dated 26 March 2025. The clearing permit is required for the proposal under the *Environmental Protection Act 1986*, and an appropriate offset will also be required to satisfy State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region.

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Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
CoW	City of Wanneroo
DBCA	Department of Biodiversity, Conservation and Attractions
DER	Department of Environment Regulation – Now DWER
DPLH	Department of Planning Lands and Heritage
DWER	Department Water and Environmental Regulation
OBRM	Office of Bushfire Risk Management
WAPC	Western Australian Planning Commission

Table A2: Abbreviations – Legislation

General terms	
Bush Forever	*State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region*
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*

Table A4: Abbreviations – units of measurement

Units of measurement	
ha	Hectare
m	Metre
mAHD	Metres Australia Height Datum
m/y	Metres per year
mm	Millimetre
m2	Square metre
Km	Kilometre

Table A3: Abbreviations – General terms

General terms	
CARA	Coastal Aquatic Risk Assessment
CHRMAP	Coastal Hazard Risk Management and Adaptation Plan
DMP	Dust Management Plan
DSP	District Structure Plan
EMP	Environmental Management Plan
FMP	Foreshore Management Plan
LPP	Local Planning Policy
LPS	Local Planning Scheme
LSP	Local Structure Plan
MRS	Metropolitan Region Scheme
Ramsar	Convention on Wetlands of International Importance
S1	(S1 Erosion) Allowance for the current risk of storm erosion
S2	(S2 Erosion) Allowance for historic shoreline movement trends
S3	(S3 Erosion) Allowance for erosion caused by future sea level rise
SPP	State Planning Policy
UXO	Unexploded Ordnance

1 Introduction

1.1 Project scope and document purpose

The City of Wanneroo (the City) is proposing to develop a beach access track and car park for Southern Two Rocks beach in Two Rocks, Western Australia (the proposed development) **(Figure 1, Figure 2, Appendix A).**

The proposed development will address the demand for formal access points to the Southern Two Rocks beach. Components of the proposed development are outlined in **Section 3**. The population of Two Rocks is expected to grow from 3,967 people in 2021 to 44,680 by 2041 with further development planned (Population and household forecasts, 2021 to 2026, Australian Bureau of Statistics). Southern Two Rocks beach visitation rates are currently lower than the surrounding areas which are more developed and have more formal access points along the foreshore reserve (SLS WA 2019). However, with current development and population growth, there is an increased demand for formal access points to the beach (SLS WA 2019).

The intended use is for a beach access track and car park that is suited to the Southern Two Rocks local beach. The proposed development will be of a smaller scale than other accesses/parking areas at busier beaches and will be developed as a local beach in accordance with the City's *Local Planning Policy 4.21 Coastal Assets Policy* and the City's Coastal Management Plan (CoW 2016, 2021a).

Design details of the proposed development include constructing a limestone subbase with an emulsion stabilised asphalt surface with an adjoining 2 m wide concrete footpath and concrete kerb around the car park and edge of the road. The car park will include approximately 48 car parking spaces with two ACROD/accessible parking bays, lighting and a minimum of one bin will be provided. A formalised beach access path will connect the car park to the beach and fencing and signage will be installed to restrict access and control erosion. No additional facilities are proposed due at this stage to the nature of the development and the intention to support a local beach. Refer to the proposed development under Section 3 of this report.

This Foreshore Management Plan (FMP) has been prepared in accordance with *State Planning Policy 2.6 Coastal Planning* (SPP 2.6) which requires a FMP to be prepared prior to any development within the foreshore area. This FMP ensures best practice management is implemented prior to, during and post development, and outlines commitments for the ongoing management of the beach access track and car park. Whilst this FMP does not require Western Australian Planning Commission (WAPC) approval, the FMP will support the City's development application and as a guide in matters relating to both the site and ongoing foreshore management.

This FMP reflects the most current information of the development footprint, the approved clearing permit and the City's Foreshore Management Plan Guidelines (2021b).

The objectives of this FMP are to:

1. Engage successful planning methods to ensure that current and future generations of Western Australians can benefit from the opportunities presented by the values and resources of the Western Australian coast.
2. Minimise environmental impacts while creating additional access and amenity for beach visitors and residents of Two Rocks.
3. Enable the site and adjacent foreshore reserve to be managed in a sustainable manner prior to, during and post construction and during all stages of development.
4. Ensure revegetation and other conservation activities are carried out in accordance with best practice to ensure the viability of the coastal vegetation within the foreshore reserve.
5. Protect the Foreshore Reserve and associate environmental values present while enhancing the use of the foreshore and beaches for the local community.

1.2 Site details

The site is located approximately 53 km north of Perth Central Business District (CBD) within the City of Wanneroo. Specifically, the site is a section of beach and coastal foreshore reserve known as Unwin Shoals (hereafter referred to as Southern Two Rocks Beach) that is located approximately 900 m south of the Two Rocks Marina, along Two Rocks Road in Two Rocks (**Figure 1**). The final design of the proposed development is attached as **Appendix A**.

The site comprises 1.56 ha and falls partly within four lots (**Table 1**). The proposed beach access and car park are located within Lot 8613 (94) and Lot 8989 (50) Two Rocks Road, as shown in **Table 1**. All lots are currently zoned by the Metropolitan Region Scheme (MRS) as 'Parks and Recreation' and zoned by the District Planning Scheme Number 2 (DPS2) as 'Regional Parks and Recreation'. The whole site also falls within the Yanchep-Two Rocks District Structure Plan No. 43. Additional lot details are provided in **Table 1.**

Table 1: Details of lots situated within the site

Lot Number	Address	Reserve number	Subdivision number	Deposited Plan	Lot size	Proposed development area
8613	94 Two Rocks Road, Two Rocks 6037	30959	NA	213232	5.86ha	0.25ha
8989	50 Two Rocks Road, Two Rocks 6037	54046	NA	213232	4.67ha	0.63ha
15452	110 Spot View, Two Rocks 6037	20561	NA	40341	67.78ha	0.68ha **(offset area)**
13321	100 Spot View, Two Rocks 6037	45935	162742	21931	40.88ha	
				Total area	**78.31ha**	**1.56ha**

1.2.1 Site selection

An access location was initially proposed in the Two Rocks Beach Access Feasibility Study undertaken by Emerge on behalf of the City (Emerge 2019). This access location was further revised following the

analysis of information within the flora and vegetation survey to reduce impacts to known priority flora in the area (One Tree Botanical 2019).

The updated access location for the proposed development presents the least environmental disturbances and offers the best possible outcome for beach and traffic safety. The beach to be accessed via the proposed development is considered the most suitable for beach swimming and recreational activities compared to nearby beaches to the north and south (SLS WA 2019). Additionally, the car park has been sited behind the 2050-year coastal vulnerability line to account for coastal hazards (MP Rogers & Associates 2015; Cardno 2018). Refer to Figure 8: Coastal Zones and Setbacks.

1.3 Background

Key investigations have been undertaken by various consultants to inform the most appropriate alignment for the proposed development. Documents, surveys and online available resources that were reviewed during the preparation of this FMP are listed below:

- Two Rocks Beach Access Way: Flora and Vegetation Survey - Detailed and Targeted (One Tree Botanical 2019)
- Vertebrate Fauna Survey - Two Rocks Beach access, Two Rocks (Terrestrial Ecosystems 2020)
- Flora, Vegetation and Vertebrate Fauna Environmental Impact Assessment (Terrestrial Ecosystems and One Tree Botanical 2019) (based on the above studies)
- Access Feasibility Study (Emerge 2019)
- Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) Part 1 and 2 (MP Rogers & Associates 2015; Cardno 2018)
- Coastal Aquatic Risk Assessment (SLS WA 2019)
- Two Rocks Archaeological Report (Terra Rosa Consulting 2020) (This report contains sensitive information. A request can be made to the City of Wanneroo to obtain a copy of this document by sending a request to foi@wanneroo.wa.gov.au).
- Two Rocks Beach Access Way Revegetation and Rehabilitation Plan (CoW 2022c)

The following investigations are currently being progressed and will be finalised prior to the start of construction:

- Unexploded ordinances survey
- Geotechnical survey.

1.3.1 Document status

Following information from the Two Rocks Beach Access Feasibility Study (Emerge 2019), Council approved the construction of a new beach access and car park in Two Rocks. Emerge has prepared this FMP to support the City's development application to meet the requirements of SPP 2.6.

As part of this construction work, an unexploded ordnance search and remediation is required which necessitates clearing of native vegetation. The City was successful in obtaining clearing permit CPS 8807/1 from the Department of Water and Environmental Regulation (DWER) in July 2021 for clearing no more than 3.54 ha of native vegetation subject to conditions.

Following an appeal to clearing permit CPS 8807/1 the City commenced discussions with stakeholders and concluded to revoke the clearing permit in September 2021 and refine the beach access design.

The City redesigned the beach access and reduced the clearing footprint by 62% with an application to clear 1.43ha that was granted with conditions on the 14 October 2022 (CPS9578). As part of this clearing permit the City also committed to the following offsets and revegetation:

- Provided an offset by vesting two land parcels from freehold to crown land to secure the tenure of the land in perpetuity.
- Transferred the management of the two parcels of land from DPLH to the City for perpetual on ground management.
- Provided a revegetation and rehabilitation plan to revegetate 0.78ha of temporary clearing areas disturbed during construction.
- Provided an offset involving the 1.475ha within a blown-out area of Lots 13321 and 15452.
- Retained a three (3) metre wide track to be fenced along either side of the blown out offset site.
- Committed to measures that manage to flora, vegetation and fauna impacts by salvaging and demarcating priority flora, providing training awareness to all personnel involved in all stages of the project and conducting fauna spotting during construction.
- Managing construction impacts by restricting access to adjacent vegetation, undertaking feral animal control and adhering to the City's weed and dieback measures.

Following the completion of the final design (**Appendix A**) an amendment to the clearing permit application was submitted in September 2024. Approval for the clearing permit CPS9578/2 was issued by DWER on 26 March 2025 and applies to this FMP. The FMP addresses the management and mitigation measures regarding construction impacts to the foreshore reserve and surrounding native vegetation.

The FMP has been prepared in accordance with the City's available policies and guidelines including the Foreshore Management Plan Guidelines (CoW 2021b), which provide guidance on preparing a FMP for approval with the City expectations and corresponding statutory and City documentation.

This FMP has been updated to include the final design and development area taking into consideration the new FMP guidelines and responding to feedback provided by the City.

1.3.2 Community consultation

There is strong support for access in this location from the Two Rocks community, and in 2018, the City received a petition from residents requesting the construction of a beach access track and car park in Two Rocks. Since this time, the City and DWER have engaged with the Two Rocks community in relation to this proposal on several occasions since its inception. This has included:

- Consultation by the City between 13 August and 3 September 2019 to advise the community of the location nominated for the proposed access and to invite questions or comments in response to the proposal for the beach access and car park. This included letters being sent to 17 landowners with properties adjacent to the access and car park, a sign which was placed on

Two Rocks Road in the location of the proposed access and information about the consultation on the City's YourSay and Facebook pages.

- Consultation by DWER at four different times on the application for clearing. This occurred for 21 days on 11 March 2020, 28 June 2021, 18 February 2022 and 20 November 2023. This engagement included information being provided on the Department's public portal for landowners and community groups to access as well as some direct engagement with other State Agencies and Departments.
- Additionally, in November 2019 the City advised Two Rocks community members that it would be preparing this FMP and invited their comments on environmental issues in the subject location of importance to them. As part of this, the City placed an advertisement in the local paper and undertook a mail out to approximately 250 residents and community groups within 400 metres of the proposed beach access. The City also set up a webpage to invite further public comments and provided a link to the page on the City's Facebook page.

Table 2 summarises the key issues raised during consultation related to foreshore protection. Note that comments related to the type of access or facilities have not been reported as they were outside the scope for the community consultation.

Table 2 Key issues raised through community consultation and response to these issues.

Issue	City's Response to issue
Concerns about rising sea levels and coastal erosion.	The development will be located landwards of the 50-year vulnerability setback for coastal processes in accordance with LPP 4.21.
Recommendation of no further development west of Two Rocks Road. Ensure area is not over developed.	Noted. The proposed development, facilities and amenity is minor and consistent with a local beach.
Concern about the safety of the ocean for swimming along this shoreline. Location not ideal due to swimming conditions.	The section of beach directly accessible from the proposed access has been assessed via a Coastal Aquatic Risk Assessment (CARA) and is considered to be a safe swimming beach.
Underutilised car park and safer reef-protected swimming area at Leeman's Landing. Leeman Landing is within able-bodied walking distance of Atlantis Beach's southern estate area and is a short vehicular distance. Most families swim at the area opposite the beach access adjacent Leeman Landing toilet, playground and BBQ area.	There is projected demand for additional beach access in the area. The existing accesses to the north and south are considered less protected for swimming.
Seaweed is not a concern as it is primarily deposited at the dog exercise area of the beach.	Noted.
Dog owners use the dog area access track.	Noted.
Many beaches close to Two Rocks are over commercialised and ruined due to over development.	The proposed access and carpark will be of a smaller development size than other public facilities in the area.
It is important to retain natural habitat and vegetation for future generations. Development should be done with sensitivity to the environment.	Foreshore restoration and management have been addressed as part of this FMP. The environmental condition has been considered in the choice of location for the access.

The draft Southern Two Rocks Beach Access Foreshore Management Plan will be presented to City of Wanneroo's Council at an upcoming Ordinary Council Meeting to inform both Councillors and the general public that the final FMP is available for its approval. Once approved the City will publish the final FMP on its website and notify residents and community groups within 400 meters of the proposed access road. It is important to note that the FMP currently contains sensitive information including the location of priority species on the site as well as information included in the Archaeological report. Should any member of the public seek access to this information they may contact the City of Wanneroo via email at foi@wanneroo.wa.gov.au.

2 Compliance with guidelines, policy and legislation

The proposed development will have due regard to Federal, state and local government regulations and policies. The relevant guidelines, policies and legislation are outlined below.

2.1 Federal government guidelines and policies

2.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal mechanism for the Commonwealth government to play a role in the protection and management of nationally and internationally important flora, fauna, wetlands, ecological communities, and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (MNES). Under the EPBC Act, a person must not take an action that has, will have, or is likely to have a significant impact on any MNES without approval from the Australian Government Environment Minister.

A desktop assessment search, flora survey and fauna survey (Terrestrial Ecosystems and One Tree Botanical 2019) have been undertaken to understand potential impacts to MNES. The reports conclude that the proposed development is not considered to have a significant impact on MNES and there is no requirement for the development to be referred to the Environment Minister (Terrestrial Ecosystems and One Tree Botanical 2019). This is further discussed in **Section 4**.

2.1.2 Unexploded Ordinances

The Department of Defence has developed the *Commonwealth Policy on the Management of Land in Australia Affected by Unexploded Ordnance* (DoD 2018) with an aim to outline the general approach of UXO land, provide guidance on the management measures to protect the public from hazards of UXO and describe the approach in relation to land known or suspected to be affected by UXO arising from military activities.

The Department of Fire and Emergency Services (DFES) has undertaken research to identify and record sites where there is potential for UXO contamination in WA. The site is mapped as Yanchep Two Rocks Artillery Range located between Moore River and Yanchep extending 15 km inland with 'Slight' UXO potential (DFES 2022) as seen in **Figure 3**. There have been extensive UXO surveys undertaken in the surrounding mapped area (DFES 2022).

However, the Department of Defence recommends that land parcels classified as 'Slight' have an appropriate UXO Risk Assessment undertaken (DOD 2024). As such, the appropriate risk assessment will be undertaken by the City.

2.2 State government guidelines and policy

2.2.1 *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the key piece of environmental legislation under the WA state government. The EP Act provides for the prevention, control and mitigation of pollution and for the conservation, preservation, protection, enhancement and management of the environment.

The Environmental Protection Authority (EPA) provides the government with advice on the environmental acceptability of development proposals and statutory planning schemes. Any proposal for development that is likely or has potential to have significant environmental impacts or effects should be referred to the EPA. There are two relevant considerations under the act in relation to any potential development applications, which are:

- The potential requirement for a future development proposal to be referred to the Environmental Protection Authority (EPA) as a significant proposal pursuant to Part IV of the EP Act, and any associated EPA assessment and Ministerial approval of the proposal.
- The requirement for a clearing permit for the clearing of any native vegetation associated with any future development proposal pursuant to Part V of the EP Act.

The Department of Water and Environmental Regulation (DWER) manages Western Australia's environment and the environmental impacts of the clearing of native vegetation through the provisions of the *Environmental Protection Act 1986* and via the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Any clearing of native vegetation under a development application would require a clearing permit.

Section 1.3.1 outlines the history and current process the City has undertaken in regard to obtaining a clearing permit under Part V of the EP Act.

2.2.2 *Planning and Development Act 2005*

The *Planning and Development Act 2005* (the Act) is the primary planning legislation for WA. The purpose of the Act is to provide for an efficient and effective land use planning system for the state and to promote the sustainable use and development of land in the state. The Act endeavours to:

- Establish and specify the functions and powers of the Western Australian Planning Commission (WAPC).
- Establish the need for and process by which the WAPC can create and administer state planning policies, region planning schemes, planning control areas and interim development orders whilst identifying the relationships between these instruments.
- Provides the power for local governments to develop local planning schemes for their area and establish the processes by which these plans should be formulated, administered, and reviewed; and

Establishes the requirement for WAPC approval to subdivide or amalgamate any lot and outlines the functions of the WAPC and processes they must follow in dealing with applications of this nature. Development approval will be obtained for the proposal. The development application will be

assessed by the WAPC due to the presence of an MRS reserve. A Development Approval (DA) will be obtained for the proposed development. The City will prepare a DA for assessment by the WAPC who are the determining authority for developments within MRS Parks and Recreation zoned land.

2.2.3 *State Planning Policy 2.6 State Coastal Planning Policy*

The *State Planning Policy 2.6 State Coastal Planning Policy* (WAPC 2013) (SPP 2.6) recognises the Western Australian coastal zone as a significant asset in terms of environmental, economic, social and cultural resources. The Policy provides guidance on how to balance competing needs and desires of user groups, taking into account the values of the coastal zone, and the presence of coastal hazards. The Policy also provides guidance in how development should consider existing natural drainage patterns and how to provide appropriate drainage for stormwater runoff.

The objectives of SPP 2.6 are to:

- *'ensure that development and the location of coastal facilities takes into account coastal processes, landform stability, coastal hazards, climate change and biophysical criteria;*
- *ensure the identification of appropriate areas for the sustainable use of the coast for housing, tourism, recreation, ocean access, maritime industry, commercial and other activities;*
- *provide for public coastal foreshore reserves and access to them on the coast; and*
- *protect, conserve and enhance coastal zone values, particularly in areas of landscape, biodiversity and ecosystem integrity, indigenous and cultural significance'.*

The Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) Part 1 and 2 (MP Rogers & Associates 2015; Cardno 2018) was developed to meet the requirements of the SPP 2.6. The CHRMAP aims to understand the City's current and future coastal hazard vulnerability; and identify risk management and adaptation management strategies to manage coastal vulnerability over the next 100 years. The CHRMAP provides a long term view of the potential future coastal hazard and highlights possible strategies to adapt to changing future oceanic and coastal conditions. The CHRMAP was prepared in accordance with SPP 2.6, which supports a risk management approach to coastal erosion and inundation. The CHRMAP Part 1 and 2 has been taken into consideration during the preparation of this FMP to ensure compliance with SPP 2.6. The City manage risks in accordance with and as part of its CHRMAP. The adaptation and management options outlined in Appendix F, Table 2-1 of the CHRMAP has been considered for the management of the coastal processes for this development which is discussed in **Section 6.1** of this FMP.

Surf Life Saving WA (SLSWA) completed a Coastal Aquatic Risk Assessment (CARA) for the City in July 2014 which encompassed the site, shown in **Appendix B**. The CARA included an assessment of a section of beach greater than the site and recommendations regarding suitability for aquatic and recreational activities. The CARA report has been taken into consideration during the preparation of this FMP to address SPP 2.6. **Section 4.8.1** provides a detailed description of the environment for the next 50 years to 2065 and demonstrates the required setbacks for the 2070 vulnerability based on the CHRMAP. Refer to **Figure 8** showing the coastal setback and the proposed development.

2.2.4 *State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region*

The *State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region* (SPP 2.8) (WAPC 2010) aims to ensure bushland protection and management issues in the Perth metropolitan region are appropriately addressed and integrated with broader land use planning and decision making to ensure long-term protection of biodiversity and associated environmental values. SPP 2.8 does not prevent development where it is consistent with the policy and other planning and environmental considerations.

Bush Forever sites are considered a key component of Western Australia's environmental infrastructure contributing to biodiversity, ecological, natural resource management and sustainability outcomes for the area.

Section 5.1.1 and 5.1.2 of SPP 2.8 apply to any proposal or decision-making that is likely to have an adverse impact on regionally significant bushland within a Bush Forever area. Appendix 2 of SPP 2.8 states that where proposals cannot avoid negatively impacting a Bush Forever area, the applicant:

'needs to provide documentation showing how they minimised the impact. If any clearing of native vegetation within the Bush Forever area is to occur, then the applicant needs to provide proposed offset measures (both on-site and off-site), where appropriate and practical'.

The proposed development will require clearing of approximately 1.56 ha native vegetation within Bush Forever Site 397 (0.67 ha will be permanently cleared whilst 0.88 ha will be revegetated). Whilst there is likely to be some unavoidable adverse impact to Bush Forever Site 397 through the clearing of regionally significant bushland in order to achieve the desired development outcome the clearing permit requires mitigation and avoidance measures as well as offsets to this impact which the City has committed (**Section 1.3.1**).

Flora and fauna surveys and investigations (Terrestrial Ecosystems and One Tree Botanical 2019) have been undertaken to consider the existing environmental values within Bush Forever site 397. The clearing and development footprint has been selected to minimise environmental impacts and avoid environmental values and minimise impact.

The City as part of CPS9578 has an approved offset package for the development in response to the significant adverse impact of clearing vegetation within a Bush Forever Area. This package is outlined in (**Section 1.3.1**).

2.2.5 *State Planning Policy 3.7 Planning in Bushfire Prone Areas*

The *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) is applicable to the proposed development and as such a separate Bushfire Management Plan (BMP) will be prepared by the City should it be required.

The vegetation along the foreshore in this area is considered bushfire-prone as defined in Australian Standard 3959 2018 (Standards Australia 2018). The site is mapped as a 'bushfire prone area' under the *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2021). However, no habitable buildings or vulnerable or hazardous uses are proposed, therefore there are no additional planning or building requirements with respect to bushfire risk. It is noted that a significant bushfire occurred in the area during the 2019-2020 bushfire season, highlighting the very

real risk from bushfire. Management actions to limit potential ignition sources on site have been included in this FMP.

2.2.6 *Aboriginal Heritage Act 1972*

In Western Australia, Aboriginal cultural heritage is currently managed pursuant to the *Aboriginal Heritage Act 1972* (AH Act). The DPLH maintains the Aboriginal Cultural Heritage Inquiry System (ACHIS), which is a directory containing locations and information about Aboriginal Cultural Heritage (ACH) in the state. Further investigations into the Aboriginal heritage present within the site and applicable management actions are discussed in **Section 4.6** of this FMP.

2.3 Local government guidelines and policy

The City has various local planning policies and guidelines that may apply to development applications. The relevant local planning policies to this FMP and how the proposed development is compliant with each local planning policy and guideline is discussed in sections 2.3.1 to 2.3.6 below.

2.3.1 Management plans and guidelines

2.3.1.1 Coastal Management Plan

The City has prepared a Coastal Management Plan (CMP) with the following objectives:

- *'To develop vibrant and distinct coastal nodes that offer varied opportunities for enjoyment;*
- *To ensure development that is sustainable and sympathetic to the coastal location;*
- *To conserve and protect natural, cultural and heritage assets; and*
- *Minimise the impacts of sea-level rise and climate change'.*

The FMP was prepared with consideration to the City's Coastal Management Plan (CoW 2021a).

2.3.1.2 Environmental Management Plan Guidelines

The Environmental Management Plan (EMP) Guidelines (City of Wanneroo 2018) were prepared by the City to outline the format and content of EMP's lodged with the City for approval, more specifically to assist the approval of district or structure plans prior to subdivision. Whilst not specific to foreshores, the EMP Guidelines have similar environmental requirements to address.

2.3.1.3 Foreshore Management Plan Guidelines

The City's Foreshore Management Plan Guidelines (CoW 2021b) provide advice to landowners and developers on the information required when preparing an FMP and outline the City's expectations on a number of different aspects of foreshore development.

The guidelines outline when the City requires an FMP to be submitted, e.g. as a requirement of a District Structure Plan or Local Structure Plan, as a condition of subdivision or to support a development approval, as is the case with the Southern Two Rocks Beach Access FMP. The determining authority for the FMP is at the discretion of the WAPC. Final determination of all works within the foreshore is at the discretion of the WAPC as the foreshore is a regional reserve (e.g. Reserve for Parks and Recreation under the Metropolitan Region Scheme). The City of Wanneroo Council will consider the final FMP for its approval to be submitted to WAPC as a support document to the development application.

Once approved by Council the FMP requires applicants to undertake a range of actions and to monitor the implementation of the proposed actions. A comprehensive monitoring program includes parameters to be monitored, targets, performance indicators, completion criteria, timing and location of monitoring. Through the guidelines, the City ensures that all requirements for an FMP are clearly shown. The City will maintain the area for at least five years after the construction of the facility, as specified for the Contractor's "Defects Liability period" and then it will be City managed after that period. Revegetation will be monitored for 5 years or until completion criteria is achieved. Refer to the clearing permit conditions and revegetation and rehabilitations plans for the construction revegetation area and offset area. The City will undertake general maintenance after that.

The FMP report is consistent with the requirements under the City's FMP guidelines and the implementation of activities through the Implementation Plan.

2.3.2 *Local Planning Policy 4.13: Caves and Karstic Features*

Local Planning Policy 4.13: Caves and Karstic Features (LPP 4.13) (CoW 2018) applies to all planning proposals that affect or are affected by, caves or karstic features. LPP 4.13 is intended to conserve caves and karstic features and minimize risks to people and property in karst hazard zones. The required assessment and management for planning proposals depends on the stage of planning and the level or karst risk.

The site is located in a low-Risk Zone for karstic features as demonstrated in Figure 1 of LPP 4.13. A development application in a low-risk zone requires a Geotechnical Report to be prepared only where specifically requested for further karst investigation.

As such, the City appointed consultants to undertake a Geotechnical Survey and Report to be completed before commencement of construction.

2.3.3 *Local Planning Policy 4.18: Earthworks and Sand Drift*

Dust and sand drift are considered to be a matter of significant nuisance with a high risk of adversely impacting on public amenity, health and safety. The City has developed *Local Planning Policy 4.18: Earthworks and Sand Drift* to guide assessment of development applications for earthworks and dust management measures during earthworks (CoW 2021c). The objectives of the policy are to:

- Minimise the risk of adverse impacts caused by sand drift and dust nuisance on the health and amenity of adjacent residents.

- Incorporate a procedure for the assessment of the potential for a development site to generate dust prior to site works commencing.
- Clarify responsibilities and provide guidance for determining appropriate measures and contingency arrangements to manage the potential for sand and dust leaving the site during and following earthworks.
- Establish guidance on the consideration of development applications proposing earthworks to ensure that these are dealt with in a consistent manner.
- Facilitate the timely development of land without prejudicing future development outcomes.

Proponents are required to prepare a Dust Management Plan (DMP) for proposed earthworks as a condition of development approval. The City outline the guidelines for the preparation of DMP within LPP 4.18 which requires DMP's to be prepared in accordance with the DWER guideline for dust emissions (DWER 2021).

A DMP will not be separately prepared for this project, as it has been incorporated into this FMP in **Sections 6.4, 6.8.1** and **6.8.2**. This FMP is prepared in accordance with LPP 4.18 and the Guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities (DEC 2011). These guidelines require a risk assessment which has been incorporated into **Section 5, Section 6.4** and **Appendix C**. Appropriate rehabilitation will also assist in mitigating dust.

2.3.4 *Local Planning Policy 4.21: Coastal Assets Policy*

Local Planning Policy 4.21 Coastal Assets Policy (LPP 4.21) (CoW 2016) is intended to provide guidance on the type of permanent and temporary assets that will be considered within the foreshore reserve, and guide the location of proposed assets relative to the projected onset of coastal processes in accordance with SPP 2.6.

There is no current Local Structure Plan for the area; therefore, the proposed development must provide the following information, as per clause 1.2.1 to 1.2.5 of the LPP 4.21:

- 1.2.1. Population projections for the local, district and regional catchment area at the time of handover to the City at full build out;
- 1.2.2. Assessment of beach safety through a Coastal Aquatic Risk Assessment (CARA) and a beach safety signage audit to be provided at the applicant's cost for their management area to the satisfaction of the City;
- 1.2.3. Hazard mapping of the subject area illustrating the location of proposed and current assets relative to the projected onset of coastal processes over a 100- year planning timeframe. Vulnerability timeframes to be depicted in increments of 30 years, 50 years, 75 years and 100 years from the foreshore development's estimated date of completion;
- 1.2.4. Proximity to established coastal nodes within the City and the classification of those nodes; and
- 1.2.5. Proximity to future coastal node locations endorsed by the City through a Coastal Management Plan (CMP), Local Structure Plan (LSP) or Foreshore Management Plan.

The proposed development will incorporate appropriate facilities for a local coastal node including a car park, lighting and bin pads. As the needs for the area may change in the future with increasing population of Two Rocks, the current proposed development considers the need for potential

additional facilities such as bench seats. As such, the proposed development aligns with the type of coastal assets for a local node development that the City will consider. Refer to **Section 3** Proposed development.

Appropriate assessments of beach safety, hazards, vulnerability timeframes, proximity to current and future coastal nodes have been undertaken and incorporated into this FMP to satisfy LPP 4.21. These include a CARA (SLS WA 2019) and the Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) Part 1 and 2 (MP Rogers & Associates 2015; Cardno 2018). The CARA and CHRMAP are discussed in detail in **Section 4.8**.

The nearest beach nodes and swimming beaches to the site are:

- Leeman's Landing, which is a local beach, located approximately 800 metres north of the proposed access area; and
- The Spot, which is a local beach, located approximately 1.5 kilometres south of the proposed access area.

2.3.5 *Local Planning Policy 3.3: Fauna Management*

Local Planning Policy 3.3: Fauna Management (LPP3.3) (CoW 2022a) has been developed to ensure the effective management and impact avoidance of proposed urban development on fauna specifically referring to kangaroos and emu's. According to the Fauna survey conducted by Terrestrial Ecosystems (2020) both kangaroos and emus are potentially found near the site, giving rise to consider LPP3.3.

It is the City's responsibility along with the Department of Biodiversity, Conservation and Attractions (DBCA) to protect and manage all fauna on the site. All fauna is to be managed proactively noting that directional clearing does not qualify as an acceptable method of fauna management. A fauna specialist will be onsite during clearing and trapping.

2.3.6 *Local Planning Policy 4.4: Urban Water Management*

Local Planning Policy 4.4: Urban Water Management (LPP4.4) (CoW 2020) has been developed to ensure planning and development optimises the use and management of water resources (including rainwater, stormwater, groundwater, drinking water and waste water) consistent with *State Planning Policy 2.9: Water Resources and Better Urban Water Management*. LPP4.4 also requires the implementation of Water Sensitive Urban Design (WSUD) principles and best management practices. The principles of WSUD derived from the Stormwater Management Manual for Western Australia (DoW 2004-2007) to be applied are as follows:

- Provide protection to life and property from flooding that would occur in events up to 1% Annual Exceedance Probability (AEP) event.
- Manage runoff from small rainfall events on-site or as close to the source as possible
- Retain and restore existing elements of the natural drainage system, including waterway, wetland and groundwater features, regimes and processes and integrate these elements into the urban landscape.
- Protect and enhance sensitive receiving environments.
- Minimise pollutant inputs.

- Increase Water use efficiency and reduce potable water demand.
- Achieve good urban liveability and amenity.
- Reduce urban temperatures, runoff volumes, and peak flow rates and improve water quality, biodiversity and aesthetics by managing stormwater through the retention and planting of vegetation and mimicking natural hydrological processes

The FMP has been prepared to incorporate these principles through its design (**Appendix A**) that minimises water run-off and provides structural controls. Stormwater run-off from the road will be managed by installing kerbs to direct the water to stormwater pits. The water will be discharged on to gabion mats that reduce the velocity of the water and control erosion.

3 Proposed development

The City is proposing to construct an additional beach access to support a local beach primarily catering for nearby residential areas. The detailed design of the proposed development can be seen in **Appendix A**. To address the needs of the community while protecting the surrounding coastal dunes the development has minimised the footprint and maintained the local purpose. The main components of the proposed development and those relevant to the management of the foreshore have been summarised below.

3.1.1 Public road interface and car park

A public road featuring an asphalt surface and a limestone sub-base will be constructed, connecting Two Rocks Road to the newly developed beach car park. This roadway will ensure a safe and efficient link between the main road and the 48-bay car park, facilitating convenient beach access. Designated ACROD parking bays will be available to accommodate accessibility needs.

Additionally, the foreshore road will support emergency vehicle access, with Beach Emergency Number (BEN) signage installed for rapid location identification. To enhance safety for both motorists and pedestrians during nighttime hours, energy-efficient LED street lighting will be implemented.

Illustrative example of beach access road

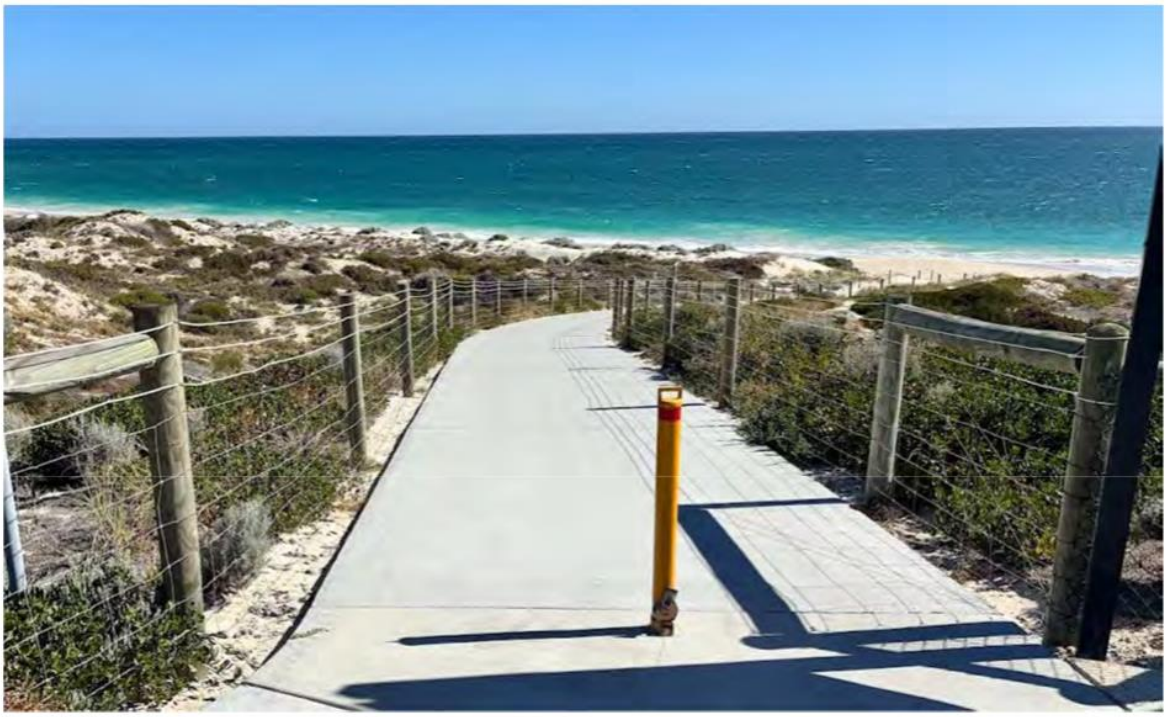
3.1.2 Fencing

Conservation fencing will be used within the Two Rocks Beach Access Way foreshore reserve to restrict access to intended areas. The road reserve will be fenced in order to reduce impacts on native vegetation and revegetation. In addition, fencing will restrict access by dogs, which can be a significant threat in the urban environment to ground-dwelling birds and mammals.

3.1.3 Beach Access Path

Beach access will be facilitated by a 5.0-meter-wide emulsion-stabilized limestone footpath. To prevent unauthorized vehicle entry, the pathway will be equipped with removable bollards.

This access path will serve multiple functions, acting as an emergency vehicle access route while also ensuring universal accessibility for individuals using wheelchairs and strollers, providing an inclusive and safe route to the beach area.



Illustrative Example of Beach Access Path

3.1.4 Paths and networks

A 2.0-meter-wide concrete footpath will connect the existing pathway on Two Rocks Road to the beach car park, ensuring safe and convenient pedestrian access.

Additionally, bike racks will be installed to provide secure storage for bicycles, promoting alternative and sustainable transport options.

Illustrative example of bike racks

4 Existing environment

4.1 Climate

The area receives the highest rainfall between the months of May to September, averaging 610 mm per year (recorded at Woodridge Estate weather station) (BoM 2024). The month of July generally records the highest rainfall. The average maximum temperature recorded at Gingin Aero weather station is 26.7°C annually, with January and February recording the highest annual average temperature, of around 35°C.

Prevailing winds are generally easterly (offshore) in the morning (9am) with afternoon wind (3 pm) primarily from the south west (land/sea breeze). This trend is more pronounced in the summer months, though December has a strong influence from the south-east in the morning. Morning wind speed is lower on average than afternoon wind speed. The annual average 9am wind speed in January is 20.9 km/h, while in the afternoon the average wind seed Is 25.5 km/h, based on 14 years of data.

According to M.P. Rogers and Associates (2015), the seasonal patterns along the Perth Metropolitan shoreline are primarily controlled by the Subtropical High Pressure Belt. This causes high pressure cells to continuously move from west to east across the southern portion of the continent. The high-pressure ridge created by this weather pattern lies at around 25°C -30°C during winter and moves south between 35°C -40°C in the summer. The latitudinal shift of the ridge is key to the seasonal wind patterns in the region.

4.2 Geomorphology and soils

The site occurs on the Swan Coastal Plain, which is the geomorphic unit that characterises much of the Perth metropolitan area. The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly, the Swan Coastal Plain consists of two sedimentary belts of different origin. Its eastern side has formed from the deposition of alluvial material washed down from the Darling Scarp, while its western side is comprised of three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004). These dune systems, referred to as Quindalup, Spearwood and Bassendean associations, represent a succession of coastal deposition that has occurred since the late Quaternary period (approximately two million years ago) (Kendrick *et al.* 1991) and, as a result, they contain soils at different stages of leaching and formation.

Mapping by Gozzard (2011) places the site in the Quindalup dune system which are the youngest dunes on the Swan Coastal Plain and comprise beach ridges and parabolic dunes with calcareous sands (Churchward and McArthur 1980).

Three soil types are mapped within the site by Purdie *et al.* (2004):

- ‘S2’ occurs across the majority of the south western portion of the site, with a small area mapped as ‘S1’. Both of these soil types are described as ‘calcareous sand - white, fine to medium-grained, sub-rounded quartz and shell debris, of eolian origin’.

- 'LS1' occurs across the remainder of the site and is described as '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 origin'.

The dissolution of soluble rocks by surface or groundwater produces landforms known collectively as 'karst' (Gozzard 2011). On the Swan Coastal Plain, karst generally occurs as limestone, particularly in the Yanchep-Wanneroo region. Mapping by Gozzard (2011) indicates that the site is a 'potential karst area'. The soils and topography within the site are shown in **Figure 4**.

4.3 Topography

The elevation of the site ranges from 3 m in relation to the Australian height datum (mAHD) on the western side to 12 mAHD on the eastern side (DoW 2008). Multiple low rises to 19 mAHD occur in the central portion of the site.

The topography of the site and surrounding area are shown in **Figure 4**.

4.4 Flora and vegetation

A 'detailed' and 'targeted' flora and vegetation survey were previously undertaken within the site and surrounding areas in September and October 2019 (One Tree Botanical 2019) (**Appendix D**). The survey recorded the following flora and vegetation values within the site and surrounding areas:

- A total of 158 flora species comprised of 99 native and 59 non-natives. A full species list is provided in **Appendix D**
- Three flora species listed as 'priority' in Western Australia (**Figure**)
  - Leucopogon maritimus ('priority 1')
  - Beyeria cinerea subsp. cinerea ('priority 3')
  - Stylidium maritimum ('priority 3').
- Six vegetation types (**Figure 5**)
  - 'A1 Incipient Foredune (younger)' which was described as 'uniform regrowth of grassland *Spinifex longifolius*'.
  - 'A2 Established Foredune (older)' which was described as 'sparse shrubland *Olearia axillaris* over grassland *Spinifex longifolius*'.
  - 'A3 Beach-ridge plain' which was described as 'open shrubland *Olearia axillaris, Rhagodia baccata* subsp. *baccata* and **Pelargonium capitatum* over sparse grassland *Spinifex longifolius* and sparse vineland *Cassytha flava* var. *flava*'.
  - 'B1 Tall secondary dunes on unconsolidated sand' which was described as 'shrubland dominated by Acacia cyclops, Scaevola crassifolia, Spyridium globulosum, Santalum acuminatum, Myoporum insulare, Olearia axillaris, Rhagodia baccata subsp. baccata and Acanthocarpus preissii, sparse vineland Hardenbergia comptoniana and Cassytha flava var. flava. over forbland dominated by Senecio pinnatifolius var. latilobus'.
  - 'C1 Low dunes on semi-consolidated sand' which was described as 'species rich low shrubland dominated by *Melaleuca systena* and species rich forbland dominated by *Lomandra maritima* and sparse sedgeland *Lepidosperma calcicola* and sparse rushland *Desmocladus asper*'.

- ‘D1 Low rises with limestone outcropping’ which was described as ‘closed shrubland *Melaleuca cardiophylla* with other typical shrubs *Melaleuca huegelii*, *Acacia xanthina* and *Dodonaea aptera* with sparse vineland *Cassytha aurea* var. *aurea* over forbland of native and introduced herbs’.

- The remainder of the site was classed as ‘cleared areas’ and comprised ‘historically cleared areas; informal walking paths, informal vehicular sand tracks (unused and partially overgrown)’.
- The vegetation in the site ranged from ‘degraded’ to ‘very good to excellent’ condition, with the majority being in ‘very good’ condition using the *Bush Forever* scale (Government of WA 2000). (**Figure 6**)
- Two priority ecological communities (PECs) listed as ‘priority 3’ in Western Australia were recorded in the site:
  - ‘SCP 29a: Coastal shrublands on shallow sands, southern Swan Coastal Plain’
  - ‘SCP 24: Northern Spearwood shrublands and woodlands’.

4.5 Fauna

A ‘level 1’ vertebrate fauna survey was previously undertaken within the site in August 2019 (Terrestrial Ecosystems 2020) (**Appendix E**). The survey recorded three broad fauna habitats being coastal low heath on sand, mixed open shrubland and heath on sand and mixed closed shrubland over sand and limestone. The remainder of the site was determined to be ‘highly disturbed’ as shown in **Figure 7** of this FMP report.

In relation to fauna species, a desktop review indicated that a wide range of fauna may occur in the site, including birds, amphibians, mammals and reptiles. It was considered probable that quenda (listed as ‘priority 4’ in Western Australia) and black-striped snake (‘priority 3’ in WA) occur within the site.

Two species of black cockatoo listed as threatened under the EPBC Act, Carnaby’s cockatoo and forest red-tailed black cockatoo, were considered likely to fly over the site very infrequently. The site does not comprise preferred foraging, roosting or breeding habitat for these species.

Three fauna (bird) species listed as migratory under the EPBC Act, fork-tailed swift, grey wagtail and osprey, were considered to have potential to use the site occasionally, based on the species preferred coastal habitat aligning with site location.

The fauna survey undertaken in 2020 by Terrestrial Ecosystems, confirmed that the three migratory species identified from the desktop Protected Matters Search Tool (PMST) results may use the area on occasion, as detailed in **Table 3** below (Terrestrial Ecosystems 2020). The three listed migratory species returned from the PMST search area are limited to birds flying overhead and none of which are expected to rely on habitat present within the site. Based on the findings of Terrestrial Ecosystems report there is no considerable impact of this development on these three migratory birds.

Table 3: Migratory species potentially present in the project area (Terrestrial Ecosystems 2020)

Species	DBCA Schedule	Status under EPBC Act	Comment on presence
Fork-tailed swift (*Apus pacificus*)	Migratory	Migratory	May infrequently be seen flying in the area.
Grey wagtail (Motacilla cinerea)	Migratory	Migratory	Highly unlikely to be seen in the project area.
Osprey (Pandion haliaetus)	Migratory	Migratory	Regularly seen flying over the project area but there are no roosting trees, so it is unlikely to roost in the project area.

The proposed development will not substantially modify, destroy or isolate an area of important habitat for the known migratory species nor introduce or facilitate an invasive species harmful to the migratory species. The proposed development will also not seriously disrupt the lifecycle of the migratory species as the area is not used for breeding, feeding or roosting behaviour. If any interruptions to migration occur, they will be of a limited nature as the result of the construction phase of the development. Even this is considered unlikely as the development involves earthworks and ground level construction and will not introduce tall new structures into the airspace.

The fauna species with potential to occur within the site are not restricted to the site or significantly rely on the site for survival, breeding, foraging or roosting.

4.6 Heritage

The Department of Planning Lands and Heritage (DPLH) maintains an Aboriginal Inquiry system for the heritage site register and the heritage survey database. The Aboriginal heritage site register is maintained pursuant to Section 38 of the *Aboriginal Heritage Act 1972* and contains information on over 22,000 listed aboriginal sites throughout Western Australia (DPLH 2023).

In 2019, the City determined that a total of five heritage surveys had previously been undertaken across the Two Rocks area to determine the presence of Aboriginal archaeological or ethnographic material. A total of eight reports had been compiled based on the results of these surveys. Two of these reports are restricted and as a result, access to these documents was not granted to the City due to culturally sensitive content. No registered Aboriginal sites within the proposed Two Rocks beach access FMP area have been recorded in the heritage site register.

To ensure its adherence to the Aboriginal Heritage Due Diligence Guidelines the City still engaged Terra Rosa consulting to undertake a site identification heritage survey over areas planned for development in the Two Rocks Archaeological Report (Terra Rosa Consulting 2020) (**Appendix F**). This was done with the endorsement of South West Aboriginal Land and Sea Council (SWALSC) who represent the Whadjuk Traditional Owners. The survey was undertaken on the 28 May 2020 however, due to COVID-19 the representative for the Whadjuk Traditional Owners, SWALSC, were not present on site during the heritage survey, provided they are given the opportunity to monitor ground disturbance of any risk areas.

Based on the results of the survey and consultation with the Traditional Owners, the following recommendations were made to the City:

1. The City of Wanneroo is advised that the archaeological heritage survey of the 'Clearing Area' is complete and the area is clear of archaeological heritage material.
2. The City of Wanneroo is advised that the 'Floral survey area' is considered likely to be clear of archaeological heritage material due to its proximity to 'Clearing Area'.
3. The City of Wanneroo is advised that no ethnographic heritage survey is required by SWALSC.
4. The City of Wanneroo is advised to have Whadjuk Traditional Owners present to monitor all ground disturbing works.
5. All employees and contractors working within the Two Rocks Beach Access area must restrict access and works to areas that have been subject to heritage survey.
6. If the City of Wanneroo proposes to alter the type of works or to expand their program of works, either in size or scale, beyond what was subject to the heritage survey, it is advised that further consultation with the Whadjuk Traditional Owners should be undertaken prior to the commencement of works.

The City will adhere to the above recommendations and the Whadjuk Traditional Owners will be invited to be present to monitor all ground disturbing works during the project's construction phase.

4.7 Unexploded Ordinance

As previously mentioned in **Section 2.1.2**, there is a 'slight' potential for UXO to occur within the site as indicated by Department of Defence UXO mapping as seen in **Figure 3**. The City will undertake risk assessment and further site investigations if required prior to the commencement of development.

4.8 Coastal Hazard Risks

4.8.1 Coastal Hazard Risk Management and Adaptation Plan

The Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) Part 1 and 2 (MP Rogers & Associates 2015; Cardno 2018) was developed to understand current and future coastal hazard vulnerability; and identify risk management and adaptation management strategies to manage coastal vulnerability over the next 100 years. The CHRMAP provides a long-term view of the potential future coastal hazard and highlights possible strategies to adapt to changing future oceanic and coastal conditions. The CHRMAP was prepared in accordance with SPP 2.6, which supports a risk management approach to coastal erosion and inundation.

The site supports Bush Forever site 397 and is presently vulnerable to coastal erosion and inundation. The beach in this area is described as a sandy coastline interrupted by a small reef-attached foreland to the south. The beach receives waves just over 1 m on average and these waves are likely to increase in height during stormy periods. According to the CHRMAP the site is located in

Zone 1 of Sediment cell 30b between chainage 7,000 to 7,500 and is tied to a calcarenite reef capped with a sea stack at the northern end. The Zone is characterized by a low accreting foredune.

The CHRMAP found that the beach near the site has been accreting at a rate of around 2 m/year since the Two Rocks marina was constructed. It is expected that the shoreline has the potential to continue accreting at a rate of 1.6 m/yr for the next 50 years to 2065. The erosion in this area will depend significantly on the extent of rock behind the coastal headland. **Figure 7** demonstrates the required setbacks for the 2070 vulnerability based upon the CHRMAP. The erosion allowances derived from the CHRMAP are outlined in **Table 4**.

Table 4: Erosion allowances derived from the CHRMAP (MP Rogers & Associates 2015; Cardno 2018)

Year	S1 Erosion (m)	S2 Erosion (m)	S3 Erosion (m)	Factor of Safety (m)	Allowance for Erosion (m)
2015	22	0	0	0	0
2030	22	-12	7	3	20
2050	22	-28	20	7	21
2070	22	-44	39	11	28
2090	22	-60	62	15	39
2120	22	-84	97	21	56

S1 = Allowance for current risk of storm erosion, S2 = Allowance for historic shoreline movement trends, S3 = Allowance for erosion caused by future sea level rise.

As the development will partially be shoreside of the 50 and 100 year vulnerability setbacks, particularly the proposed limestone path, monitoring and management to ensure access to the beach is maintained with safety of users prioritised will be required. The life span of the car park and roads is approximately 30 years before resurfacing will be required. At the point that the asset will need to be resurfaced in the future an assessment into the coastal vulnerability through CHRMAP revisions should occur and a managed retreatment should be undertaken if required at the end of the car park design life landward of the appropriate coastal vulnerability line corresponding to the life span of the proposed new assets. The City identified a potential location for the car park retreat set back behind the 100 year vulnerability line as shown in **Figure 10** of this FMP. The area would provide adequate access to the beach. Coastal erosion is monitored regularly, and the potential locality for the car park retreat will be fully investigated when the need arises.

The Department of Planning, Lands and Heritage (DPLH) requested the City to provide the trigger for a potential future relocation of the car park (**Figure 10**). The trigger distance is based on the S1 value which is the erosion allowance for the current risk of erosion. The City of Wanneroo's Coastal Vulnerability Study and Hazard Mapping – CHRMAP Part 1 by MP Rogers & Associates pl (November 2015) indicates the S1 erosion allowance for the current planning timeframe (present day), refer to Table 4 in the FMP. However, specific to the proposed development the site is located at the 7,300 m chainage with 22 meters from the seaward boundary of the carpark. Refer to Appendix D of the CHRMAP (2015). The S1 line runs approximately parallel to the seaward boundary of the 2050 vulnerability line, as shown in **Figure 10**.

4.8.2 Asset Management

Assets installed during the construction works will be periodically inspected in line with the City's Asset Management Plan requirements.

4.8.3 Coastal Aquatic Risk Assessment

Based on results from the Coastal Aquatic Risk Assessment (CARA) (SLS WA 2019) (**Appendix B**), the beach to be accessed via the proposed development is considered the most suitable for beach swimming and recreational activities compared to nearby beaches to the north and south. The site as detailed in the CARA (SLS WA 2019) has a beach hazard rating of five (moderate) and does not appear to be more hazardous than other beaches within WA. However, the site may increase in hazard rating on any given day, and this will be influenced by swell, wave, wind and tide conditions.

The CARA assessed the site as having a medium risk level of dune erosion.

This proposal supports the implementation of the formal beach access recommended in the CARA, preventing beach users from creating informal tracks that contribute to erosion and vegetation fragmentation.

Other recommendations of the CARA are to consider the implementation of fencing/barriers along Two Rocks Road to restrict access to undefined tracks and to install beach safety signage that includes shark hazard signage, reference to the 'SharkSmark' website and app, and State Government Beach Emergency Numbering. The beach safety signage should also be reviewed in conjunction with Surf Life Saving WA. Refer to **Section 6** – Management.

4.8.4 Coastal Monitoring Program

The City has an ongoing coastal monitoring program to assess seasonal and long term changes along the coastline to assist with the management and protection of the coastal environment into the future. This program includes 6 monthly manual photographic monitoring, 6 monthly coastal surveys, analysis of aerial imagery, capture of local wave data, remote monitoring cameras and 6 monthly reporting. The southern Two Rocks beach area adjacent to the proposed beach access and car park is included within this coastal monitoring program.

Further information on the coastal monitoring program and 6 monthly monitoring reports since 2022 are available on the City's website below:
www.wanneroo.wa.gov.au/coastalmonitoring

5 Risk assessment

An environmental risk assessment has been completed for the project, identifying risks and controls to be implemented to avoid or minimise those risks. Reasonably predicable risks have been identified based on the existing environment (**Section 4**) and proposed construction activities (**Section 3** - Proposed development). Risks related to coastal processes have been derived from the CHRMAP.

A risk assessment has been undertaken to guide the management of potential environmental impacts during construction. The assessment is based on the guidance provided in AS/NZS ISO 31000:2018 Risk management –Guidelines (AS/NZS 31000) (Standards Australia Limited 2018) and the Commonwealth of Australia Environmental Management Plan Guidelines (Commonwealth of Australia 2014).

AS/NZS 31000 and the Environmental Management Plan Guidelines identify a requirement for a risk assessment to assess the likelihood and consequence of each potential impact in order to ensure that risks are translated into controls, mitigation and management actions.

Environmental risk has been rated in accordance with risk assessment matrix below in **Table 5** and the consequence and likelihood classification system provided below in **Table 6** and **Table 7**. The environmental risk register for the project is provided in **Table 8**. The risk assessment has calculated the inherent risk and the residual risk of the proposed impacts when implementation of the proposed management actions (controls), detailed in **Section 6**, are considered. Proactive planning, installation and maintenance of appropriate environmental controls and ongoing monitoring will reduce the risks associated with each environmental impact identified for the project.

The scoring classifications for consequence and likelihood are adopted from the Environmental Management Plan Guidelines (Commonwealth of Australia 2014) and the DWER Guidance Statement: Risk Assessments (DER 2016). The timeframe that risks have been considered includes the initiation of clearing works to five years post initial plantings of revegetation, herein referred to as the project timeframe.

Table 5: Risk Assessment Matrix

	Consequence				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Severe**
Almost certain	Low	Moderate	High	Extreme	Extreme
Likely	Low	Low	Moderate	High	Extreme
Possible	Low	Low	Moderate	High	Extreme
Unlikely	Low	Low	Low	Moderate	High
Rare	Low	Low	Low	Moderate	Moderate

Table 6: Consequence scoring classification

Descriptor	Criteria
Insignificant	• Minor incident of environmental damage that can be reversed. • On-site impact: minimal • Specific Consequence Criteria (for environment) (DWER 2016) met
Minor	• Minor instance/s of environmental damage that could be reversed with intensive efforts. • On-site impacts: low level • Off-site impacts local scale: minimal • Off-site impacts wider scale: not detectable • Specific Consequence Criteria (for environment) (DWER 2016) likely to be met
Moderate	• Substantial instances of environmental damage that could be reversed with intensive efforts. • On-site impacts: mid-level • Off-site impacts local scale: low level • Off-site impacts wider scale: minimal • Specific Consequence Criteria (for environment) (DWER 2016) are at risk of not being met
Major	• Major loss of environmental amenity and real danger of continuing. • On-site impacts: high level • Off-site impacts local scale: mid-level • Off-site impacts wider scale: low level • Short term impact to an area of high conservation value or special significance • Specific Consequence Criteria (for environment) (DWER 2016) are exceeded
Severe	• Severe widespread and irrecoverable environmental damage on-site or major or above offsite loss of environmental amenity. • On-site impacts: catastrophic • Off-site impacts local scale: high level or above • Off-site impacts wider scale: mid-level or above • Mid to long term or permanent impact to an area of high conservation value or special significance • Specific Consequence Criteria (for environment) (DWER 2016) are significantly exceeded

Table 7: Likelihood scoring classification

Descriptor	Criteria
Rare	Rare, only occurring in exceptional circumstances. < 1% chance of occurring.
Unlikely	Could occur at some time during the project. ~1% chance of occurring.
Possible	Might occur at some time during the project. ~10% chance of occurring.
Likely	Will probably occur during the project. ~ 50% change of occurring.
Almost Certain	Is expected to occur during the project. ~ 90% or > chance of occurring

Table 8: Risk Assessment register

NO.	Potential environmental risk (source)	Potential causes (pathway)	Potential impacts/receptors	Risk without controls			Management Actions as per Table 13	Risk with controls		
				Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Coastal Processes										
R1.	Erosion of sand within the vicinity of the proposed development and deposition elsewhere	Tidal action and coastal storm surges	Sand deposits in car park, erosion of infrastructure, sedimentation of nearby roads or stormwater systems	Likely	Moderate	Moderate	Ma1, Ma2, Ma3, Ma4	Unlikely	Minor	Low
Vegetation										
R2.	Removal and/or damage of vegetation proposed for retention or external to the site	Clearing and works outside of designated areas causing damages to retained flora including priority species.	Existing vegetation proposed for retention; vegetation external to the site.	Possible	Moderate	Moderate	Ma1, Ma5, Ma6	Unlikely	Moderate	Low
R3.	Introduction and/or spread of weeds and plant diseases.	Vehicle movements to and from the site, importation of fill material.	Weeds present at high density, areas not subject to disease exposed	Possible	Moderate	Moderate	Ma1, Ma7, Ma8, Ma9, Ma10, Ma11	Unlikely	Moderate	Low
Fauna										
R4.	Fauna and fauna habitat within the site is injured, damaged or destroyed	Fauna being in areas subject to clearing and/or earthworks, vehicle movements	Injury or death to fauna within the site, or damage or destruction of fauna habitat indicated to be retained	Likely	Minor	Low	Ma1, Ma12, Ma13, Ma14, Ma15, Ma16	Unlikely	Minor	Low
R5.	Vehicle and machinery movement and operation causing excessive noise and vibration.	Operation of plant and equipment	On site personnel, nearby residents, and any fauna present.	Likely	Minor	Low	Ma1, Ma17	Possible	Minor	Low
R6.	Feral fauna are introduced to the site and impact vegetation and native fauna through herbivory and predation	Feral fauna are present within the site or are attracted to the site	Surrounding environment native fauna and revegetation areas	Possible	Minor	Low	Ma1, Ma18, Ma19, Ma20	Unlikely	Minor	Low
Dust										
R7.	Vehicle and machinery movement and wind erosion of cleared dunes generating dust causing health concern and nuisance.	Bare sands exposed to wind, movement of dry materials and sand as part of excavation or construction, movement of vehicle and machinery.	On site personnel and nearby residents.	Likely	Minor	Low	Ma1, Ma21	Possible	Minor	Low
Stormwater										
R8.	Stormwater is not managed appropriately and leads to erosion and the spread of weed seeds.	Water flows not considered or drainage basins not constructed as per detailed engineering plans or Water Sensitive urban design	Erosion of coastal dunes adjacent to infrastructure potentially undermining the structural integrity, and the spread of weed seeds throughout the site.	Unlikely	Moderate	Low	Ma1, Ma22	Unlikely	Moderate	Low
Bushfire										
R9.	Bushfire damages vegetation, infrastructure or surrounding residential areas	Ignition of surrounding vegetation from construction activities or smoking on site	Surrounding vegetation indicated to be retained as well as adjacent residential areas	Unlikely	Moderate	Low	Ma1, Ma23	Unlikely	Moderate	Low
Heritage										
R10.	Disturbing heritage values	Ground disturbing works	Damage or disturbance caused to heritage values	Unlikely	Moderate	Low	Ma1, Ma24	Unlikely	Moderate	Low
Restoration										
R11.	Loss of local biodiversity	Clearing of native vegetation to allow for the proposed development	The coastal dunes ecosystem occurring within and surrounding the site	Likely	Moderate	Moderate	Ma1, Ma25, Ma26	Unlikely	Minor	Low

6 Management

These management actions address statutory requirements and applicable policies as well as the specific coastal risks associated with the site. Coastal hazard processes present risks including erosion and sand drift, which are common in coastal developments and are a focus in the proposal's management approach. The management actions aim to mitigate the risk of coastal hazard processes and protect environmental values (**Section 4**) of the site. The management actions below have taken into consideration the Two Rocks Beach Access Way Revegetation and Rehabilitation Plan (CoW 2022c) (**Appendix G**) which addresses potential impacts, revegetation commitments and sets completion target criteria and monitoring. The following are discussed in this FMP:

- Coastal processes
- Vegetation
- Fauna
- Dust
- Stormwater
- Bushfire
- Heritage
- Restoration

6.1 Coastal processes

The CHRMAP outlines adaptation and management options for assets currently within coastal vulnerability and areas likely to become vulnerable in the future in Appendix F Table 2-1 which are included below in **Table 9** (MP Rogers & Associates 2015; Cardno 2018). These adaptation and management options outlined in the CHRMAP were derived from the Coastal Hazard Risk Management and Adaption Planning Guidelines (WAPC 2014). The options to be undertaken in this plan are highlighted in the table and summarised below.

The City undertook appropriate risk assessments when determining the location of the proposed development and the siting of infrastructure in relation to the vulnerability setback lines. It has been noted that repairs to the beach access path from the car park is expected to be affected by coastal processes but this has been determined to be an acceptable loss.

The short term risk associated with coastal process will be managed as outlined in MR1 where assets are left unprotected and loss is acceptable in the event (especially the limestone path extending to the shore side of the 2050 vulnerability line). In the longer term, MR2 will be implemented in response to coastal erosion risks. Where assets are in the hazard zone, they are relocated further inland or are destroyed as an acceptable risk. The accommodation of the proposed development will be considered through the implementation of AC2 in this plan. This includes outlining safety procedures for the erosion events including limiting access after erosion events.

The car park infrastructure, road and beach access pathway will require inspection after severe winter storms to assess potential issues. Triggers for further response in relation to asset management include sand drift into the car park, erosion or inundation, foredune movement, erosion around the access path or access being limited due to ground and or level changes. If these

triggers are observed, access to the car park may need to be temporarily restricted and remediation works implemented. The site is also located within the City's coastal monitoring program which includes 6 monthly coastal surveys of the beach and dune areas, photographic monitoring and reporting. If determined to be required in the long term the retreat of the assets will be located landward of the coastal vulnerability line that corresponds to the lifespan of the proposed new assets.

6.1.1 Beach renourishment sand source investigations

The City conduct beach renourishment at vulnerable beach locations annually with locations and sand quantity dependent on coastal erosion impacts and coastal monitoring recommendations. Currently the sand is sourced externally from local sand quarries, however investigations are underway to identify alternate sand sources for future beach renourishment. One of these sources includes the accreting beach immediately adjacent to the proposed southern Two Rocks beach access and car park. Future beach renourishment works may seek to extract sand from this beach location annually via the proposed beach access and car park, subject to further investigations.

Table 9: Adaptation and Management Options to Respond to Coastal Erosion as Outlined in the CHRMAP

Option Category	Option Name	Option Code	Description
Avoid	Avoid Development	AV	New residential or commercial development within the coastal foreshore reserve is not allowed.
Managed Retreat	Leave Unprotected / Repair	MR1	Assets are left unprotected and loss is accepted following hazard event. Repairs may be implemented for public safety, and asset is retreated outside hazard zone, or in the case of beaches/vegetation, as natural recession occurs.
	Remove / relocate	MR2	Assets located in the hazard zone are relocated or destroyed. Applied to assets of low value where it is impractical to re-design to withstand hazard impacts.
	Prohibit further development / redevelopment	MR3	Allows continued use of the current infrastructure until such time that impacts arise but prohibits the development of further infrastructure (densification) as the area/asset is known to be vulnerable.
Accommodate	Notification on Title	AC1	Indicates to current and future landholders that an asset is likely to be affected by coastal hazards over the planning timeframe. Helps owners to make informed decisions about level of risk they are/may be willing to accept and that risk management and adaptation is likely to be required at some stage.
	Emergency Plans and controls	AC2	Implement plans for assets/areas that are at risk of coastal erosion. Have procedures in place for before, during and after the events for safety. E.g. signage/barriers to prevent access.
	Re-design to withstand impact	AC3	Where avoiding or relocating is not an option, re-design to withstand impacts. E.g. raising houses and roads.
Protect	Dune Care Program	PR1	Development of a long term program for revegetation and rehabilitation of the dune system
	Sand Management	PR2	Involves the use of machinery to perform beach scraping or reshaping, which is the movement of sand along or up the beach face to optimise retention of material. Can also be in the form of sand bypassing or back passing, which involves moving sand along a beach where it has been restricted by a structure. Sand fencing to manage wind-blown erosion also falls under this category.
	Beach Nourishment	PR3	Replacement of sand on upper beach face and dunes to re-establish the sandy beach and provide additional buffer and sediment supply. Generally utilised in conjunction with other methods for sand retention (such as groynes).
	Groyne	PR4	Construct shore normal groynes along the beach to compartmentalise sediment and stabilise sections of shoreline.
	Nearshore reef/ breakwater	PR5	Construct artificial reef or raise existing natural nearshore reef structure to maintain level of protection as sea level rises.
	Seawall	PR6	Construct seawall in front of asset or along length of coastline to protect it from coastal hazards. This may need to be accompanied by beach replenishment/renourishment.
Do Nothing	Do Nothing	DN	No limitations on development or controls on adaptation planning. Accept risk.

6.2 Vegetation management

To ensure works are not undertaken outside of the approved development area, temporary fencing demarcating the boundary of the site will be installed prior to construction, however a survey of the development area will occur prior to erecting the temporary fencing. At the completion of works temporary fencing will be removed and conservation boundary fencing installed as described in **Appendix H**.

Vegetation within the site will be cleared in a systematic manner and suitable vegetative material will be stockpiled in an appropriate location for mulching and/or use as brushing, as described in **Section 6.8.** Similarly, topsoil from weed free areas will be identified and stockpiled in a suitable location for use in restoration areas (**Section 6.8**). Seeds and cuttings will be collected by a licensed collector from the site, prior to clearing, to be used for revegetation of the site.

6.2.1 Priority flora management

As identified by the flora surveys there are three priority species identified within and surrounding the site boundary. The City will initiate salvage of the priority species remaining within the site boundary using a professional revegetation nursery and these species will be installed into the revegetation area. Any relocation that may be investigated or undertaken for the priority species on site will be done so in accordance with the *Guidelines for the Translocation of Threatened Plants in Australia (L.E. Commander et al. 2018)* and in consultation with DBCA.

Prior to any works commencing, priority species that are to be retained will be identified and clearly demarcated. The preservation of these species will also be clearly communicated to all key personnel involved in the project. The condition of these species and the effectiveness of the demarcation will be checked regularly for impacts from the project. Demarcation of priority species will also be re assessed after construction and revegetation of battered surfaces to include any additional priority species transplanted.

6.2.2 Disease and weed management

The primary plant disease consideration relates to the management of *Phytophthora cinnamomi* (commonly known as dieback). Dieback is a soil borne fungal pathogen which spreads through surface and sub-surface water flows and soil movement and is a serious threat to the flora of the south west Western Australia. The movement of infested water and soil is a key mechanism in how this pathogen is spread.

Human activities have contributed significantly to the rapid and widespread distribution of the pathogen in southwest Western Australia (DPaW 2015). There is no practical large-scale cure for dieback and therefore prevention and containment are the primary options for management. While dieback is not expected to be a critical issue for vegetation within the site, good hygiene practices are nonetheless recommended.

Invasive non-native plants, or weeds, may degrade native vegetation through competition for space and resources. An increase in weed presence could therefore limit revegetation outcomes. Some weeds are already established within the site with 60 weed species listed in the One Tree Botanical

survey (One Tree Botanical 2019). The cover and/or diversity of weeds may be increased during construction through the effects of ground disturbance and by the introduction of new weeds on vehicles or equipment. Management will be required to limit the introduction of weeds and to control weeds within revegetated areas. The City will adhere to the conditions of the approved clearing permit concerning weed and disease management needs.

To ensure dieback and weeds are not spread within the site and to other areas the following management measures shall be undertaken during works relating to this FMP:

- Vehicles, tools, equipment and machinery shall be free of all soil, insect pests and weed seeds on arrival at the site.
- If vehicles, tools, equipment and machinery are temporarily removed from the site during works they must be free of all soil, insect pests and weed seeds on return.
- Where possible, all vehicles will travel on existing tracks.
- Topsoil from weed infested parts of the site will be removed or buried at depth and not re-used in restoration areas (as part of topsoil or mulch treatments).
- Topsoil from relatively weed free areas may be stockpiled for latter reuse in restoration areas as required.
- Vegetation material from relative weed free cleared areas could be stockpiled for later reuse in restoration areas.
- Imported fill or mulch material shall be certified free of dieback and environmental weeds.

The Two Rocks Beach Access Way Revegetation and Rehabilitation Plan (CoW 2022b) (**Appendix G**) highlights nine weed species rated high for management and 30 weed species rated moderate. **Table 10** outlines the nine species for priority management during and after construction and revegetation activities.

Table 10: High priority weeds for management for proposed development

Species	Common Name
Brassica tournefortii	Mediterranean Turnip
Bromus diandrus	Great Brome
Eragrostis curvula	African Love Grass
Euphorbia terracina	Geraldton Carnation Weed
Hyparrhenia hirta	Tambookie Grass
Lagurus ovatus	Hare's Tail Grass
Lupinus cosentinii	Blue Lupin
Pelargonium capitatum	Rose Pelargonium
Romulea rosea	Guildford Grass

6.3 Fauna management

The site supports native vegetation that is contiguous with vegetation to the north and south and provides an ecological linkage. The retention of native coastal vegetation within the site and the revegetation of construction battered areas will minimize impacts to this linkage in the long term. The small areas of landscaping and hard stand that are associated with the development will not obstruct movement of fauna species expected to use the foreshore reserve.

Fauna is to be proactively managed prior to the removal or disturbance of habitat as outlined in LPP3.3: Fauna Management which relates to macro fauna, specifically kangaroos and emus. During vegetation clearing kangaroos present on the site will be managed through traffic calming. There are also several conservation significant species that have potential to occur within the site including:

- Quenda
- Carnaby's Black Cockatoo
- Forest Red-tailed Black Cockatoo
- Fork-tailed Swift
- Osprey
- Peregrine Falcon
- Black-striped snake

According to the Two Rocks Beach Access Way Revegetation and Rehabilitation Plan (**Appendix G**) potential impacts of fauna will be managed by:

- Awareness sessions via an induction process communicating the importance of fauna species to all key personnel involved in the project
- Limiting speed limits with the site to minimise risk of fauna injury or mortality
- A fauna spotter with appropriate DBCA licenses will be present during any clearing within the site
- Awareness of fauna movement across the site by all site personnel and where required a qualified wildlife handler will be called to relocate the fauna
- Details of a wildlife carer for injured wildlife to be made visible to all site personnel and utilised where necessary.

6.3.1 Fencing

Temporary fencing will be installed on the Eastern and Western boundaries prior to clearing and earthworks. Temporary fencing will remain in place until the opening of the site but will be replaced by Conservation style fencing (TS 01-7-1) once earthworks are completed to restrict access into other areas of the foreshore. A fencing specification from the City of Wanneroo is provided in **Appendix H**.

Fencing will be offset from the edge of the road/path as well as any revegetation plantings. No pedestrian gates will be provided but 800mm wide gaps will be provided in the fence to allow the movement of macro fauna, especially kangaroos.

Signage will be installed on the fencing to state 'no access' and to notify pedestrians of the revegetation works being undertaken, where applicable.

6.3.2 Fauna translocation

A fauna taking (relocation) licence to take or disturb fauna for the purpose of relocating will be sought from the Department of Biodiversity, Conservation and Attractions (DBCA) prior to trapping and clearing and a suitable translocation release site will be identified in consultation with DBCA.

Fauna trapping within the site is to take place three nights prior to commencement of clearing, only within areas to be cleared. In addition, any fauna spotted during clearing will be relocated to the nearby conservation area utilising a DBCA license. This will include both small and large fauna.

6.3.3 Pre clearing inspection and fauna spotting

A pre-clearing site assessment will be undertaken by an experienced fauna specialist to identify potential for fauna interactions during clearing and recent evidence of native fauna activity. In particular, the site will be searched for signs of recent use by kangaroos, emus, and native ground-dwelling vertebrate fauna such as quenda and reptiles.

As far as practical, clearing will be completed in a single westwards direction without creating islands of vegetation to ensure that fauna do not become trapped during works.

An experienced fauna specialist with knowledge of the site will be present as a fauna spotter during clearing works. This role will involve active searching for fauna in areas to be cleared and during the clearing with the aim to identify the presence of common ground dwelling fauna species, such as small mammals, lizards, and snakes. If encountered, these animals will be assisted to disperse to nearby vegetation, if appropriate, or translocated.

Should injured fauna be encountered, the severity of injuries will be assessed. If the experienced fauna specialist considers that an injured native animal has a reasonable chance of being satisfactorily rehabilitated, it will be transferred to a registered DBCA wildlife carer. Where the experienced fauna specialist considers that any injured fauna is unlikely to be satisfactorily rehabilitated, they will be humanely euthanised.

6.3.4 Feral fauna

Cats and dogs captured during trapping will be taken to a local vet or ranger to be checked for a microchip. If no microchip is identified, then appropriate action is to be taken at the discretion of the Ranger, vet and/or supervising fauna specialist.

Any other feral animals trapped on site such as rabbits and foxes will be humanely euthanised.

6.3.5 Reporting

On completion of any required trapping, translocation, and/or fauna spotting tasks, a report summarising the number of fauna captured and/or relocated and a licence return will be prepared and submitted to DBCA and the City of Wanneroo.

6.4 Dust management

There is potential for the creation of dust due to clearing and construction activities and presence of exposed sandy soils present within the site. To assess the risk of dust generation related to the

construction of the proposal a site risk assessment/classification for activities generating uncontaminated dust has been completed (see **Appendix C**). This in a Class 3 with a score of 675. However, if construction is to occur between 1 October and 31 March the development will automatically be classified as Class 4 as per Sheet 3 of Appendix 1 of the guidelines (DEC 2011).

The dust management and monitoring requirements for class 3 include the provisions, contingency arrangements and the monitoring requirements summarised below which are derived from the guidelines and attached in full in **Appendix C**.

Provisions

- Wind fencing needs to be stored on site or available within an hour of being requested any the site engineer for the city.
- All disturbed land should be stabilised to keep areas exposed to a practical minimum
- Works with dust creating potential will be closely maintained by the engineer for the City
- The site should be assessed as stable before contractors vacate the site.

Contingency Arrangements

- Suitable water carts or other suitable alternatives shall be available to commence watering on site within 18 hours of being required to do so by the engineer for the City.
- Surface stabilisation equipment shall be available on site within 48 hours of being required by the engineer for the City with sufficient capacity to cover the disturbed site area within a further 48 hours.
- Wind fencing shall be erected within 18 hours of the contractor being required by the engineer for the City with dust generating works on the site ceasing in the interim.
- If dust related complaints are generated due to activities on site, the City may be required to distribute advisory notices to adjoining land occupiers within 48 hours. A notice form is provided at the end of **Appendix C**.
- If dust related complaints are generated due to material which has been excavated for trenching, the City shall ensure this material is stabilised within 48 hours of being requested to do so by the engineer for the City.
- Include an allowance for water-cart operation, wind fencing and surface stabilisation during and after the construction period for the purpose of dust and wind-borne material suppression

Monitoring requirements

- Site dust management system in place
- On-site dust monitoring against short term criteria
- Off-site (compliance) dust monitoring at site boundary
- Complaints management system in place with records kept and prompt responses
- Exceedances to be reported to the relevant authorities
- Notice to be erected at the site, with contact details of the person to be contacted regarding the works

The dust management and monitoring requirements of class 4 are also provided in **Appendix C.**

The City will apply hydro mulch to the entire site after vegetation clearing has occurred and as needed during earthworks to mitigate dust and erosion. and Dust Management is discussed further in terms of long-term landform stabilisation in **Section 6.8.1.**

6.5 Stormwater management

The inclusion of impervious surfaces in this development will increase surface runoff during rainfall events which will need to be appropriately managed. Implementation of water sensitive urban design (WSUD) principles in LPP4.4, via structural controls will be used to mimic existing environmental flows, minimising scouring and future erosion events.

Detailed engineering drawings have been progressed to incorporate the drainage infrastructure required as a part of the proposed development to manage stormwater. Throughout the development specifically within the road and car park, side entry pits (SEP) and soakwells have been included in the proposal to direct water flow from hard surfaces for the management of storm water (DWER 2022). SEPs will be connected to soakwells with some also having gabion mats installed to slow down and dissipate water flows. Revegetation (**Section 6.8.2**) will occur in the areas surrounding the gabion mats allowing for pollutants in the runoff to be managed. The details of the design and location of the structures implemented to manage waterflow across the site can be seen in **Appendix A.**

6.6 Bushfire hazard management

As indicated in Section 2.2.5, the site falls within a bushfire prone area and has previously experienced bushfire events. As the proposed development does not contain any habitable structures there are no further planning considerations required to address bushfire risk for the site.

To manage the risk of unintended ignition of bushfires, ignition sources are to be carefully managed on site at all times. This includes no burning of cleared vegetation, no smoking in the vicinity of vegetation or vegetation material and no driving on vegetation during total fire bans or machinery movement bans.

6.7 Heritage management

The results of the Two Rocks Heritage Survey indicated that the site is clear of archaeological heritage material. Notwithstanding this the recommendations made to the City included having the Whadjuk Traditional Owners present to monitor all ground disturbing works. During site inductions all staff and sub-contractors will also be made aware of this requirement.

If the City proposes to alter the type of works or to expand their program of works, either in size or scale, beyond what was subject to the heritage survey, it is advised that further consultation with the Whadjuk Traditional Owners should be undertaken prior to the commencement of works.

6.8 Restoration

Post construction the City will undertake restoration activities to stabilise the land form and revegetate the cleared areas with local providence species. The City has progressed a Revegetation and Rehabilitation plan (**Appendix G**), to support clearing permit CPS9578/2 which has informed the following sections.

6.8.1 Landform stabilisation

Dust and sand drift from the site must be controlled in accordance with the DWER guidelines and the City of Wanneroo *Local Planning Policy 4.18: Earthworks and Sand Drift.* Measures are required after earthworks to both stabilise the site and reduce the potential for dust and erosion. Revegetation (as outlined in **Section 6.8.2**) is an effective measure to stabilise sand dunes and reduce dust in the longer term. However, as the coastal sand dune landform present within the site is dynamic, the *in situ* sands will require stabilisation in order to provide a suitable planting medium and secure landforms until plants have matured.

A range of options for stabilisation are specified below that can be applied as required across the restoration area.

6.8.1.1 Brushing

Brushing is an effective and natural method for stabilising slopes and enhancing the outcomes of coastal erosion. Brushing can be sourced from vegetation cleared within the site. Brushing may be laid by hand in a roughly interwoven or interlocked pattern across restoration areas or spread by machine (i.e. coarse mulch). Brushing should be spread over selected areas of the restoration site, with a particular focus on moderate to steep slopes exposed to prevailing winds.

Brushing will also be installed within portions of the restoration areas that previously functioned as tracks. In these areas the brushing will be established for approximately 10-15 m from the proposed development edge, to reduce erosion and encourage rehabilitation of these areas.

6.8.1.2 Mulch and topsoil

Mulch in foreshore areas is generally not accepted as it prevents natural regeneration if it is too applied too thick. Applying mulch with machinery can also lead to compaction of the topsoil. As such, mulch will not be used extensively throughout the site.

Mulch and topsoil will only be harvested from the permanently cleared areas or areas requiring shaping. Due to the requirement to mulch the vegetation layer prior to the UXO survey, the relatively low volume of vegetation cover and the time between mulching and harvesting, the topsoil and mulch will be harvested at the same time.

6.8.1.3 Coir mesh matting

Coir mesh matting is also effective in stabilising slopes and may be required for steep slopes or if sufficient brushing material cannot be sourced. Coir mesh matting (900GSM) should be installed according to manufacturer's specification. An example of coir matting used in coastal dunes is provided below in **Plate 1**.

Plate 1: Example of Coir matting used in coastal dunes with tubestock installed.

6.8.1.4 Sand trap fencing

Sand trap fencing may also be applied as an effective method of landform stabilisation. Sand trap fencing involves erecting post and wire fencing with shade cloth or similar material that collects wind-borne sand to reduce sand movement, break up slopes and create incipient dunes over time. During construction sand trap fencing should be installed at locations susceptible to erosion to stabilise slopes prior to installation of brushing and/or mulch.

Plate 2: Example of Sand trap fencing used in a coastal dune environment

6.8.2 Revegetation

The proposed development activities involve the clearing of native vegetation to facilitate construction. Areas that do not define part of the final development, such as earth-worked areas and batters will be identified and assessed as suitable for revegetation. Revegetation will be undertaken in suitable areas from seeds and cuttings collected within the site, wherever possible. The Revegetation and Rehabilitation plan's (**Appendix G**) overall objectives include:

- Revegetate disturbed areas with local provenance species
- Protect the environmental values surrounding the alignment of the Two Rocks foreshore area
- Manage high priority weed infestations within the revegetation area.

6.8.2.1 Site preparation

It is expected that the landform within the site will be reshaped and battered on completion of civil construction works. Surface preparations within the restoration area may include brushing, mulch and topsoil or mesh matting as outlined in **Section 6.8.1**. Otherwise, the sandy soils within the site will provide a suitable medium for planting native species.

Weed control will be required to remove weeds that may have germinated within the site once stabilisation measures have been applied. This will include both mechanical and chemical weed control as per the Revegetation and Rehabilitation Plan (**Appendix G**)

6.8.2.2 Seed collection, plant salvaging and propagation

Local Provenance species will be sourced from within the project site as well as other suitable reserves to supply the required seed quantities to meet the evaluation criteria. The species to be collected and propagated are listed in the Revegetation and Rehabilitation Plan (**Appendix G**) and have been developed in reference to previous site biological surveys. The salvaging of plants that are unable to be commercially propagated is also proposed. The seed collection, propagation and salvaging of plant species will be undertaken by a certified contractor.

6.8.2.3 Plant establishment

Successful revegetation outcomes should be achieved if stabilisation is completed successfully (as previously outlined in **Section 6.8.1**) and tubestock are planted in autumn or winter at a sufficient depth and density. Planting seedlings as tubestock is the simplest and most effective method for revegetating the areas.

The area requiring revegetation extends over approximately 0.90 ha. To ensure the revegetated area appropriately reflects the structure of pre-existing vegetation, four areas are defined, which align with previously recorded plant communities (refer **Section 4.4**). The tubestock recommended within each revegetation area consist of species characteristic of the site's relevant plant community (refer to **Table 12** for planting list).

6.8.2.4 Timing

Tubestock shall be planted once the winter rains have started, and the ground is sufficiently moist. Planting will be initiated as soon as possible to allow plants the maximum time for establishment

before the summer dry period (WAPC 2003). Planting outside of this period is not recommended as survival rates will likely be reduced. Seed collection and propagation will commence with sufficient time for growth before the desired autumn winter plantings.

6.8.2.5 Planting list and densities

The specific densities of plantings are to be confirmed upon the approval of the clearing permit. This will be reflected in the finalisation of the revegetation and rehabilitation plans after the approval is received. Species that could be used for the revegetation of the site are informed by the vegetation and species presence within the site as outlined in **Section 4.4**. **Table 11** lists the revegetation area ID's and the corresponding vegetation types as shown in **Figure** with the area to be revegetated within each area. From this a list of species to be used for revegetation and the areas of revegetation that each species can be planted in has been provided in **Table 12**.

The density for revegetation planting is to be 2 plants per m^2 unless otherwise conditioned in the clearing permit approval. After five years from initial plantings 90% of the planting density (1.8 plants per m^2) is to be established within each restoration area, as directed by the City.

Table 11: Vegetation types and vegetation structure associated with each revegetation area

revegetation area ID	Vegetation type (One Tree Botanical 2019)	Vegetation structure	Revegetation Area (ha)
1	D1 Low rises with limestone outcropping^	Closed shrubland/sparse vineland/forbland	0.33
2	C1 Low dunes on semi-consolidated sand^	Shrubland/forbland/sparse sedgeland/sparse rushland	0.11
3	B1 Tall secondary dunes on unconsolidated sand	Shrubland/sparse vineland/forbland	0.30
4	A3 Beach-ridge plain^	Open shrubland/sparse grassland/sparse vineland	0.14

^These revegetation areas include small portions that were previously mapped as 'cleared'.

Table 12: Potential species to be used in revegetation and the applicable revegetation areas

Species	Applicable Revegetation area	Species	Applicable Revegetation area
Acacia cyclops	1, 2, 3	*Leucopogon parviflorus*	3, 4
Acacia lasiocarpa	3	*Lomandra maritima*	3
Acacia xanthina	4	*Melaleuca cardiophylla*	4
Acanthocarpus preissii	1, 2, 3	*Melaleuca huegelii*	4
Carpobrotus virescens	1, 2	*Melaleuca systena*	3
Conostylis candicans	2, 3	*Myoporum insulare*	1, 2
Dianella revoluta	4	*Olearia axillaris*	1, 2, 3
Dodonaea aptera	4	*Poa porphyroclados*	2, 3, 4
Gastrolobium nervosum	3	*Santalum acuminatum*	2, 3

Species	Applicable Revegetation area	Species	Applicable Revegetation area
Gompholobium tomentosum	3	*Scaevola crassifolia*	2
Hardenbergia comptoniana	2	*Spinifex longifolius*	1,2
Lepidosperma calcicola	3	*Spyridium globulosum*	1, 2, 3, 4
Lepidosperma gladiatum	2	*Templetonia retusa*	3, 4

6.8.2.6 Pest animal control

The control of feral animals is required to ensure the successful establishment of revegetation areas especially to limit the effects of herbivory by rabbits. Control of pest animals (feral fauna) will be undertaken the summer prior to the installation of tubestock and annually thereafter. This will include the trapping of feral animals, mainly rabbits, and the release of RHDV both within the site and surrounding area. After the initial plantings of revegetation areas rabbit proof fencing (as specified on page 28 of Appendix A) will be installed to further limit the effects of herbivory on the tubestock. This is to be implemented in accordance with the revegetation and restoration plan for the site. Specifications and implementation of the control program shall be discussed and agreed with the City of Wanneroo.

6.8.2.7 Installing tubestock

Tubestock will be installed as soon as possible after delivery to the site and will be installed using a deep planting method for appropriate species. This positions the roots closer to water supplies and decreases water loss in hot and dry conditions. Brushing which may be installed (refer **Section 6.8.1**) will provide further physical and herbivory protection for the growing seedlings.

The use of slow release fertiliser, wetting agents and other soil ameliorants may be added to the planting hole at the discretion of the City of Wanneroo or the revegetation contractor. Species will be planted in a mixed planting pattern so that diversity is maintained across the revegetation area and tubestock will be watered in at the end of each planting day with a minimum of two litres of water.

Note tree bags / guards are not recommended as these increase installation time and require removal once plants are established. Predation by fauna will be monitored and supplementary watering should also not be required if planting is timed during the optimal early winter period.

6.8.2.8 Weed control

Weed control may be required prior to planting to prepare the revegetation areas and reduce competition with establishing native plants. The number of weed control events required before planting will depend on the type and density of weeds present. An experienced licenced pesticide management technician/revegetation contractor will be able to advise on the level of weed control required prior to planting. The timing and mechanisms to be used to undertake weed management will align with the specifications of the City's *Revegetation and Rehabilitation Plan* (CoW 2022c). The City will adhere to the conditions of the approved clearing permit concerning weed and disease management needs.

6.8.2.9 Supplementary watering

Supplementary watering of the revegetation areas will be required to assist in the establishment of the tubestock especially during the warmer months. As stated in the Revegetation and Rehabilitation Plan (**Appendix G**), supplementary watering will occur in January with additional watering occurring between October and March if determined to be required. This will continue for four years after the initial planting of tubestock.

Due to access issues, it is not practical to water the offset site plantings. To compensate for this the plant quantity has been increased to ensure sufficient planting densities are achieved without the use of supplementary watering.

7 Implementation

This FMP has been prepared to facilitate the works associated with the Two Rocks Beach Access development while protecting the surrounding environmental values. A summary of the implementation details for each management outline in **Section 6** has been provided below in **Table 13.**

Monitoring and evaluation are required to ensure the management actions meet the desired objectives to ensure the success of this FMP as well as the Restoration and Revegetation Plan. The monitoring requirements of each management action as well as relevant objectives and evaluation criteria have been included in **Table 13.** The management actions outlined below are also cross referenced in **Table 8** to the relevant risks being managed.

Table 13: Summary of Management action implementation details

No.	Potential Impact	Management Measure	Objective	Monitoring Requirements	Evaluation Criteria	Responsibility	Timing
General Site Management							
Ma1.	Unintentional impacts to surrounding environment	Induct all staff and on-site personnel regarding required actions within this plan.	Inform all staff of their responsibility to follow this plan	Records kept of inductions	Inductions are conducted	All personnel	Prior to and ongoing during works.
Coastal Processes Management							
Ma2.	Coastal Erosion	Assets are left unprotected and loss is accepted following hazard event. Repairs may be implemented for public safety, and asset is retreated outside hazard zone, or in the case of beaches/vegetation, as natural recession occurs. (MR1 in CHRMAP)	Manage the impacts of coastal processes on infrastructure beyond that considered to be an acceptable loss	Monitoring is to occur after major storm events to identify sand drift onto infrastructure or the erosion of infrastructure	No losses of infrastructure beyond acceptable losses	City of Wanneroo	Ongoing
Ma3.	Coastal Erosion	Assets located in the hazard zone are relocated or destroyed. Applied to assets of low value where it is impractical to re-design to withstand hazard impacts. (MR2 in CHRMAP)	Locate assets in areas of least risk	Monitoring is to occur after major storm events to identify sand drift onto infrastructure or the erosion of infrastructure	Assets are monitored and management actions are implemented if required	City of Wanneroo	Ongoing
Ma4.	Coastal Erosion	Implement plans for assets/areas that are at risk of coastal erosion. Have procedures in place for before, during and after the events for safety. E.g. signage/barriers to prevent access. (AC1 in CHRMAP)	Ensure the safety of the public during coastal erosion events	Monitoring is to occur after major storm events to identify sand drift onto infrastructure or the erosion of infrastructure	Assets are monitored and management actions are implemented if required	City of Wanneroo	Ongoing
Vegetation Management							
Ma5.	Vegetation Clearing	Install temporary fencing to demarcate the boundary of the clearing area within which all construction activities are to be contained. Ensure that the clearing areas are also identified on all clearing plans. Install signage to indicate works and importance of clearing boundary.	Contain all clearing and disturbance of vegetation to the approved clearing boundaries	Inspect fencing and signage to prevent disturbance of vegetation and limit unauthorised access	Vegetation disturbance contained to within the site.	Civil engineer	Prior to and ongoing during works.
Ma6.	Clearing of Priority flora to be retained	To avoid unintended removal or damage to priority flora to be retained these plants will be located and clearly demarcated with star pickets and bunting prior to the commencement of clearing works.	Protect the health of priority species indicated to be retained	Inspect the health of priority flora indicated to be retained	All priority flora indicated to be retained are persisting	Civil engineer	Quarterly until 2 years post practical completion
Ma7.	Introduction and spread of weeds/disease	Ensure all vehicles, tools, equipment, machinery and staff and all on-site personnel are free of mud, soil, and plant material before entering the site, as well as before entering uncleared vegetation.	Ensure that declared weeds or disease do not enter or spread through the site.	Inspect surrounding vegetation for the presence or spread of weeds and disease	No spread of weeds or disease is evident as a result of the construction activities	Civil engineer	Prior to and ongoing during works.
Ma8.	Introduction and spread of weeds/disease	Where topsoil from areas of native vegetation is in very good and excellent condition is to be retained for later landscaping use (if required). The stockpiling of topsoil will only occur in the area indicated as the stockpiling area.	Ensure that declared weeds or disease do not enter or spread through the site.	Inspect surrounding vegetation for the presence or spread of weeds and disease	No spread of weeds or disease is evident as a result of the construction activities	Civil engineer	Prior to works.
Ma9.	Introduction and spread of weeds/disease	Ensure any soil brought into the Site for landscape construction is free from pathogens and heavy metals and produced in accordance with *Australian Standard AS 4454-2003 Composts, Soil Conditioners and Mulches*.	Ensure that declared weeds or disease do not enter or spread through the site.	Inspect surrounding vegetation for the presence or spread of weeds and disease	No spread of weeds or disease is evident as a result of the construction activities	Civil engineer and landscape contractor	Prior to and ongoing during works.
Ma10.	Introduction and spread of weeds/disease	Undertake landscape construction and revegetation in accordance with best practice dieback management procedures	Ensure that declared weeds or disease do not enter or spread through the site.	Inspect surrounding vegetation for the presence or spread of weeds and disease	No spread of weeds or disease is evident as a result of the construction activities	Landscape Contractor	During landscape works and ongoing.
Ma11.	Introduction and spread of weeds/disease	Control access to areas of significant weed infestation. Undertake weed management in areas of retained vegetation and native species planting areas	Ensure that weed cover does not exceed 10% when measured in any 10 x 10 m portion of the restoration area after five years.	Inspect surrounding vegetation for the presence or spread of weeds and disease	No spread of weeds or disease is evident as a result of the construction activities	Landscape Contractor	During landscape works and ongoing.
Fauna Management							
Ma12.	Direct injury or stress to fauna individuals	Undertake a pre-clearing fauna inspection to identify fauna habitat and the potential for fauna interactions during clearing and recent evidence of native fauna activity. Trapping will occur 3 days prior to clearing and signage will be erected to indicate this process.	Limit injury or stress caused to native fauna	Fauna handling reports post fauna trapping events	Injuries and stress to native fauna is minimised	Fauna specialist	Prior to and ongoing during works.

Table 13: Summary of Management action implementation details (continued)

No.	Potential Impact	Management Measure	Objective	Monitoring Requirements	Evaluation Criteria	Responsibility	Timing
Ma13.	Direct injury or stress to fauna individuals	Ensure a fauna spotter is present during clearing of vegetation that provides fauna habitat.	Limit injury or stress caused to native fauna	Fauna handling reports post fauna spotting events	Injuries and stress to native fauna is minimised	Fauna specialist/ Civil engineer	During all clearing works
Ma14.	Unintended fauna stress or injury	Install fauna proof fencing to allow movement of macro fauna into areas of remaining vegetation. Following clearing of vegetation, fences will be modified to enclose all works areas to prevent re-introduction of fauna.	Limit injury or stress caused to native fauna	Daily checks of installed fencing during construction and less frequent post construction	Injuries and stress to native fauna is minimised	Fauna specialist/Civil engineer	Prior to and ongoing during works.
Ma15.	Unintended fauna stress or injury	If injured fauna is encountered, engage an appropriate fauna specialist, or call DBCA WildCare Helpline (08 9474 9055).	Limit injury or stress caused to native fauna	Keep record of encounters with injured fauna	Injuries and stress to native fauna is minimised	Fauna specialist/Civil engineer	Ongoing during works.
Ma16.	Unintended fauna stress or injury	Ensure clearing is staged in a westerly direction to ensure no islands of vegetation are created. Ensure clearing occurs in a single direction as much as possible.	Limit injury or stress caused to native fauna	Report supplied by fauna specialist	Injuries and stress to native fauna is minimised	Fauna specialist	During clearing works
Ma17.	Disturbance of fauna habitat	Ensure construction vehicles remain on designated tracks and within existing cleared areas.	Limit disturbance to surrounding fauna and habits	Ensure boundary demarcation is clearly maintained and effective	Disturbance is contained to the clearing boundary	All personnel	Ongoing during works.
Ma18.	Disturbance of pest fauna	Undertake feral rabbit controls including trapping and RHDV deployment in the surrounding areas. Post initial planting rabbit proof fencing is to be installed around areas of revegetation, which is to be maintained for integrity	Limit the presence of rabbits on site and the effects of their herbivory.	Monitor the presence of rabbits through herbivory in revegetation areas	Rehabilitation areas meet evaluation criteria relevant to establishment	City of Wanneroo	Annually from the summer prior to revegetation planting.
Ma19.	Disturbance of pest fauna	Any cats and dogs captured during trapping will be taken to a local vet or ranger to be checked for a microchip. If no microchip is identified, then appropriate action to be taken at the discretion of the Ranger, vet and/or supervising zoologist. If other feral animals are captured, they should be humanely euthanised	Manage non-native fauna captured trapping appropriately	Fauna handling reports post fauna trapping events	pets managed in conjunction with vets, rangers or zoologists with other feral fauna euthanised	Fauna specialist	Ongoing during works.
Ma20.	Introduction of pest fauna	Ensure that the work area is maintained in a clean and tidy manner to ensure that feral and other fauna species are not attracted to site. Post construction at least one bin will be provided on site to limit the accumulation of litter.	Limit the introduction of pest fauna	Site walkovers to determine cleanliness and action required	No additional pest species found on site	All personnel	Prior to and ongoing during works.
Dust Management							
Ma21.	Disturbance of vegetation and/or surrounding residents due to dust creation	Prior to and during clearing and construction the application of hydro mulch, watering down, covering loads and the installation of fencing with dust curtains along the clearing boundary will be implemented to manage dust. The fencing with dust curtains should only be removed when permanent fencing is to be installed. Post clearing the application of brushing, coir matting and sand trap fencing to the revegetation areas as required will minimise dust disturbance to retained native vegetation and revegetation. Mulch could also be considered if further options are required to stabilise the landforms.	Minimise dust nuisances at all times and ensure constructed landforms are stable and do not erode.	Inspect surrounding vegetation for the presence of accumulated dust on leaves, and to ensure landforms have been effectively stabilized to minimize dust emissions. Monitor complaints received from surrounding community members.	Minimal disturbance caused to surrounding vegetation and residence with landforms effectively stabilised and minimal complaints received in relation to dust emissions	Civil engineer and contractor	Prior to works and ongoing
Stormwater Management							
Ma22.	Increased erosion from impervious surface runoff	The installation of side entry pits, and soakwells with some connected to gabion mattings as per detailed engineering drawings to slow down and dissipate the waterflows generated on site. Revegetation occurring surrounding gabion mats will strip nutrients from runoff	Use structural controls to mimic existing environmental flows to minimise scouring and erosion	After major rainfall events assess the site and surrounding area for evidence of erosion from stormwater	Stormwater is managed onsite mimicking existing environmental flows	Civil engineer and contractor	Prior to works and ongoing
Bushfire Management							
Ma23.	Unintended ignition of bushfire	To avoid unintended ignition of bushfires, ignition sources are to be carefully managed around vegetation this includes no burning of cleared vegetation, no smoking in the vicinity of vegetation and no driving on vegetation during total fire bans or machinery movement bans.	Reduce the risk of bushfire ignition events on site	Reporting of any incidences or near misses related to ignitions on site	No bushfires ignited from within the site as a result of construction activities	All personnel	During construction
Heritage Management							
Ma24.	Disturbance of heritage values	Whadjuk Traditional Owners are to be present on site during all ground disturbing activities to monitor the disturbance of heritage values.	Limit disturbance to heritage values	Whadjuk Traditional Owners present during ground disturbing works	Heritage value disturbance avoided where possible	Heritage consultants - Whadjuk Traditional Owners	During Construction

Table 13: Summary of Management action implementation details (continued)

No.	Potential Impact	Management Measure	Objective	Monitoring Requirements	Evaluation Criteria	Responsibility	Timing
Restoration Management							
Ma25.	Loss of local biodiversity	Ensure collection of and storage of seed using a qualified contractor from areas of native vegetation proposed to be cleared. Re-establish native plantings during landscaping, including the use of stripped topsoil.	Stabilise cleared areas with diverse native species plantings at a density of 2 plants per m^2	Yearly monitoring with infill planting undertaken if density is determined to be less than objective.	90% of density target (1.8 plants /m2) is established	Rehabilitation consultant and landscape contractor	For five years post initial planting
Ma26.	Loss of local biodiversity	Undertake supplementary watering each January with additional watering occurring between October and March if determined to be required.	Ensure the establishment of native species 5 years after initial planting	Yearly monitoring with infill planting undertaken if density is determined to be less than objective.	90% of density target (1.8 plants /m2) is established	Rehabilitation consultant and landscape contractor	For five years post initial planting

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8.2 Online references

The online resources that have been utilised in the preparation of this report are referenced in **Section 8.1** with access date information provided in **Table R 1** below.

Table R 1 Access dates for online references

Reference	Date accessed	Website or dataset name
(BoM 2024)	18 April 2024	Climate Data Online
(DFES 2022)	19 April 2024	UXO Potential
(DPLH 2023)	19 April 2024	Aboriginal Heritage Inquiry System
(OBRM 2021)	17 April 2024	Map of Bush Fire Prone Areas

Figures

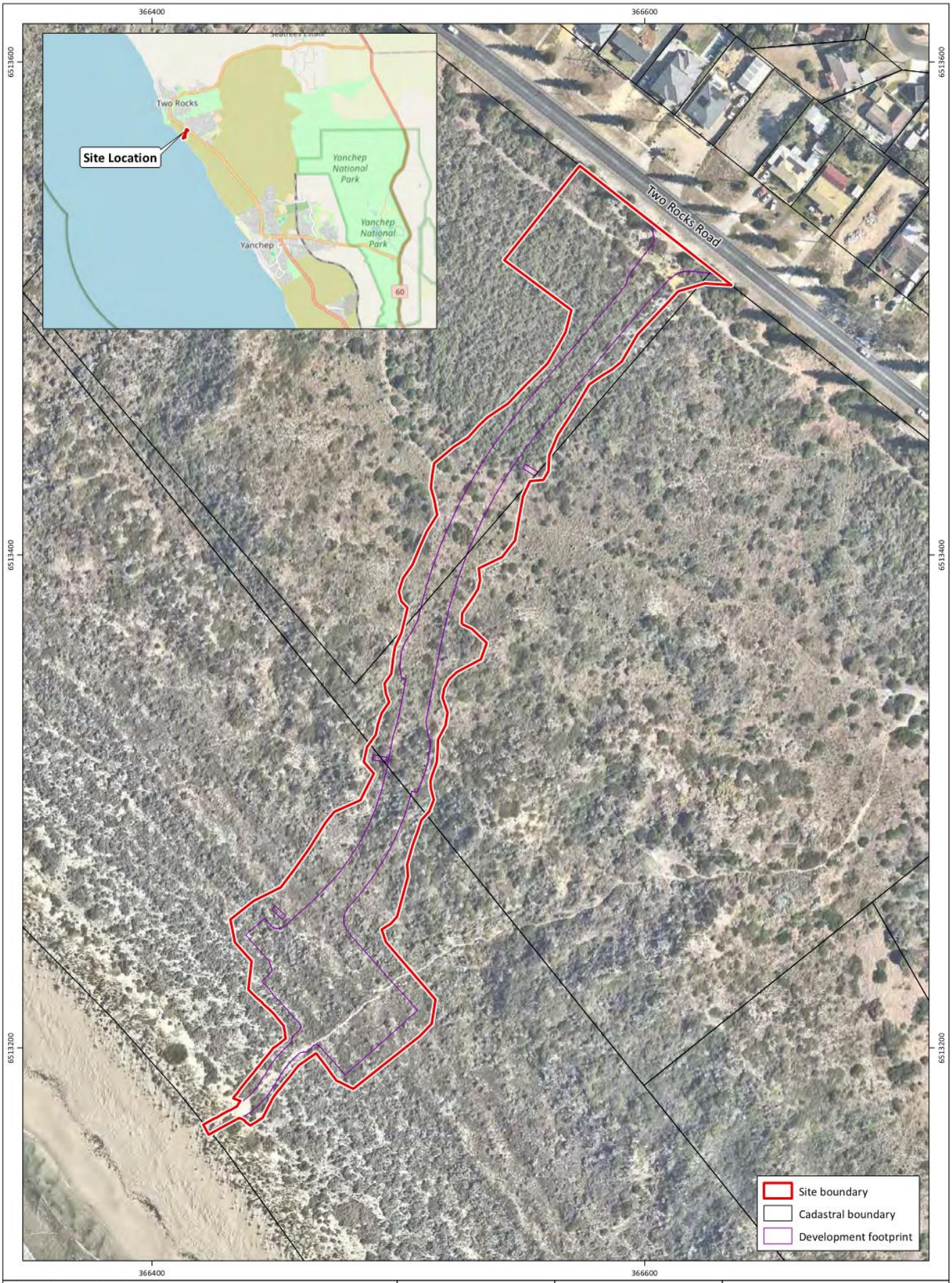

Figure 1: Site Location

Project: Two Rocks Foreshore Management Plan

Client: City of Wanneroo

Plan Number: EP19-132(03)--F06b

Drawn:	WJC
Date:	14/03/2025
Checked:	CSR
Approved:	TB
Date:	17/03/2025

N

0 20 40

Metres

Scale: 1:2,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

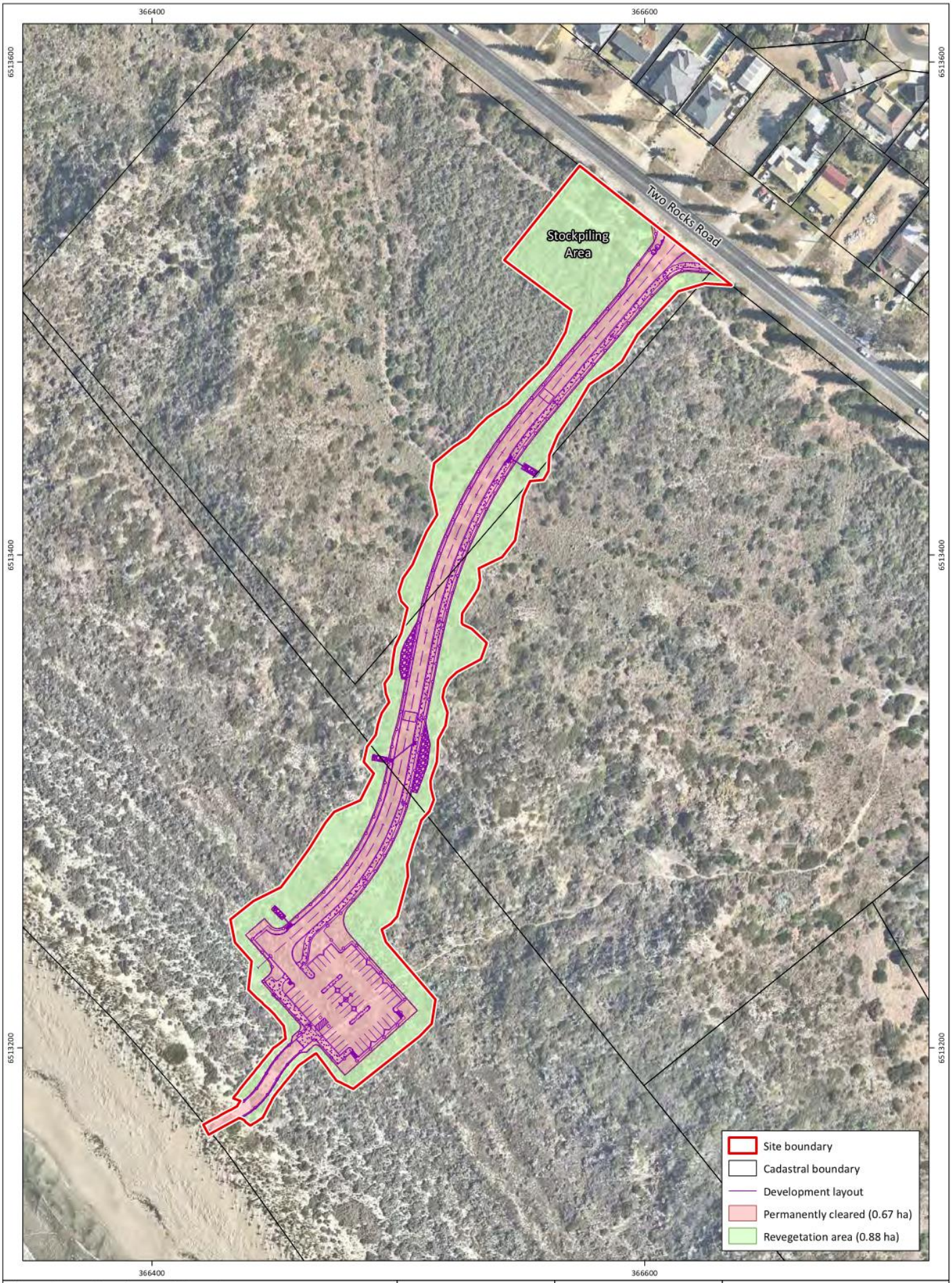

Figure 2: Development Layout

Project: Two Rocks Foreshore Management Plan

Client: City of Wanneroo

Plan Number:
EP19-132(03)--F07a

Drawn:	WJC
Date:	19/02/2025
Checked:	CSR
Approved:	TB
Date:	21/02/2025

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Scale: 1:2,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

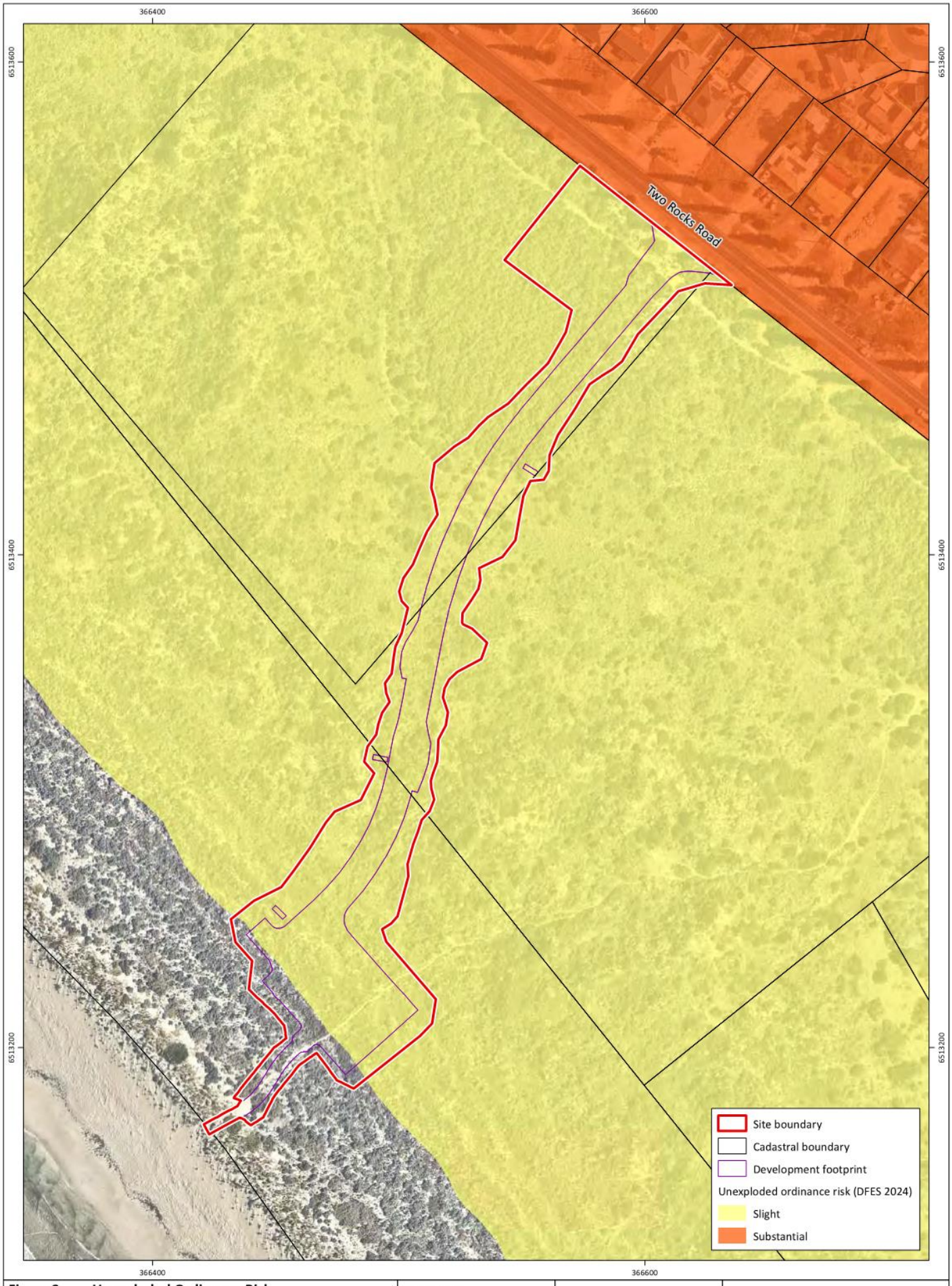

Figure 3: **Unexploded Ordinance Risk**

Project: Two Rocks Foreshore Management Plan

Client: City of Wanneroo

Plan Number: **EP19-132(03)--F09b**

Drawn:	WJC
Date:	14/03/2025
Checked:	CSR
Approved:	TB
Date:	17/03/2025

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Metres

Scale: 1:2,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

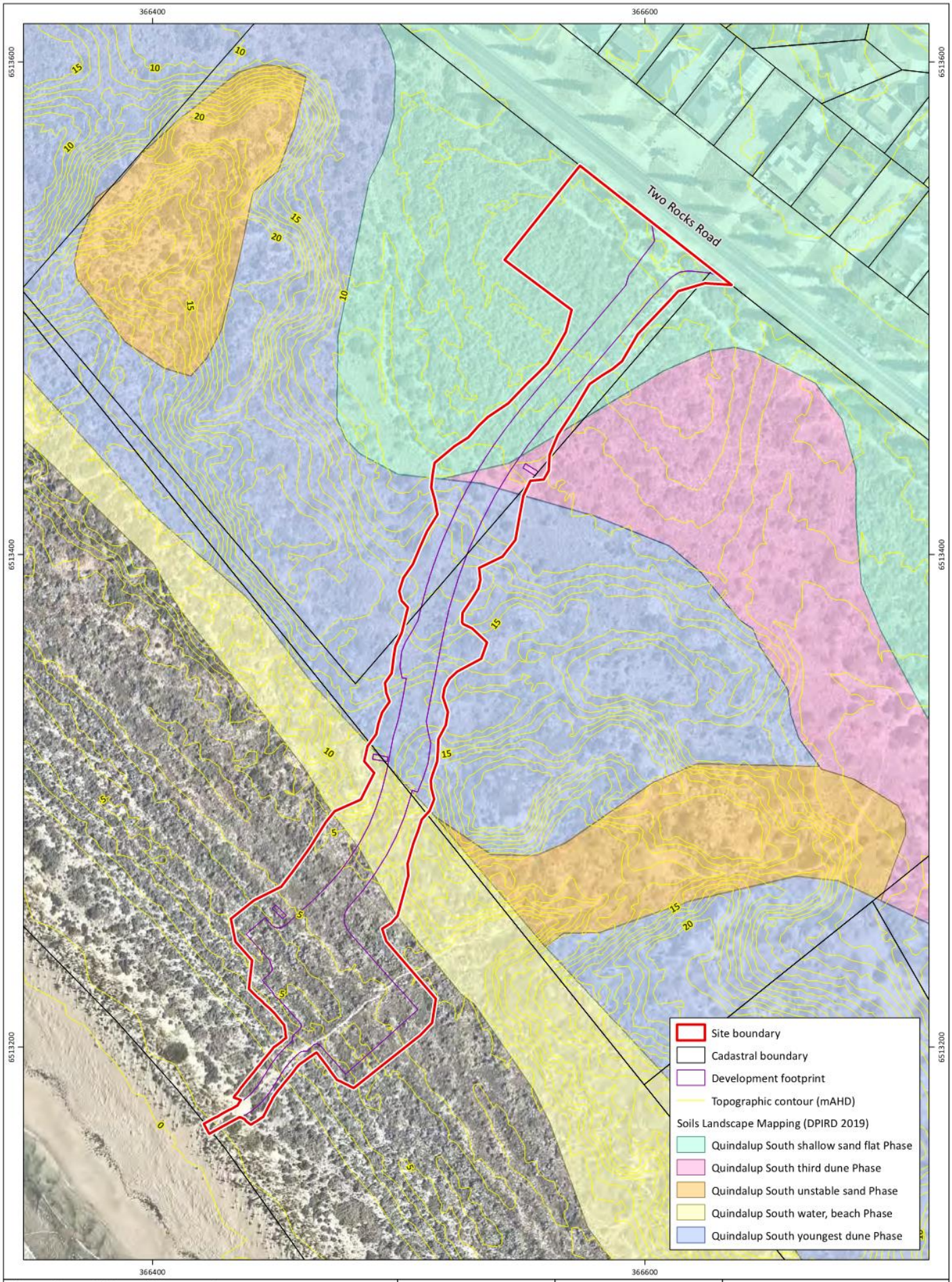

Figure 4: Soils and Topography

Project: Two Rocks Foreshore Management Plan

Client: City of Wanneroo

Plan Number: EP19-132(03)--F08b

Drawn:	WJC
Date:	14/03/2025
Checked:	CSR
Approved:	TB
Date:	17/03/2025

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Metres

Scale: 1:2,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

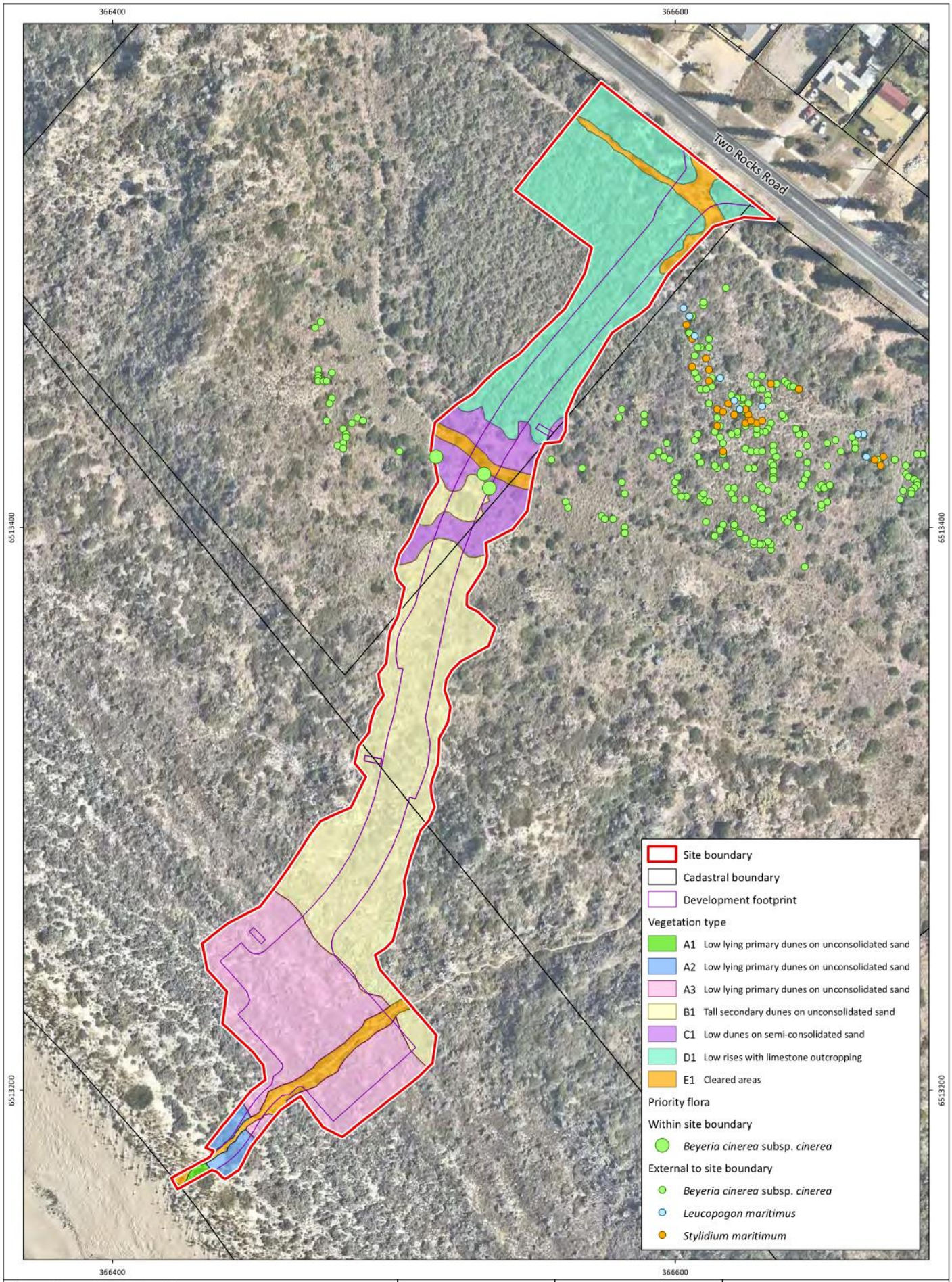

Figure 5: **Vegetation Types**

Project: Two Rocks Foreshore Management Plan

Client: City of Wanneroo

Plan Number: **EP19-132(03)--F12a**
Drawn: WJC
Date: 14/03/2025
Checked: CSR
Approved: TB
Date: 17/03/2025

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Metres

Scale: 1:1,750@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

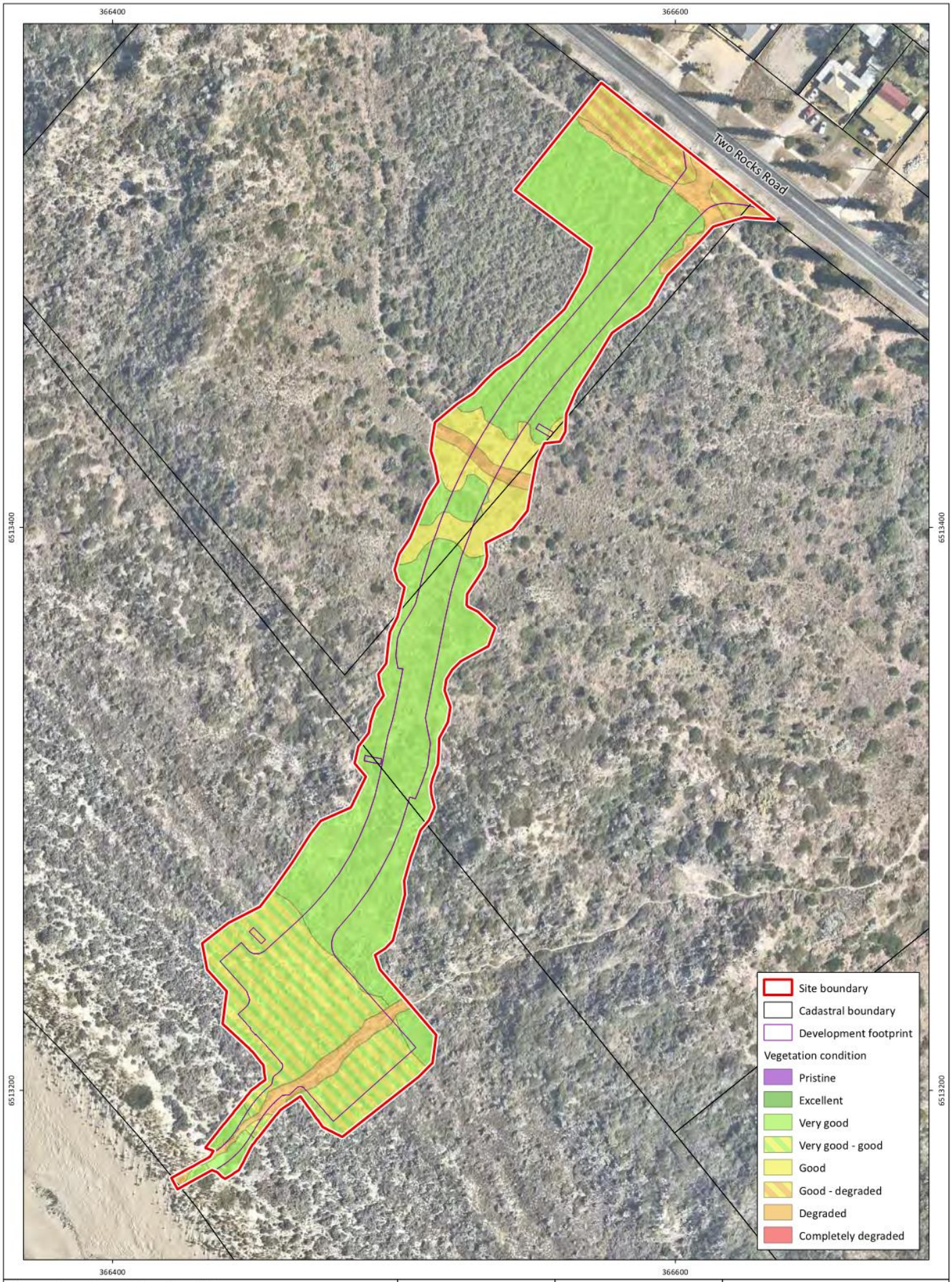

Figure 6: **Vegetation Condition**

Project:	Two Rocks Foreshore Management Plan
Client:	City of Wanneroo

Plan Number:
EP19-132(03)--F13a

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Checked:	CSR
Approved:	TB
Date:	17/03/2025

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Metres

Scale: 1:1,750@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

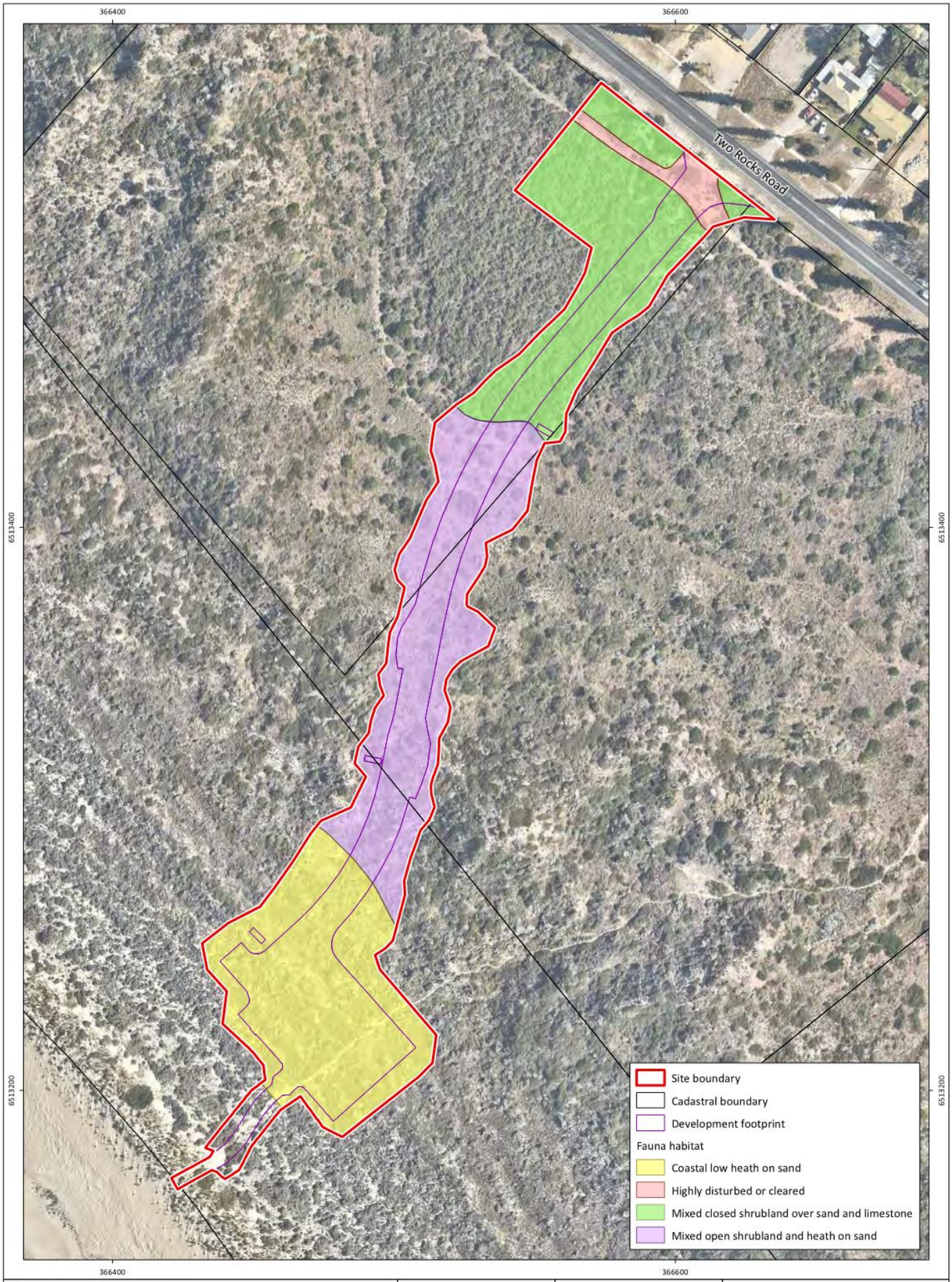

Figure 7: Fauna Habitat

Project:	Two Rocks Foreshore Management Plan
Client:	City of Wanneroo

Plan Number:
EP19-132(03)--F14a

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Date:	14/03/2025
Checked:	CSR
Approved:	TB
Date:	17/03/2025

N

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Metres

Scale: 1:1,750@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

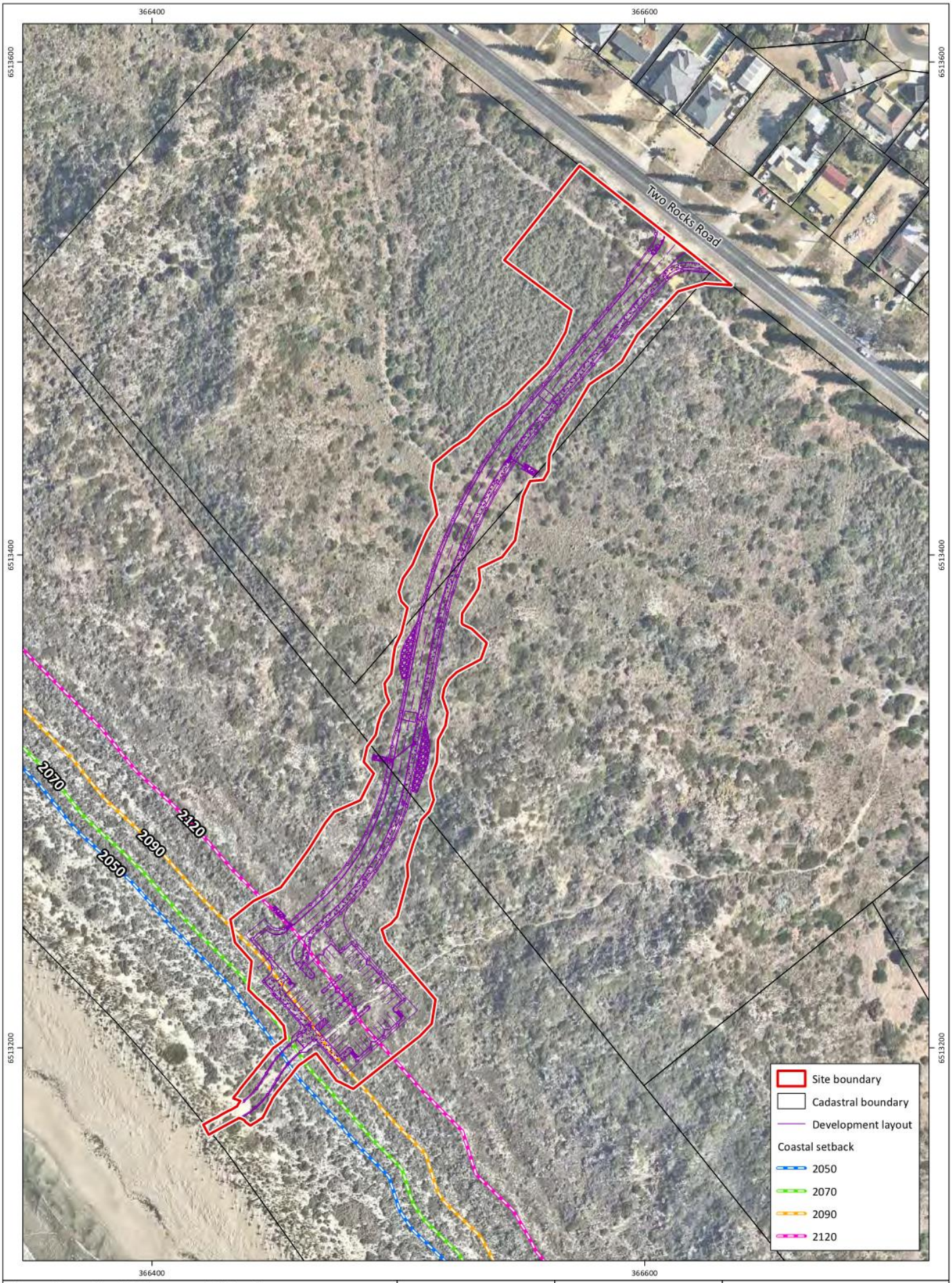


Figure 8: **Coastal Zones and Setbacks**

Project:	Two Rocks Foreshore Management Plan
Client:	City of Wanneroo

Plan Number:
EP19-132(03)--F10b

Drawn:	WJC
Date:	14/03/2025
Checked:	CSR
Approved:	TB
Date:	17/03/2025

N

0 20 40
Metres

Scale: 1:2,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

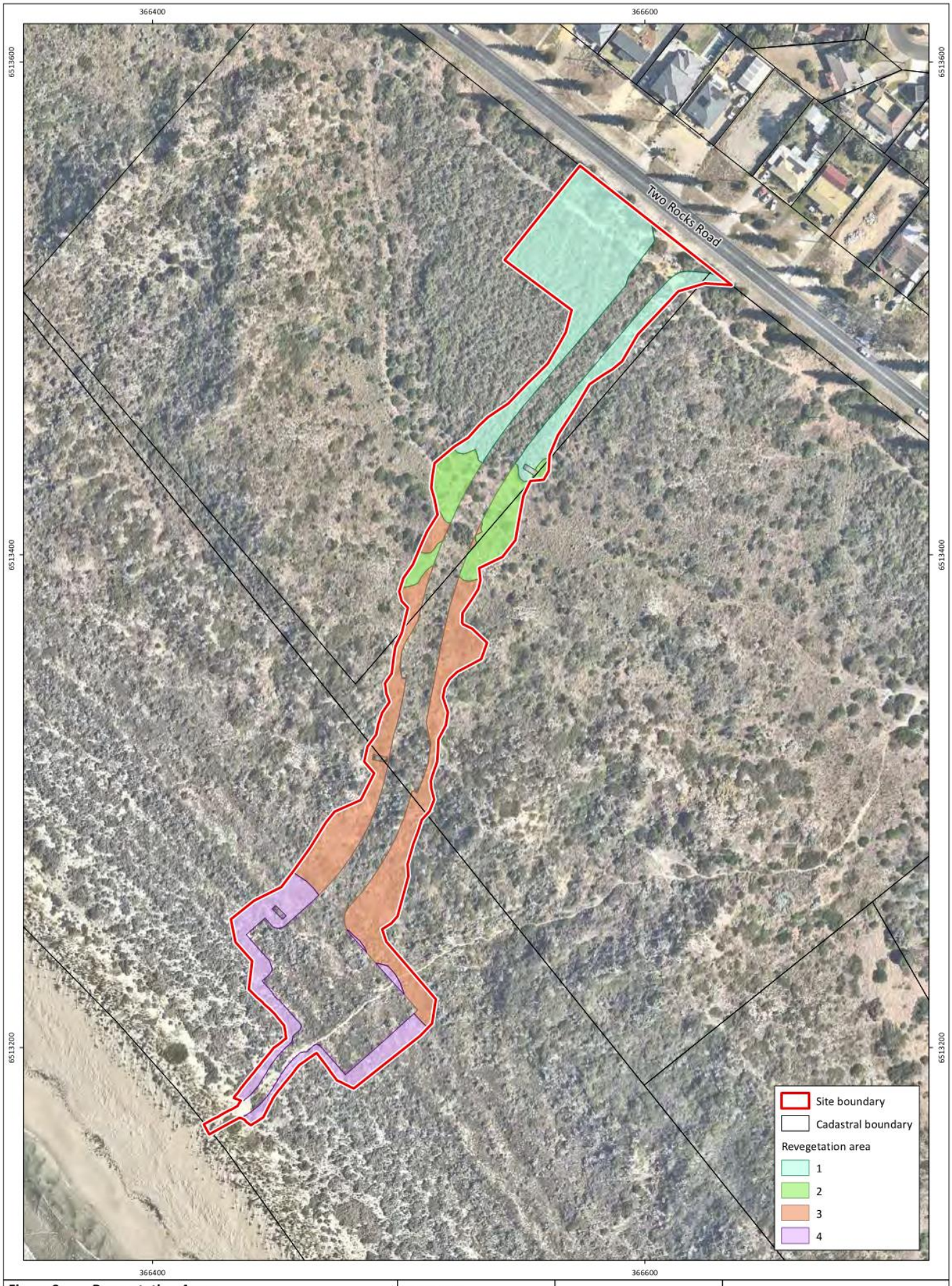


Figure 9: Revegetation Areas

Project:	Two Rocks Foreshore Management Plan
Client:	City of Wanneroo

Plan Number:
EP19-132(03)--F11a

Drawn:	WJC
Date:	19/02/2025
Checked:	CSR
Approved:	TB
Date:	21/02/2025

N

0 20 40
Metres

Scale: 1:2,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

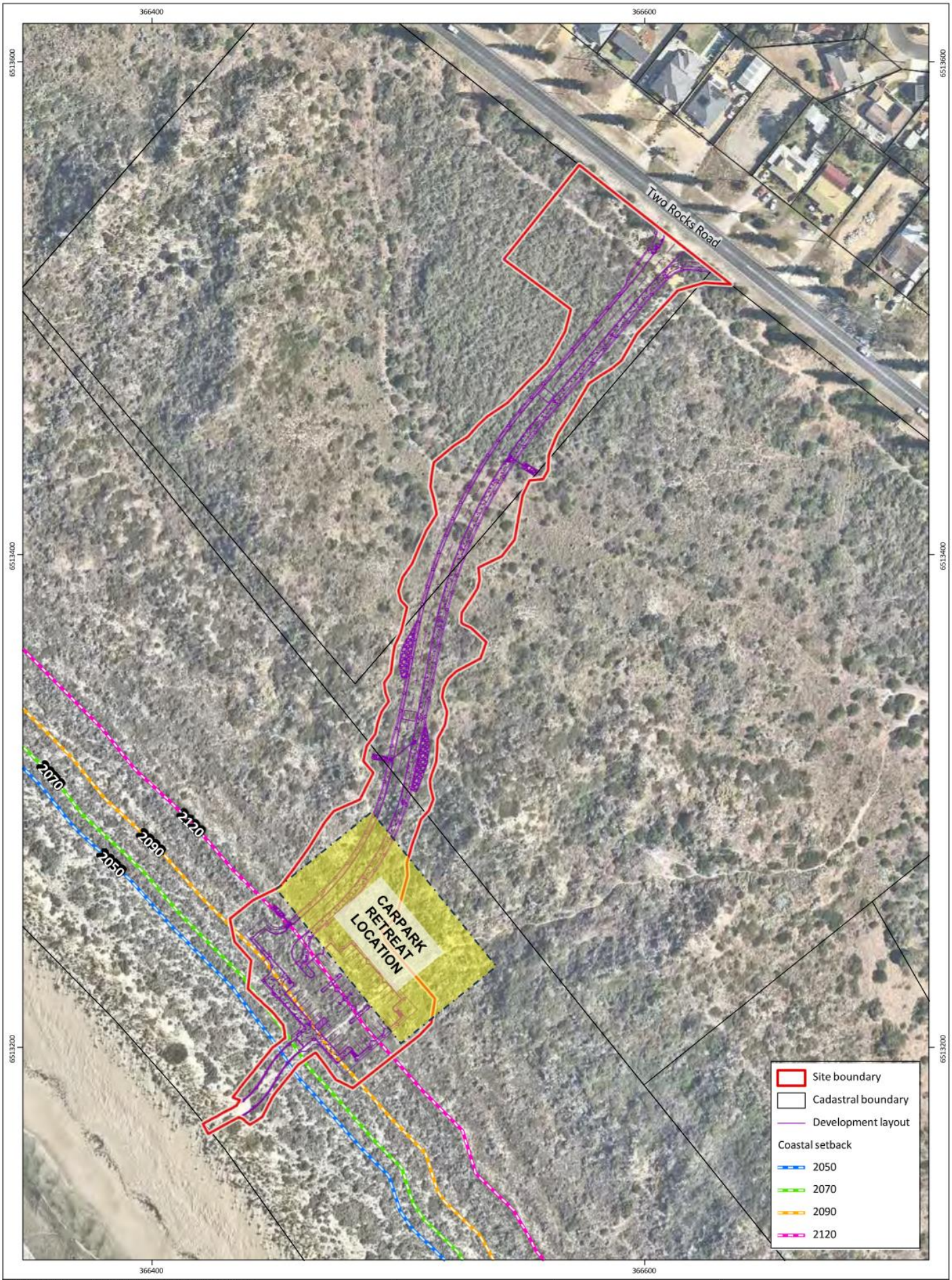


Figure 10: **Potential Location for the Carpark Retreat**

Project: STRBA Foreshore Management Plan

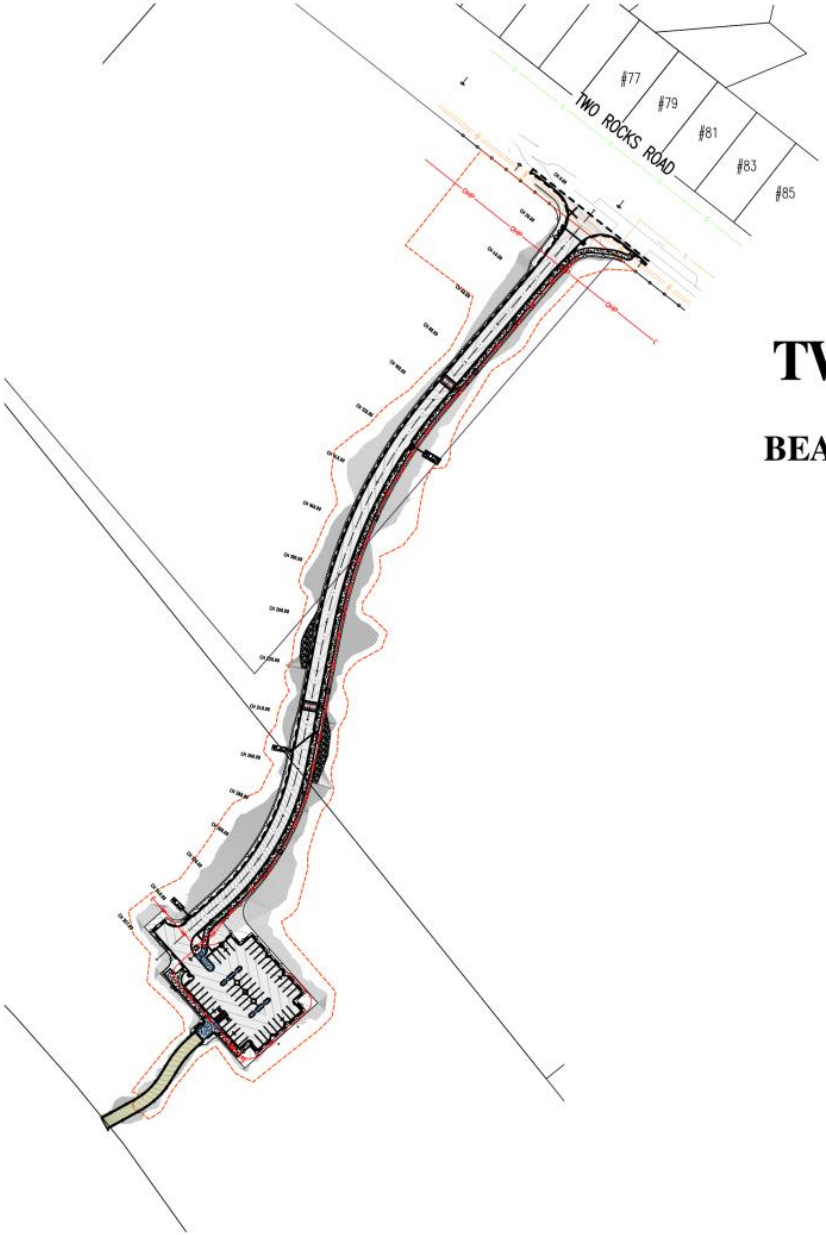
Drawn: SB
Date: 25/03/202

0 20 40
Metres
Scale: 1:2,000

City of Wanneroo

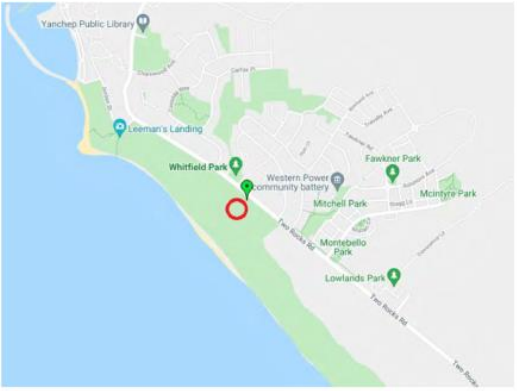
Appendix A

Final Designs



TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESS AND CAR PARK



LOCALITY

DRAWING INDEX

STREETLIGHT SPECIFICATIONS	HPE 25/6568
SET OUT FILES	HPE 23/189833
HANDOVER CHECKLIST	HPE 19/462004

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 2.5 0 2.5 5.0 7.5 10.0 12.5 — 1:1000 SCALE IN METRES
DATUM: LOCAL | GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR ... 10/2019
SURVEYOR
DESIGNED: K. RICHTER ... 8/2024
CIVIL DESIGNER
DRAWN: K. RICHTER ... 8/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS ... 22/10/24
COORDINATOR DESIGN

AUTHORISED: * B. GEE ... 01/11/24
MANAGER ASSETS MAINTENANCE
AUTHORISED: * I. NICHOLSON ... 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH ... 01/11/24
DIRECTOR ASSETS

AUTHORISED: * M. PEARCE ... 23/10/24
MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT
AUTHORISED: * G. CHETTLEBURGH ... 23/10/24
MANAGER PARKS & CONSERVATION MANAGEMENT

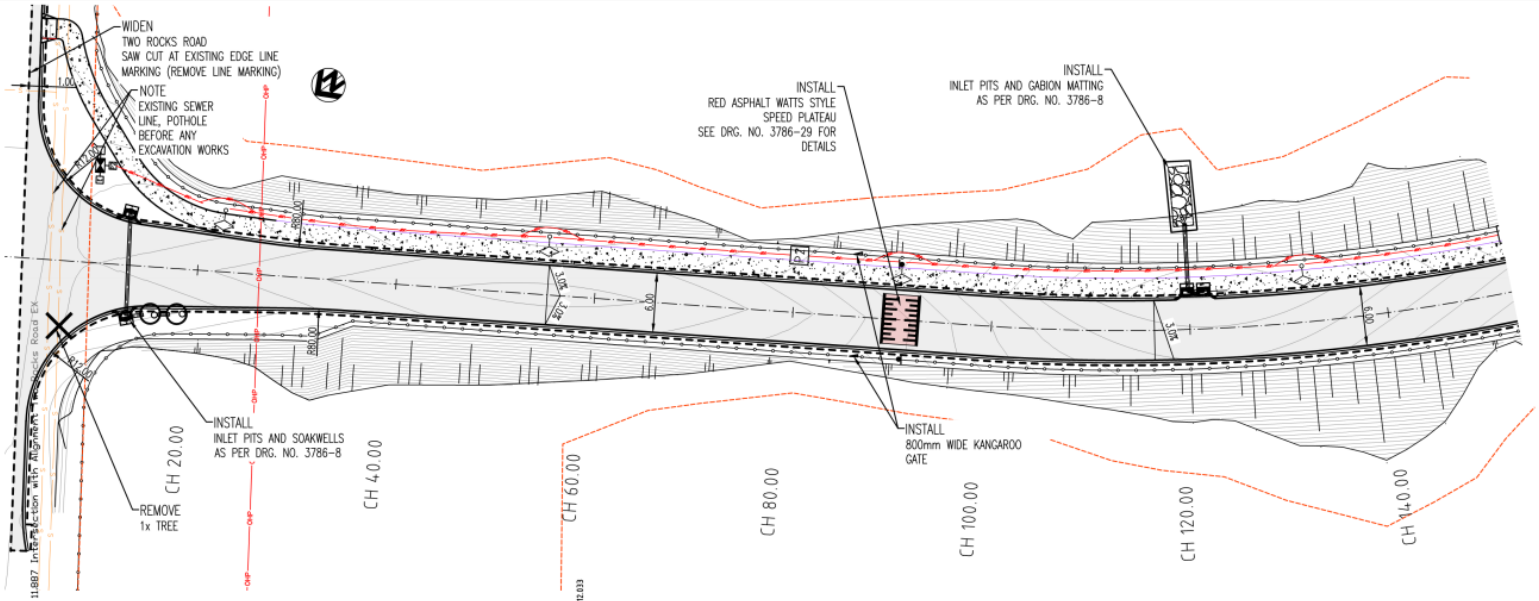
FINANCE CODE: PR-4234 | FWO No.: 20009
DRAWING SET REF: 21/561672 | FWO CONTAINER No.: 38998

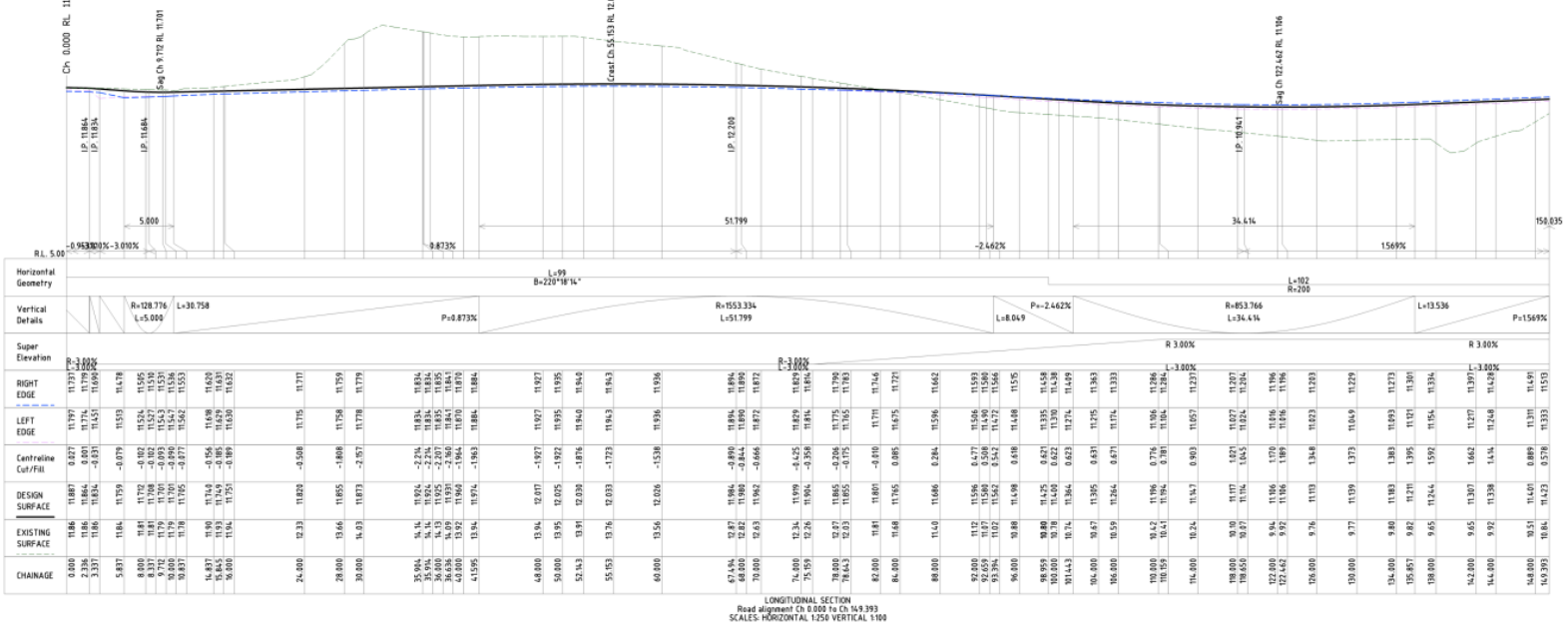
CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CAR PARK
TWO ROCKS

DRAWING INDEX
SHEET 1 OF 1

DRAWING No. 3786-4-0 | SHEET | REVISION | ORIGINAL DRG. SIZE A1





LONGITUDINAL SECTION
Road alignment Ch 0.000 to Ch 149.393
SCALES: HORIZONTAL 1:250 VERTICAL 1:100

Road alignment

LEGEND

PROPOSED

- KERBING (SEMI-MOUNTABLE)
- KERBING (MOUNTABLE)
- FOOTPATH & ISLANDS (CONCRETE)
- CONSERVATION FENCE
- BOX (COMPACTED LIMESTONE)
- LV UNDERGROUND STREETLIGHT CABLE — UGP — UGP
- CLEARING BOUNDARY

EXISTING SERVICES

- S — S — SEWER
- OHP — OHP — OVERHEAD POWER

NOTES:

1. CADASTRAL INFORMATION APPROXIMATE ONLY.
2. SERVICE LOCATIONS DIAGRAMMATIC ONLY. CONTACT SERVICE AUTHORITIES FOR EXACT IN GROUND LOCATIONS.
3. KERBING TO BE CONSTRUCTED IN ACCORDANCE WITH CITY OF WANNEROO DRG. No TS 05-1 AND TS 05-3.
4. ASPHALT AND KERB LEVELS TO BE SET OUT BY SURVEYORS AS PER SET OUT FILES.

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	
REVISION - AMENDED ACCESS ROAD AND CARPARK ELECTRICAL AND LIGHTING WORKS	K.R.	1/2025	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:250 — 2.5 0 2.5 5.0 7.5 10.0 12.5 SCALE IN METRES
DATUM: LOCAL
GRID: MGA 50

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MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
PWD No.: 20009
PWD CONTAINER No.: 38998

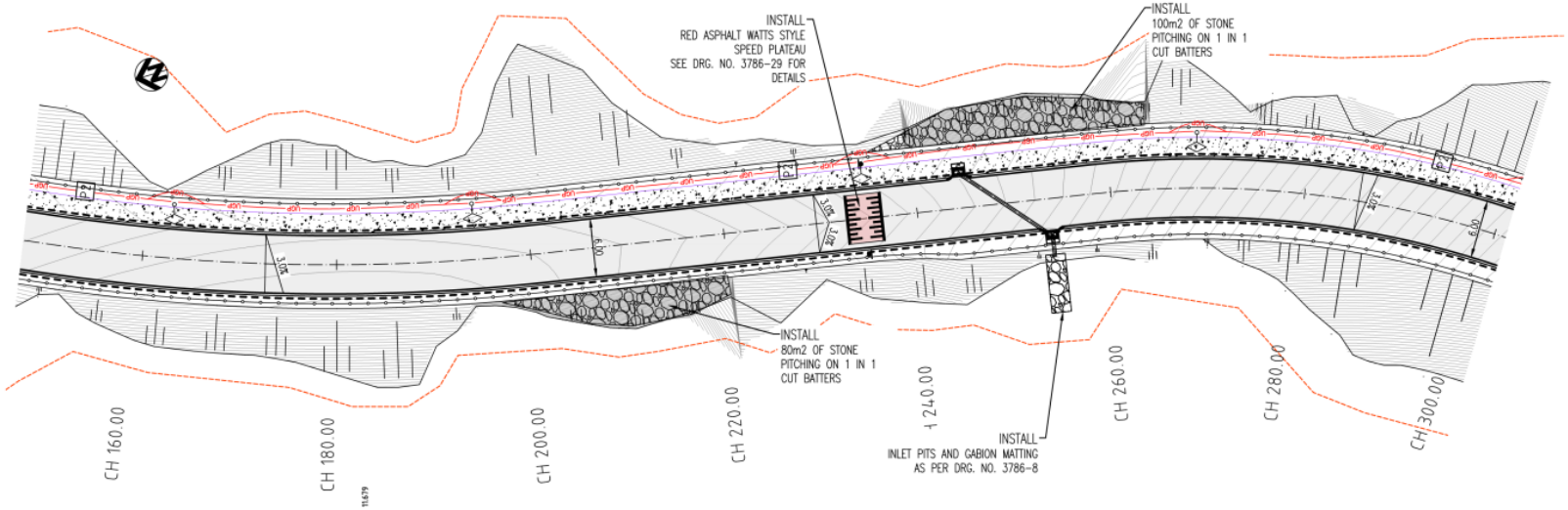
CITY OF WANNEROO
ASSETS

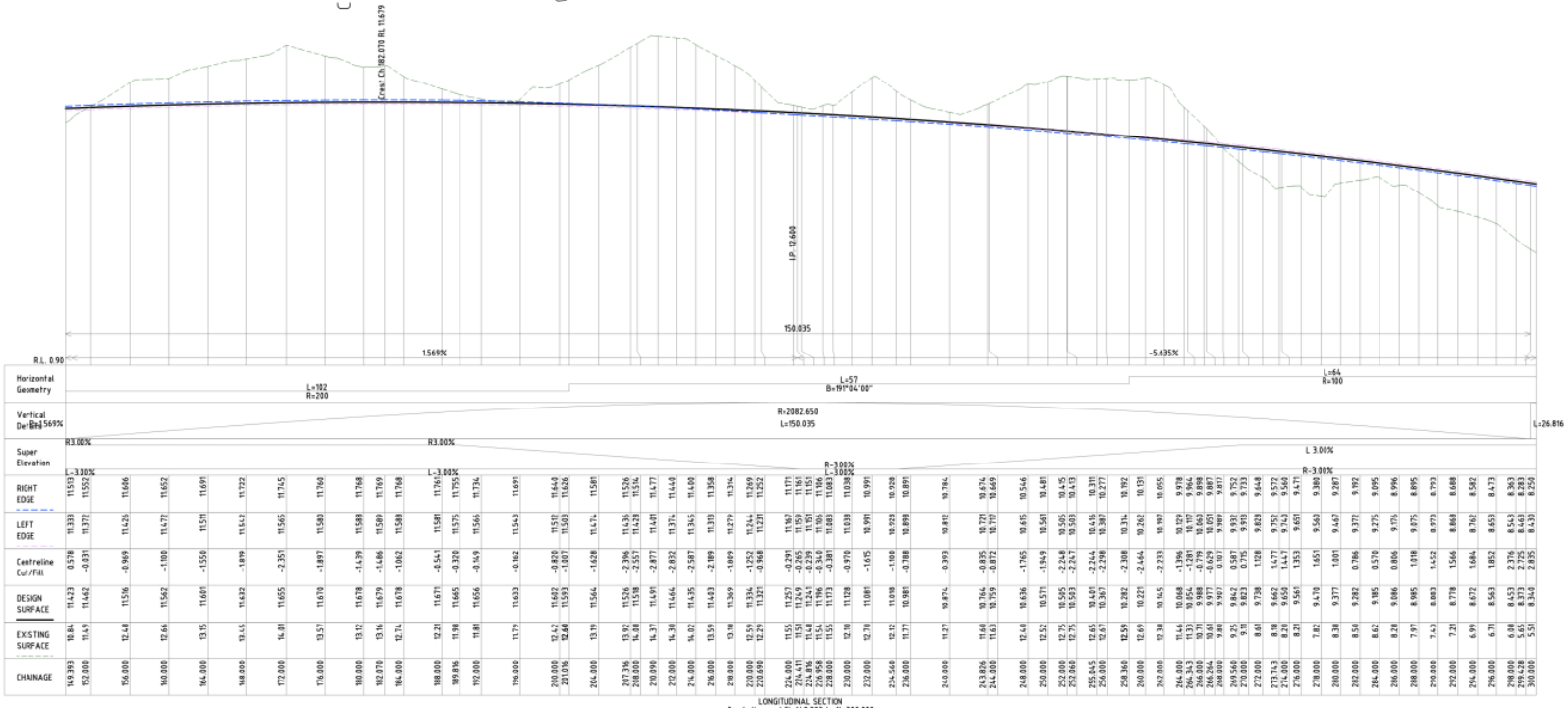
TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

PROFILE PLAN
SHEET 1 OF 3

DRAWING No. 3786-5-1 | SHEET | REVISION | ORIGINAL DRG. SIZE A1





LONGITUDINAL SECTION
Road alignment Ch 149.393 to Ch 300.000
SCALES: HORIZONTAL 1:250 VERTICAL 1:100

Road alignment

LEGEND

	PROPOSED
KERBING (SEMI-MOUNTABLE)	
KERBING (MOUNTABLE)	
FOOTPATH & ISLANDS (CONCRETE)	
CONSERVATION FENCE	
BOX (COMPACTED LIMESTONE)	
LV UNDERGROUND STREETLIGHT CABLE	UGP UGP
CLEARING BOUNDARY	

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DRAFT COPY			
ISSUED	K.R.	8/2024	

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AUTHORISED: G. CHETTLEBURGH 23/10/24
MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
FMS No.: 20009
FMS CONTAINER No.: 38998

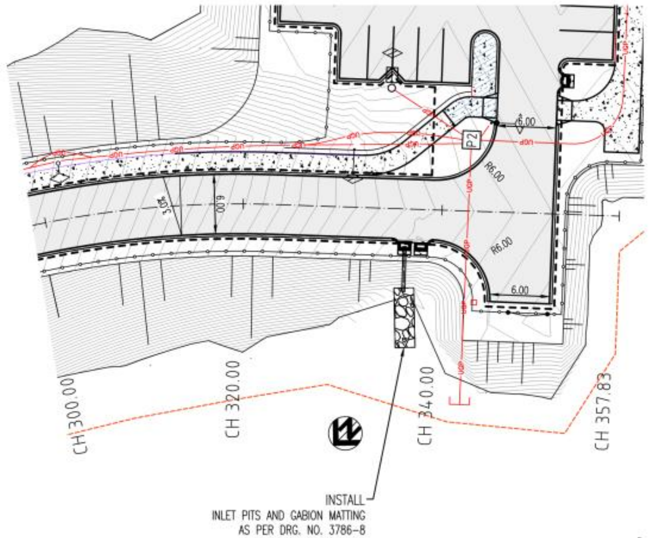
CITY OF WANNEROO
ASSETS

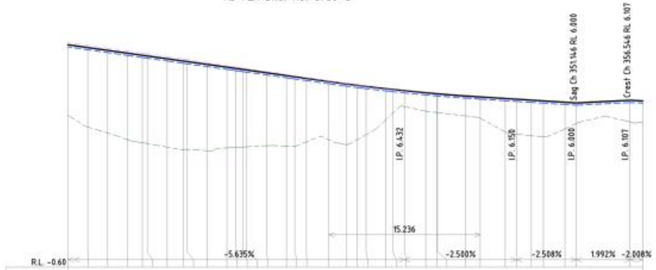
TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

PROFILE PLAN
SHEET 2 OF 3

DRAWING No. 3786-6-0 | SHEET | REVISION | ORIGINAL DRG. SIZE A1





Horizontal Geometry	L=64 R=100	L=35 B=228°00'06"

Vertical Details	L=26.816 P=-5.635%	R=485.987 L=15.236	L=5.999 P=-2.508%	L=5.399 P=1.992%

Super Elevation	L3.00% R-3.00%	R-3.00% L-3.00%

CHAINAGE	RIGHT EDGE	LEFT EDGE	Centreline Cut/Fill	DESIGN SURFACE	EXISTING SURFACE
300.000	8.250	8.430	2.835	8.340	5.51
302.000	8.138	8.318	3.193	8.228	5.03
304.000	8.025	8.205	3.323	8.115	4.79
306.000	7.912	8.092	3.478	8.002	4.52
307.508	7.827	8.007	3.517	7.917	4.40
308.000	7.800	7.980	3.520	7.890	4.37
310.000	7.687	7.867	3.554	7.777	4.22
311.624	7.595	7.775	3.580	7.685	4.10
312.000	7.574	7.752	3.551	7.664	4.11
314.000	7.462	7.629	3.475	7.552	4.08
316.000	7.349	7.506	3.248	7.439	4.19
316.908	7.298	7.451	3.172	7.388	4.22
317.590	7.259	7.409	3.119	7.349	4.23
318.000	7.236	7.383	3.088	7.326	4.24
320.000	7.123	7.260	2.933	7.213	4.28
322.000	7.011	7.137	2.839	7.101	4.26
322.824	6.964	7.087	2.809	7.054	4.24
324.000	6.898	7.014	2.557	6.988	4.43
326.244	6.772	6.876	2.340	6.862	4.52
328.000	6.676	6.772	2.454	6.766	4.31
329.124	6.618	6.708	2.181	6.708	4.53
330.000	6.574	6.660	1.941	6.664	4.72
332.000	6.481	6.557	1.233	6.571	5.34
332.712	6.450	6.522	0.929	6.540	5.61
333.862	6.402	6.468	0.636	6.492	5.86
336.000	6.320	6.374	0.740	6.410	5.67
337.099	6.281	6.330	0.755	6.371	5.62
337.193	6.278	6.326	0.756	6.368	5.61
340.000	6.191	6.225	0.801	6.281	5.48
341.480	6.152	6.178	0.860	6.242	5.38
344.000	6.089	6.102	1.339	6.179	4.84
345.146	6.060	6.060	1.403	6.150	4.75
346.624	6.023	6.023	1.433	6.113	4.68
347.835	5.993	5.993	1.441	6.083	4.64
350.000	5.939	5.939	1.074	6.029	4.95
351.146	5.910	5.910	0.820	6.000	5.18
356.546	6.017	6.017	0.868	6.107	5.24
357.832	5.992	5.992	0.858	6.082	5.22

LONGITUDINAL SECTION
Road alignment Ch 300.000 to Ch 357.832
SCALES: HORIZONTAL 1:250 VERTICAL 1:100

Road alignment

LEGEND

	PROPOSED
KERBING (SEMI-MOUNTABLE)	
KERBING (MOUNTABLE)	
FOOTPATH & ISLANDS (CONCRETE)	
CONSERVATION FENCE	
BOX (COMPACTED LIMESTONE)	
LV UNDERGROUND STREETLIGHT CABLE	UGP
CLEARING BOUNDARY	

NOTES:

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CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

PROFILE PLAN

SHEET 3 OF 3

REVISION	BY	DATE	AUTH	No.	REVISION	BY	DATE	AUTH
DRAFT COPY								
ISSUED	K.R.	8/2024						

SCALE: 1:250 — 2.5 0 2.5 5.0 7.5 10.0 12.5 SCALE IN METRES
DATUM: LOCAL — GRID: MGA 50

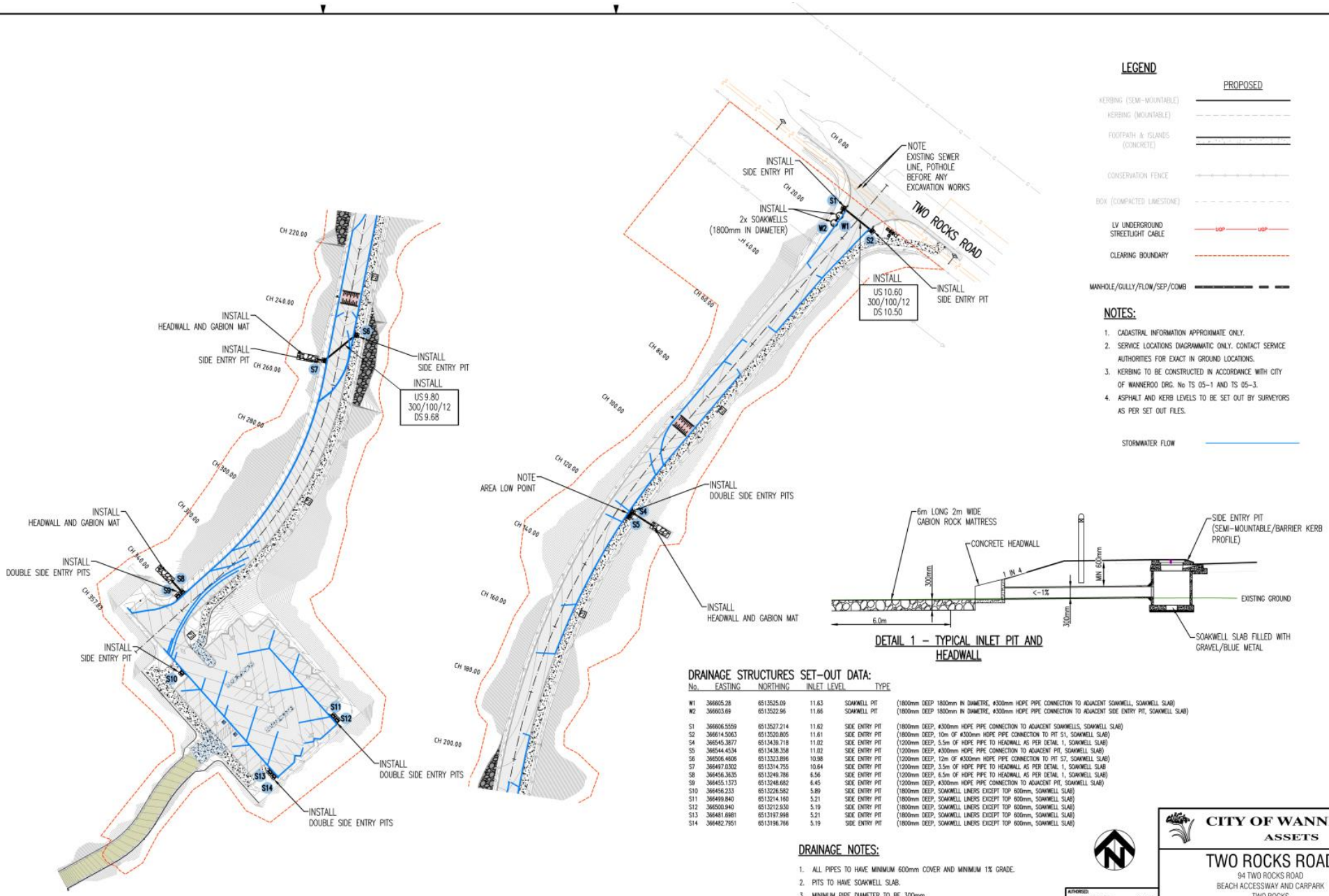
SURVEYED: S. BUCKLE, MNG LIDAR 10/2019 SURVEYOR
DESIGNED: K. RICHTER 8/2024 CIVIL DESIGNER
DRAWN: K. RICHTER 8/2024 CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24 COORDINATOR DESIGN

AUTHORISED: * B. GEE 01/11/24 MANAGER ASSETS MAINTENANCE
AUTHORISED: * L. NICHOLSON 01/11/24 MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24 DIRECTOR ASSETS

AUTHORISED: * M. PEARCE 23/10/24 MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT
AUTHORISED: * G. CHETTLEBURGH 23/10/24 MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234 — PWO No.: 20009
DRAWING SET REF: 21/561672 — PWO CONTAINER No.: 38998

DRAWING No.: 3786-7-0 — SHEET — REVISION — ORIGINAL DRG. SIZE: A1



LEGEND

PROPOSED

- KERBING (SEMI-MOUNTABLE)
- KERBING (MOUNTABLE)
- FOOTPATH & ISLANDS (CONCRETE)
- CONSERVATION FENCE
- BOX (COMPACTED LIMESTONE)
- LV UNDERGROUND STREETLIGHT CABLE — UGP — UGP
- CLEARING BOUNDARY
- MANHOLE/GULLY/FLOW/SEP/CDMB
- STORMWATER FLOW

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DETAIL 1 – TYPICAL INLET PIT AND HEADWALL

DRAINAGE STRUCTURES SET-OUT DATA:

No.	EASTING	NORTHING	INLET LEVEL	TYPE	
W1	366605.28	6513525.09	11.63	SOAKWELL PIT	(1800mm DEEP 1800mm IN DIAMETRE, ø300mm HDPE PIPE CONNECTION TO ADJACENT SOAKWELL, SOAKWELL SLAB)
W2	366603.69	6513522.96	11.66	SOAKWELL PIT	(1800mm DEEP 1800mm IN DIAMETRE, ø300mm HDPE PIPE CONNECTION TO ADJACENT SIDE ENTRY PIT, SOAKWELL SLAB)
S1	366606.5559	6513527.214	11.62	SIDE ENTRY PIT	(1800mm DEEP, ø300mm HDPE PIPE CONNECTION TO ADJACENT SOAKWELLS, SOAKWELL SLAB)
S2	366614.5063	6513520.805	11.61	SIDE ENTRY PIT	(1800mm DEEP, 10m OF ø300mm HDPE PIPE CONNECTION TO PIT S1, SOAKWELL SLAB)
S4	366545.3877	6513439.718	11.02	SIDE ENTRY PIT	(1200mm DEEP, 5.5m OF HDPE PIPE TO HEADWALL AS PER DETAIL 1, SOAKWELL SLAB)
S5	366544.4534	6513438.358	11.02	SIDE ENTRY PIT	(1200mm DEEP, ø300mm HDPE PIPE CONNECTION TO ADJACENT PIT, SOAKWELL SLAB)
S6	366506.4606	6513323.896	10.98	SIDE ENTRY PIT	(1200mm DEEP, 12m OF ø300mm HDPE PIPE CONNECTION TO PIT S7, SOAKWELL SLAB)
S7	366497.0302	6513314.755	10.64	SIDE ENTRY PIT	(1200mm DEEP, 3.5m OF HDPE PIPE TO HEADWALL AS PER DETAIL 1, SOAKWELL SLAB
S8	366456.3635	6513249.786	6.56	SIDE ENTRY PIT	(1200mm DEEP, 6.5m OF HDPE PIPE TO HEADWALL AS PER DETAIL 1, SOAKWELL SLAB)
S9	366455.1373	6513248.682	6.45	SIDE ENTRY PIT	(1200mm DEEP, ø300mm HDPE PIPE CONNECTION TO ADJACENT PIT, SOAKWELL SLAB)
S10	366456.233	6513226.582	5.89	SIDE ENTRY PIT	(1800mm DEEP, SOAKWELL LINERS EXCEPT TOP 600mm, SOAKWELL SLAB)
S11	366499.840	6513214.160	5.21	SIDE ENTRY PIT	(1800mm DEEP, SOAKWELL LINERS EXCEPT TOP 600mm, SOAKWELL SLAB)
S12	366500.940	6513212.930	5.19	SIDE ENTRY PIT	(1800mm DEEP, SOAKWELL LINERS EXCEPT TOP 600mm, SOAKWELL SLAB)
S13	366481.8981	6513197.998	5.21	SIDE ENTRY PIT	(1800mm DEEP, SOAKWELL LINERS EXCEPT TOP 600mm, SOAKWELL SLAB)
S14	366482.7951	6513196.766	5.19	SIDE ENTRY PIT	(1800mm DEEP, SOAKWELL LINERS EXCEPT TOP 600mm, SOAKWELL SLAB)

DRAINAGE NOTES:

1. ALL PIPES TO HAVE MINIMUM 600mm COVER AND MINIMUM 1% GRADE.
2. PITS TO HAVE SOAKWELL SLAB.
3. MINIMUM PIPE DIAMETER TO BE 300mm.
4. MANHOLE NOMINAL DIAMETER TO BE 1200mm (EXCEPT W1 & W2).

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	
REVISION – AMENDED ACCESS ROAD AND CARPARK ELECTRICAL AND LIGHTING WORKS	K.R.	1/2025	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:500 (5 0 5 10 15 20 25 SCALE IN METRES)
DATUM: LOCAL
SHEET: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
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MANAGER ASSETS MAINTENANCE

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
FMD No.: 20009
FMD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

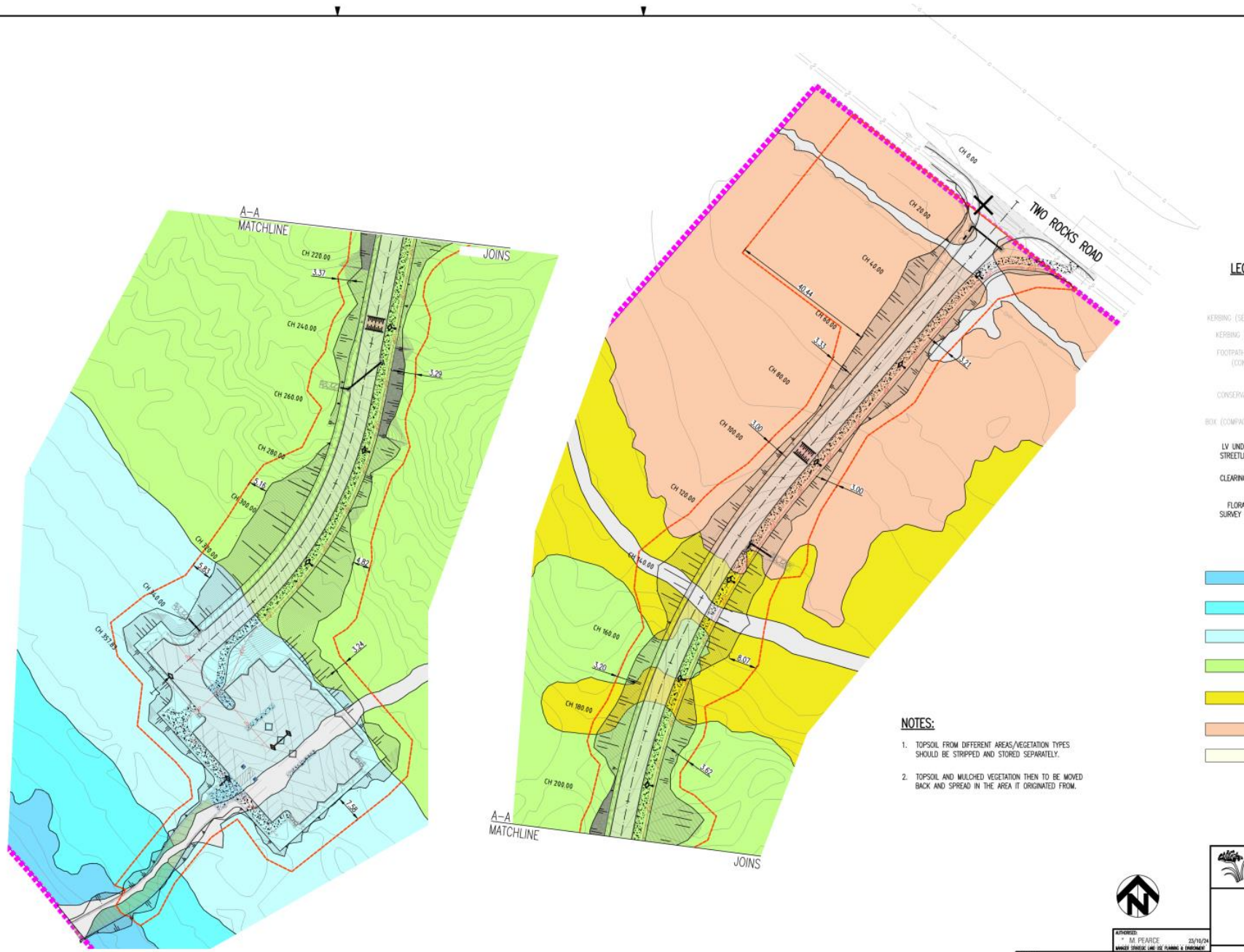
TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

DRAINAGE PLAN

SHEET 1 OF 1

DRAWING No.: 3786-8-1
SHEET: A1
REVISION:
ORIGINAL DRG. SIZE:



LEGEND

PROPOSED

- KERBING (SEMI-MOUNTABLE)
- KERBING (MOUNTABLE)
- FOOTPATH & ISLANDS (CONCRETE)
- CONSERVATION FENCE
- BOX (COMPACTED LIMESTONE)
- LV UNDERGROUND STREETLIGHT CABLE — UGP —
- CLEARING BOUNDARY
- FLORA/FAUNA SURVEY BOUNDARY

- A1: LOW LYING PRIMARY DUNES ON UNCONSOLIDATED SAND
- A2: LOW LYING PRIMARY DUNES ON UNCONSOLIDATED SAND
- A3: LOW LYING PRIMARY DUNES ON UNCONSOLIDATED SAND
- B1: TALL SECONDARY DUNES ON UNCONSOLIDATED SAND
- C1: LOW DUNES ON SEMI-CONSOLIDATED SAND
- D1: LOW RISES WITH LIMESTONE OUTCROPPING:
- AREA ALREADY CLEARED

NOTES:

1. TOPSOIL FROM DIFFERENT AREAS/VEGETATION TYPES SHOULD BE STRIPPED AND STORED SEPARATELY.
2. TOPSOIL AND MULCHED VEGETATION THEN TO BE MOVED BACK AND SPREAD IN THE AREA IT ORIGINATED FROM.

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:500 (5 0 5 10 15 20 25 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LiDAR 27/10/2019
SURVEYOR:
DESIGNED: K. RICHTER 8/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 8/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN

AUTHORISED: * B. GEE 01/11/24
MANAGER ASSETS MAINTENANCE
AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS
AUTHORISED: * M. PEARCE 23/10/24
MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT
AUTHORISED: * G. CHETTLEBURGH 23/10/24
MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
FMS No.: 20009
FMS CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

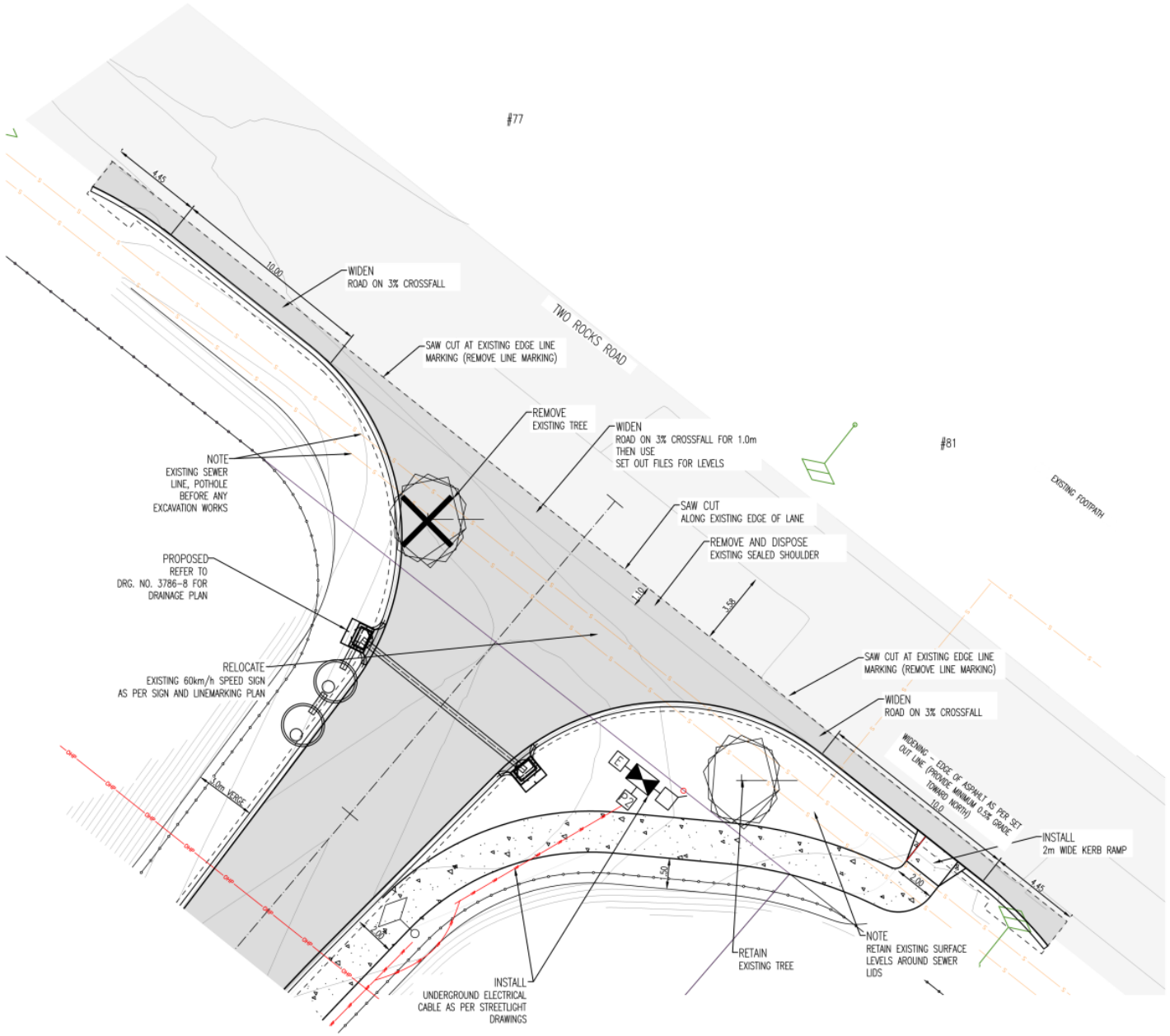
TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CAR PARK
TWO ROCKS

VEGETATION BOUNDARIES

SHEET 1 OF 1

DRAWING No. 3786-9-0 | SHEET | REVISION | ORIGINAL DRG. SIZE A1



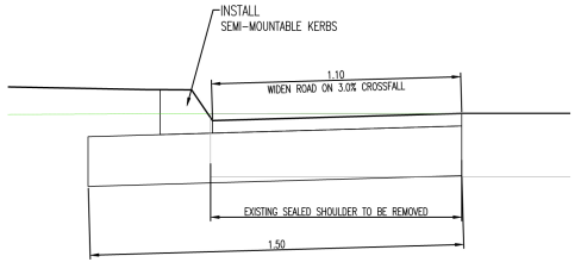
LEGEND

PROPOSED

- KERBING (SEMI-MOUNTABLE)
- FOOTPATH & ISLANDS (CONCRETE)
- KERB RAMP
- CONSERVATION FENCE
- SIDE-ENTRY PITS
- ASPHALT SEAL
- BOX
- TREE TO BE REMOVED

NOTES:

1. CADASTRAL INFORMATION APPROXIMATE ONLY.
2. SERVICE LOCATIONS DIAGRAMMATIC ONLY. CONTACT SERVICE AUTHORITIES FOR EXACT IN GROUND LOCATIONS.
3. KERBING TO BE CONSTRUCTED IN ACCORDANCE WITH CITY OF WANNEROO DRG. No TS 05-1 AND TS 05-3.
4. ASPHALT AND KERB LEVELS TO BE SET OUT BY SURVEYORS AS PER SET OUT FILES.



REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	
REVISION - AMENDED ACCESS ROAD AND CARPARK ELECTRICAL AND LIGHTING WORKS	K.R.	1/2025	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:10 (100 0 100 200 300 400 500 SCALE IN MILLIMETRES)

DATUM: LOCAL GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR

DESIGNED: K. RICHTER 8/2024
CIVIL DESIGNER

DRAWN: K. RICHTER 8/2024
CIVIL DESIGNER

CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN

AUTHORISED: * B. GEE 01/11/24
MANAGER ASSETS MAINTENANCE

AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS

APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

AUTHORISED: * M. PEARCE 23/10/24
MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT

AUTHORISED: * G. CHETTLEBURGH 23/10/24
MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
FMS No.: 20009
FMS CONTAINER No.: 38998

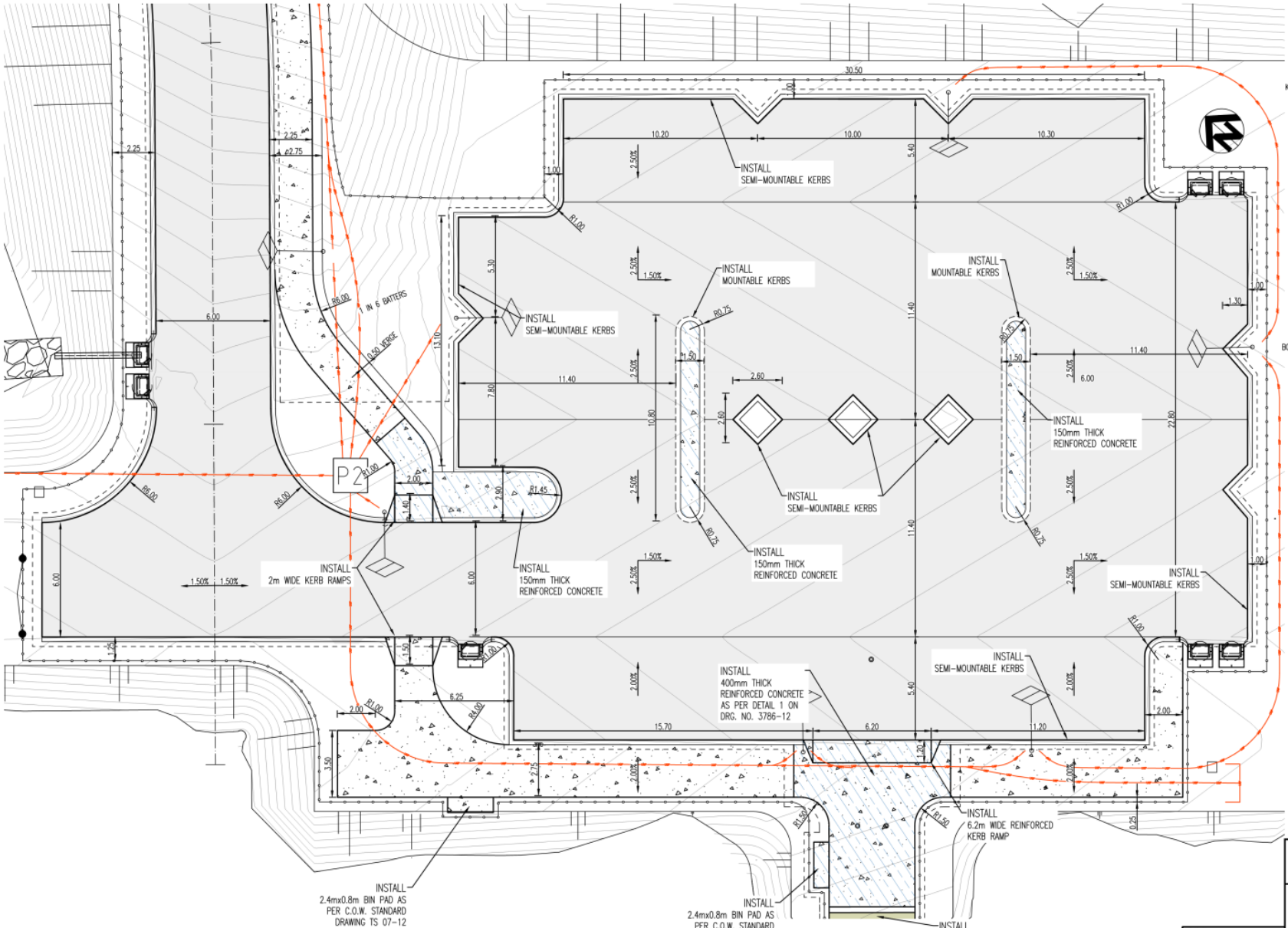
CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CONSTRUCTION DETAILS - INTERSECTION AT TWO ROCKS ROAD
SHEET 1 OF 1

DRAWING No. 3786-10-1
SHEET
REVISION
ORIGINAL DRG. SIZE A1



LEGEND

PROPOSED

- KERBING (SEMI-MOUNTABLE)
- KERBING (MOUNTABLE)
- FOOTPATH & ISLANDS (CONCRETE)
- CONSERVATION FENCE
- SIDE-ENTRY PITS
- CONCRETE PATH
- REINFORCED CONCRETE
- ASPHALT SEAL
- BOX (COMPACTED LIMESTONE)
- TREE TO BE REMOVED
- LED STREETLIGHT

NOTES:

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4. ASPHALT AND KERB LEVELS TO BE SET OUT BY SURVEYORS AS PER SET OUT FILES.

CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CONSTRUCTION DETAILS - CAR PARK

SHEET 1 OF 1

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	

No.	REVISION	BY	DATE	AUTH

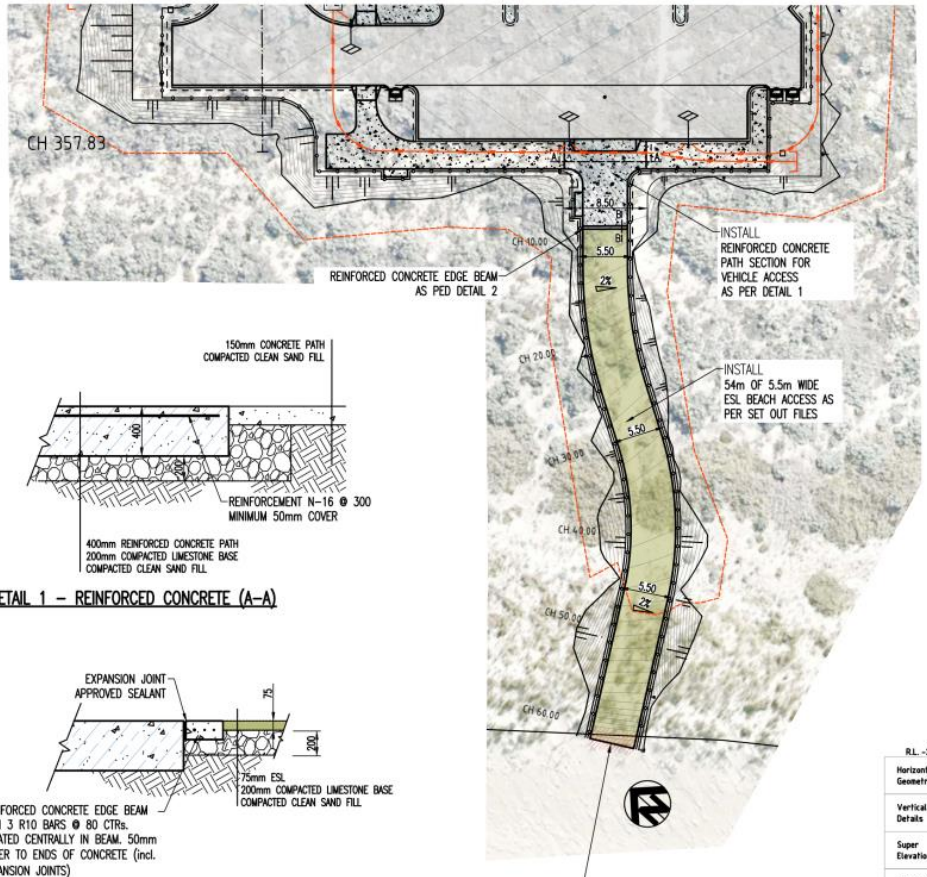
SCALE: 1:100 (1000 0 1000 2000 3000 4000 5000 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 8/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 8/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN

AUTHORISED: * B. GEE 01/11/24
MANAGER ASSETS MAINTENANCE
AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS
AUTHORISED: * M. PEARCE 23/10/24
MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT
AUTHORISED: * G. CHETTLEBURGH 23/10/24
MANAGER PARKS & CONSERVATION MANAGEMENT

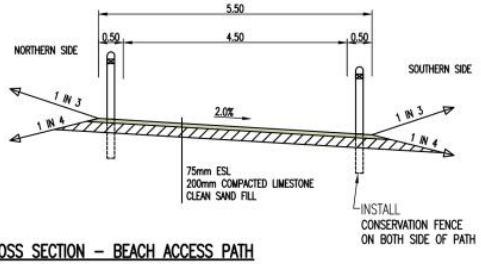
FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
FMS No.: 20009
FMS CONTAINER No.: 38998

DRAWING No.: 3786-11-0
SHEET: A1
REVISION:
ORIGINAL DRG. SIZE:



DETAIL 1 – REINFORCED CONCRETE (A–A)

DETAIL 2 – BEACH ACCES PATH CONNECTION TO REINFORCED CONCRETE PATH (B–B)



CROSS SECTION – BEACH ACCESS PATH

LEGEND

PROPOSED

- KERBING (SEMI-MOUNTABLE)
- KERBING (MOUNTABLE)
- FOOTPATH & ISLANDS (CONCRETE)
- CONSERVATION FENCE
- SIDE-ENTRY PITS
- FOOTPATH (CONCRETE)
- ASPHALT SEAL
- BOX (COMPACTED LIMESTONE)
- TREE TO BE REMOVED
- LED STREETLIGHT
- LV UNDERGROUND STREETLIGHT CABLE
- CLEARING BOUNDARY

NOTES:

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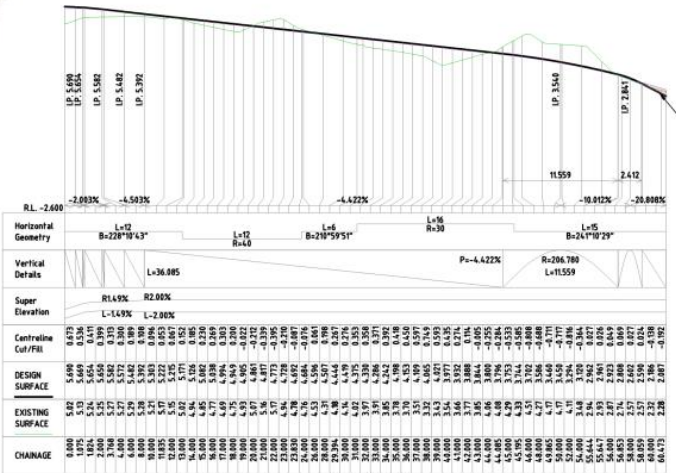

NOTE
END OF PATH TO CURVE UNDER EXISTING SURFACE AS PER SET OUT FILE LEVELS AND FILL AREA BACK UP WITH BEACH SAND.

LONGITUDINAL SECTION
Alignment footpath beach Ch 0.000 to Ch 60.473
SCALES: HORIZONTAL 1:250 VERTICAL 1:100

Alignment footpath beach

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:250 (2.5 0 2.5 5.0 7.5 10.0 12.5 SCALE IN METRES)
DATUM: LOCAL GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 8/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 8/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN

AUTHORISED: * B. GEE 01/11/24
MANAGER ASSETS MAINTENANCE
AUTHORISED: * L. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS
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MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT
AUTHORISED: * G. CHETTLEBURGH 23/10/24
MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
PWD No.: 20009
PWD CONTAINER No.: 38998

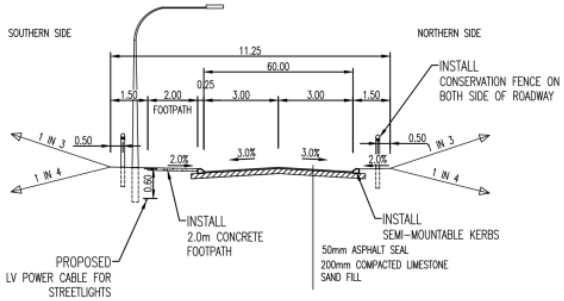
CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

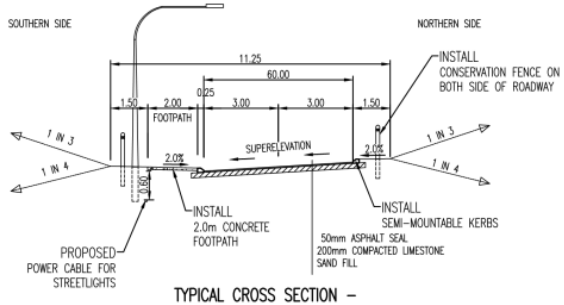
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CONSTRUCTION DETAILS - BEACH ACCESS PATH
SHEET 1 OF 1

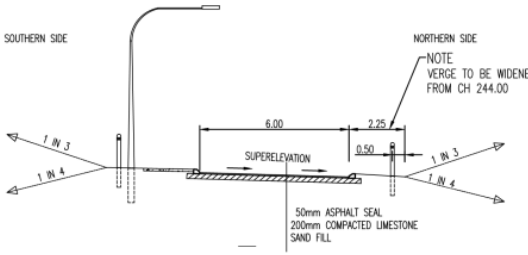
DRAWING No.: 3786-12-0
SHEET: A1
REVISION:
ORIGINAL DRG. SIZE:



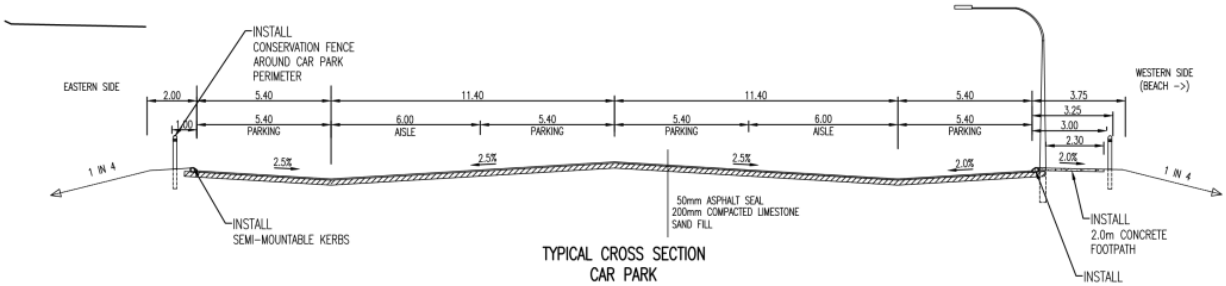
TYPICAL CROSS SECTION –
ACCESS ROAD ON STRAIGHT



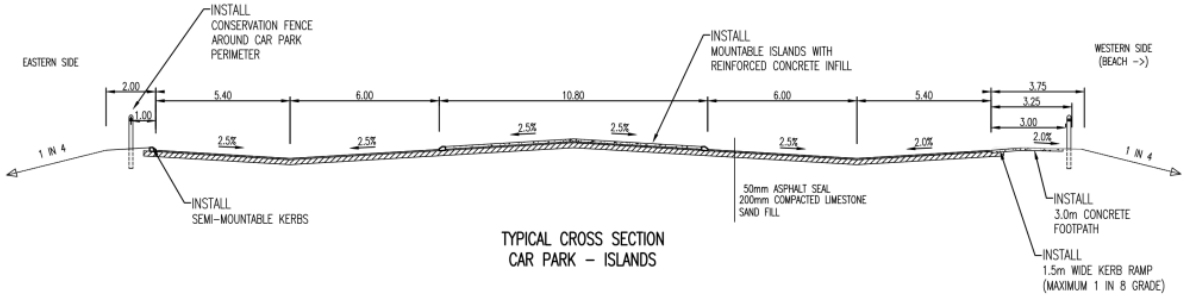
TYPICAL CROSS SECTION –
ACCESS ROAD ON BEND



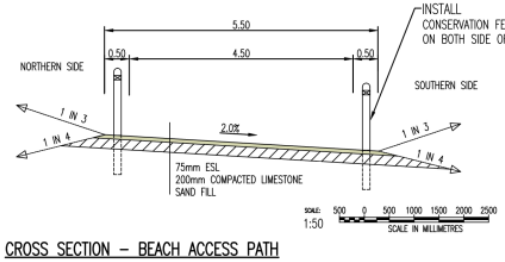
TYPICAL CROSS SECTION –
ACCESS ROAD
FROM CH 244.00 TO END



TYPICAL CROSS SECTION
CAR PARK



TYPICAL CROSS SECTION
CAR PARK – ISLANDS



CROSS SECTION – BEACH ACCESS PATH

	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	
REVISION – AMENDED ACCESS ROAD AND CARPARK ELECTRICAL AND LIGHTING WORKS	K.R.	1/2025	

No.	BY	DATE	AUTH

SCALE: 1:100 — 1000 0 1000 2000 3000 4000 5000 SCALE IN MILLIMETRES
DATUM: LOCAL
GRID: MGA 50

SURVEYED:
DRAWN: K. RICHTER 8/2024 — CIVIL DESIGNER
SURVEYOR
DESIGNED: K. RICHTER 8/2024 — CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24 — COORDINATOR DESIGN

AUTHORISED: * B. GEE 01/11/24 — MANAGER ASSETS MAINTENANCE
AUTHORISED: * I. NICHOLSON 01/11/24 — MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24 — DIRECTOR ASSETS
AUTHORISED: * M. PEARCE 23/10/24 — MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT
AUTHORISED: * G. CHETTLEBURGH 23/10/24 — MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
FMS No.: 20009
DRAWING SET REF: 21/561672
FMS CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

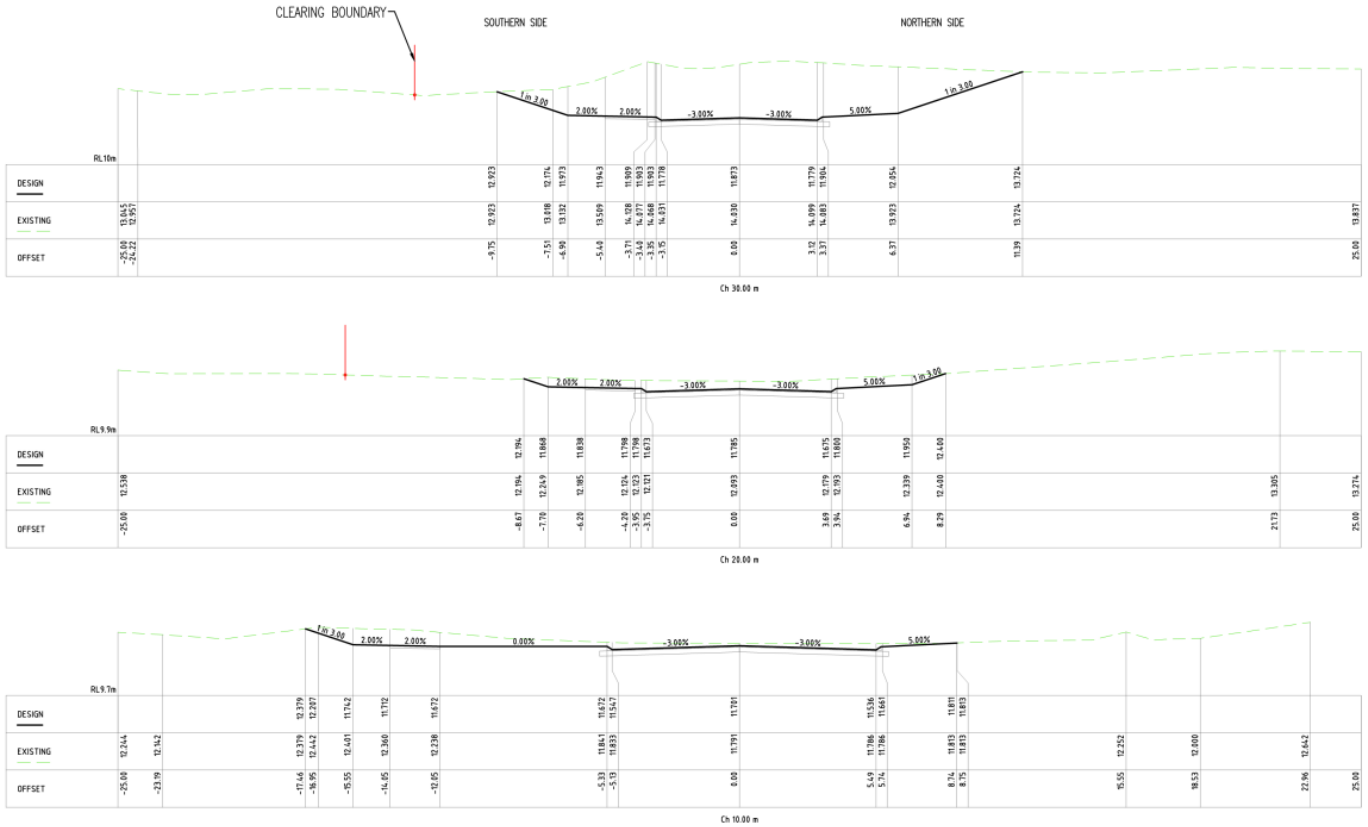
TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

TYPICAL CROSS SECTIONS

SHEET 1 OF 1

DRAWING No.	SHEET	REVISION	ORIGINAL DRG. SIZE
3786-14-1			A1



CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CROSS SECTIONS

SHEET 1 OF 13

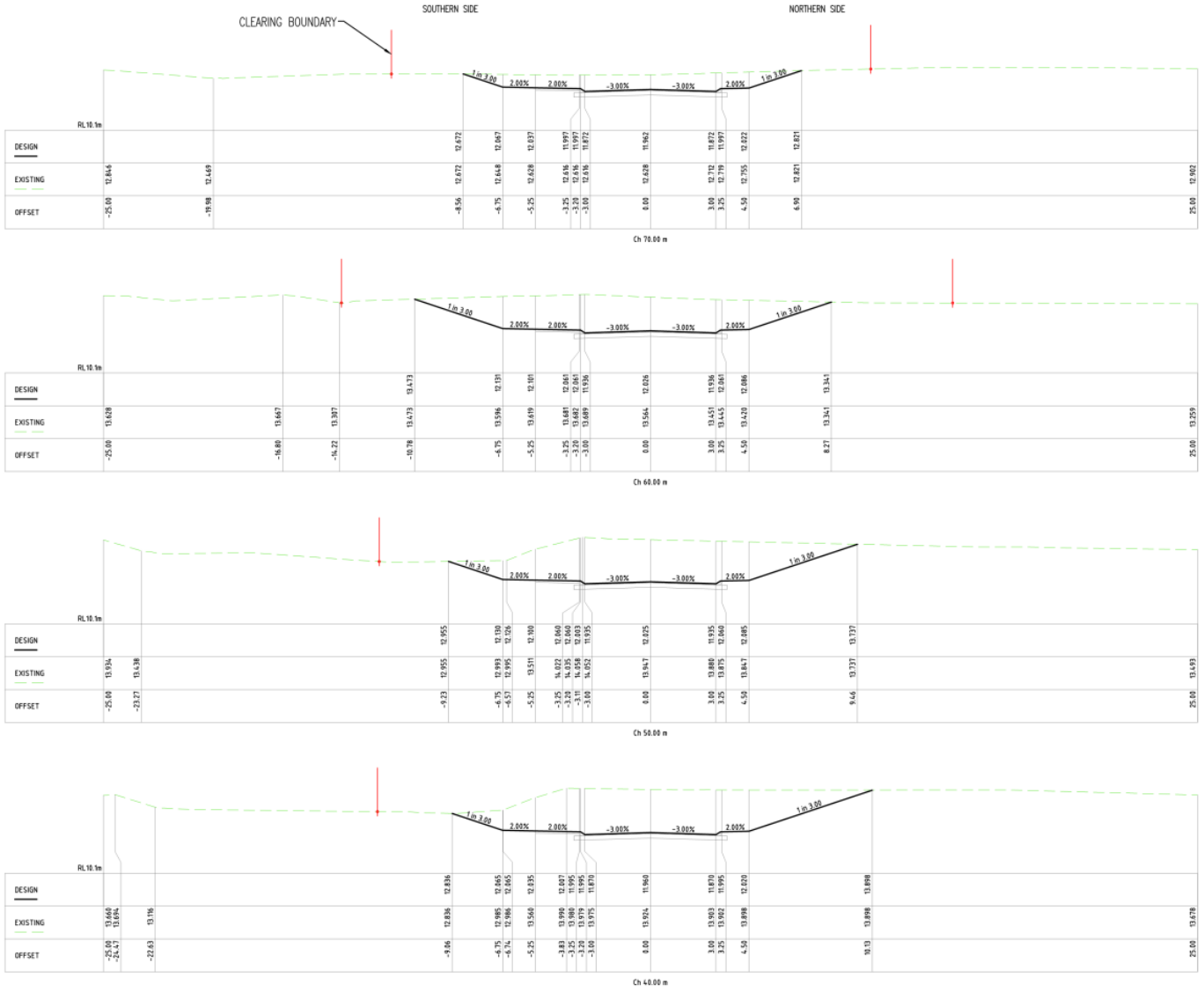
REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50
SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED:
COORDINATOR DESIGN
AUTHORISED:
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED:
DIRECTOR ASSETS

FINANCE CODE	PR-4234
DRAWING SET REF	21/561672
PWD No.	20009
PWD CONTAINER No.	38998

DRAWING No.	SHEET	REVISION	ORIGINAL DRG. SIZE
3786-15-0			A1



REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50
SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED:
COORDINATOR DESIGN
AUTHORISED:
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED:
DIRECTOR ASSETS
FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
PWD No.: 20009
PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

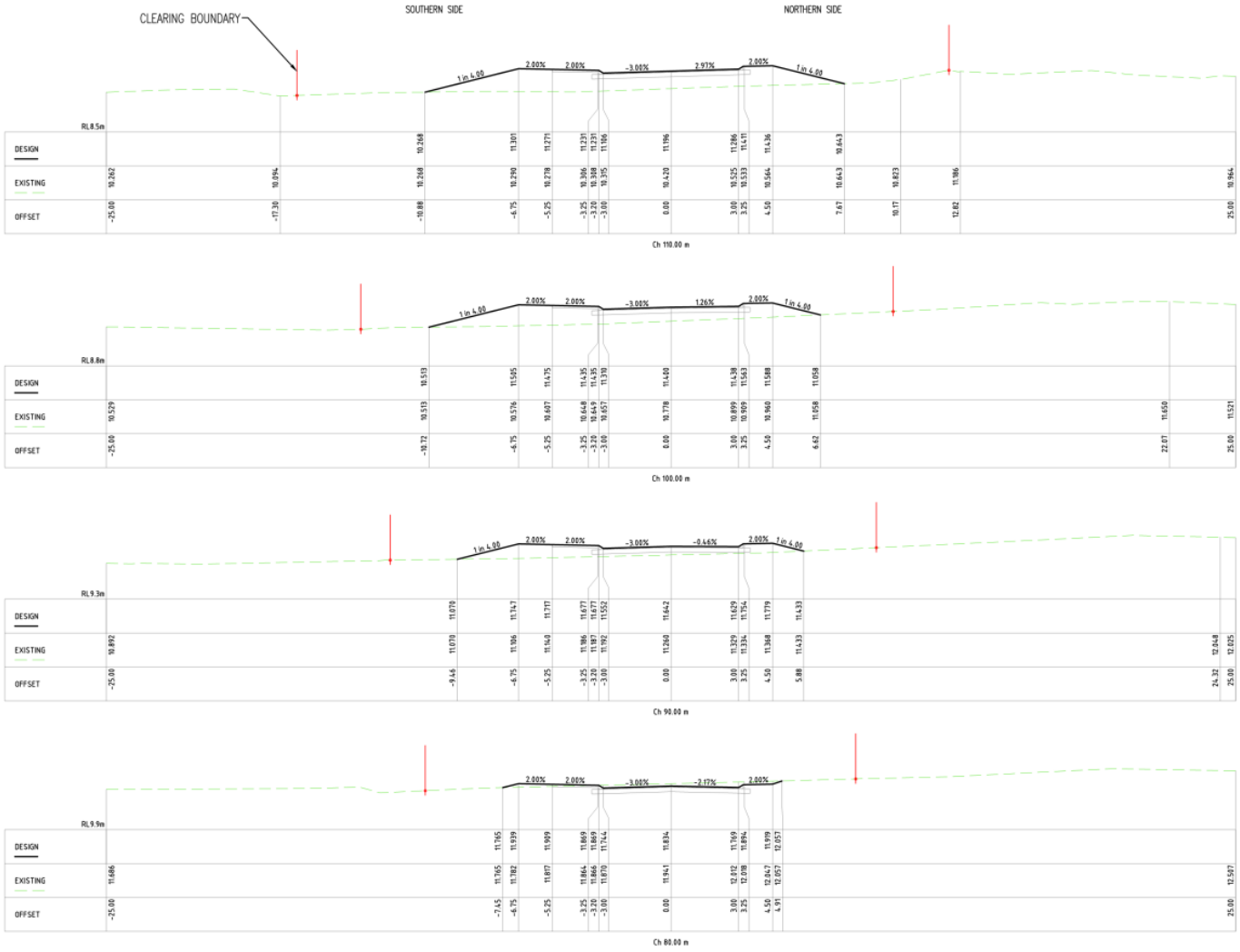
TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CROSS SECTIONS

SHEET 2 OF 13

DRAWING No. 3786-16-0
SHEET
REVISION
ORIGINAL DRG. SIZE A1



SCALE H 1:100
V 1:100

CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CROSS SECTIONS

SHEET 3 OF 13

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

SCALE:	1:100
DATUM:	LOCAL
GRID:	MGA 50

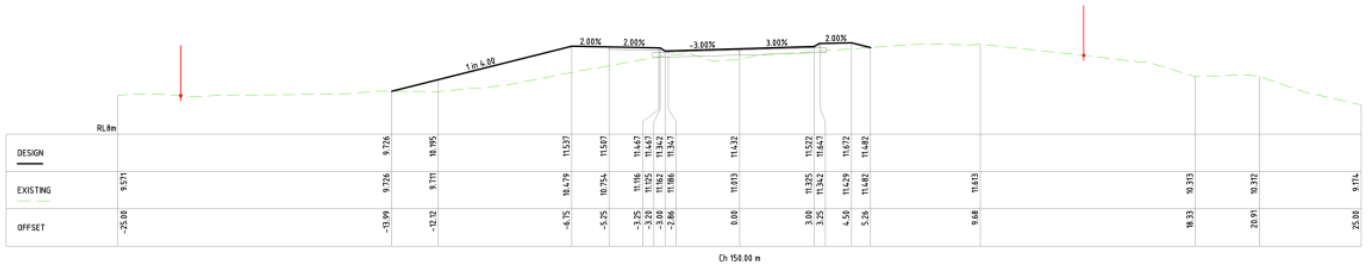
SURVEYED:	S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR	
DESIGNED:	K. RICHTER 6/2024
CIVIL DESIGNER	
DRAWN:	K. RICHTER 6/2024
CIVIL DESIGNER	
CHECKED:	* P. WILLIAMS 22/10/24
COORDINATOR DESIGN	
AUTHORISED:	* I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS	
APPROVED:	* H. SINGH 01/11/24
DIRECTOR ASSETS	

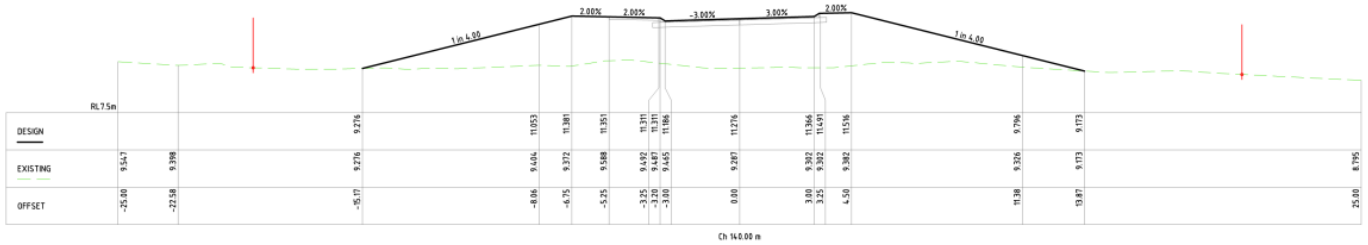
FINANCE CODE	PR-4234
DRAWING SET REF	21/561672
PMD No.	20009
PMD CONTAINER No.	38998

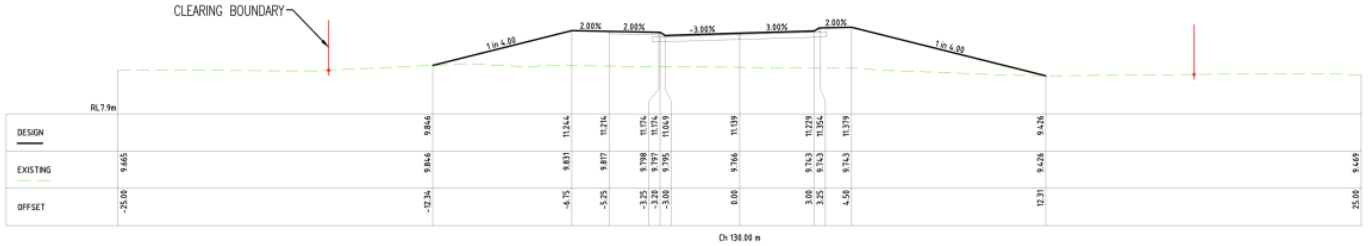
DRAWING No.	SHEET	REVISION	ORIGINAL DRG. SIZE
3786-17-0			A1

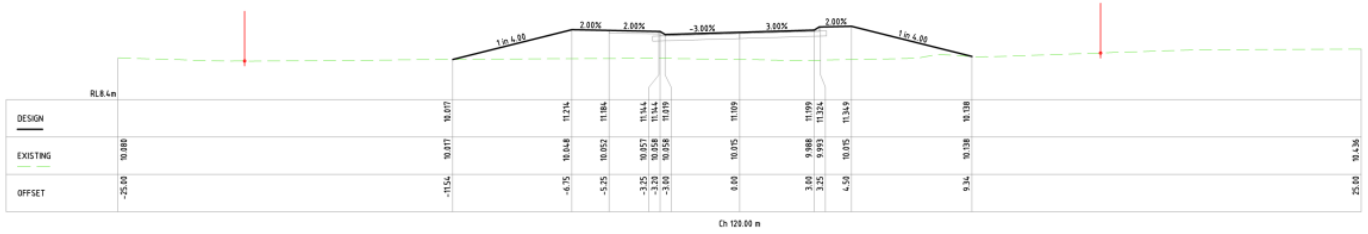
SOUTHERN SIDE

NORTHERN SIDE









SCALE H 1:100
V 1:100

CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CROSS SECTIONS

SHEET 4 OF 13

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER

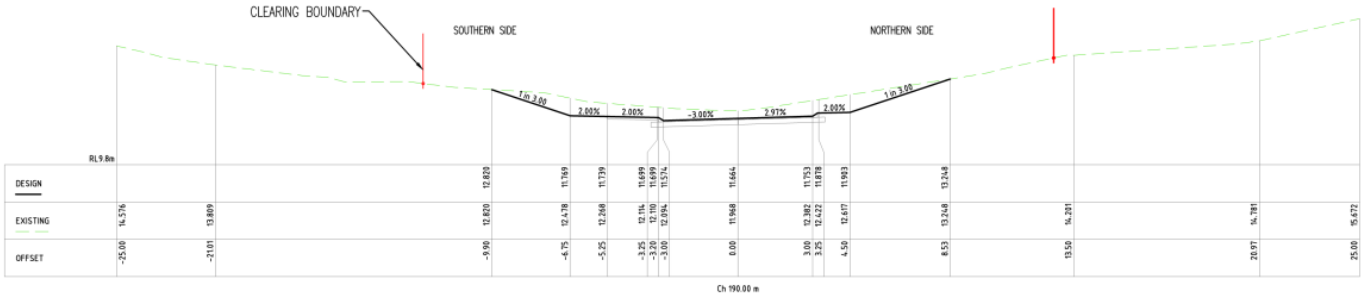
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN

AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672

PWD No.: 20009
PWD CONTAINER No.: 38998

DRAWING No.: 3786-18-0
SHEET: REVISION
ORIGINAL DRG. SIZE: A1



SCALE H 1:100
V 1:100

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN
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MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
PWD No.: 20009
PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

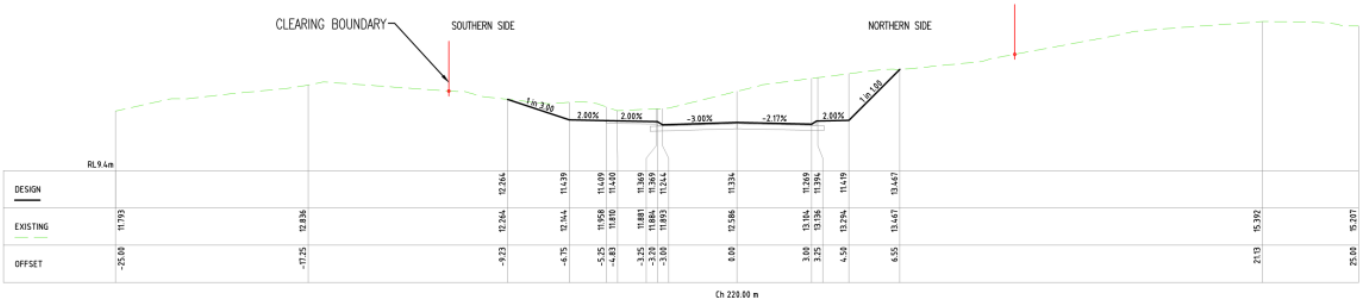
TWO ROCKS ROAD

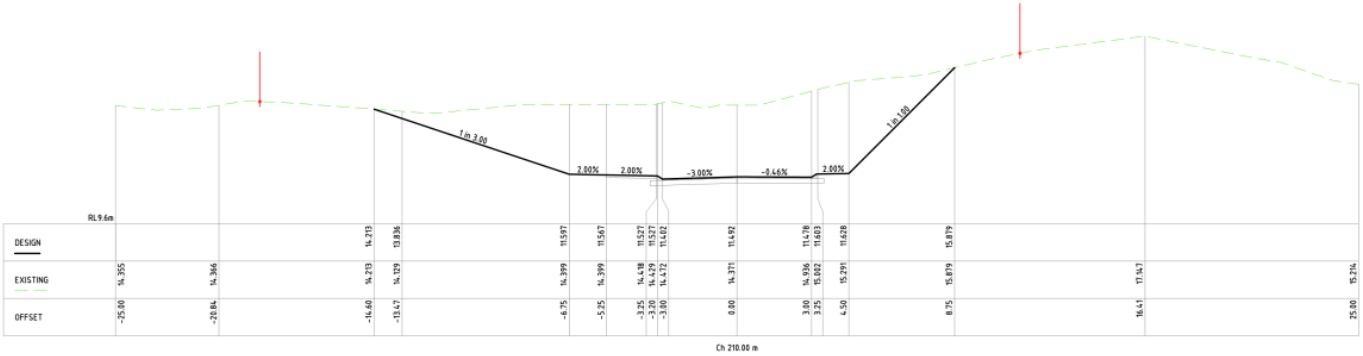
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

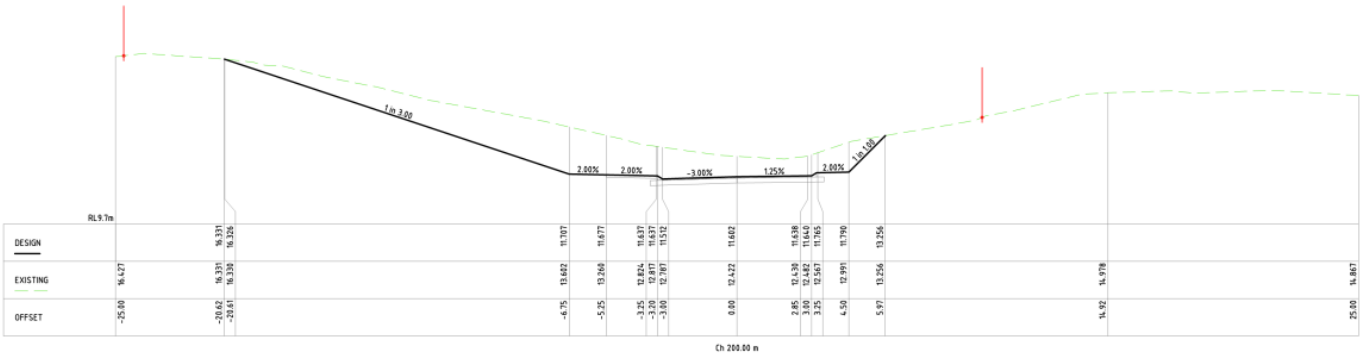
CROSS SECTIONS

SHEET 5 OF 13

DRAWING No.: 3786-19-0
SHEET
REVISION
ORIGINAL DRG. SIZE: A1







SCALE H 1:100
V 1:100

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN
AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
PWD No.: 20009
PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

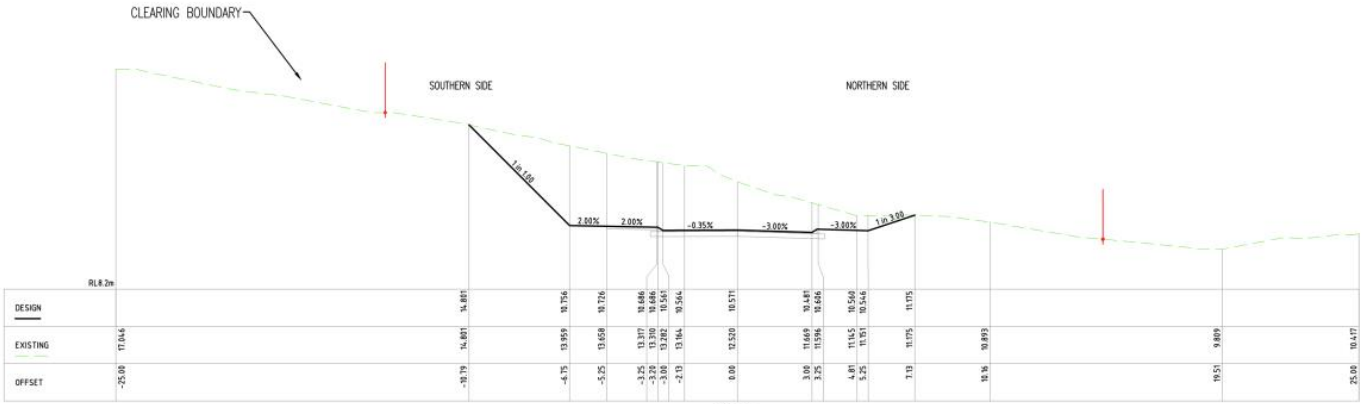
TWO ROCKS ROAD

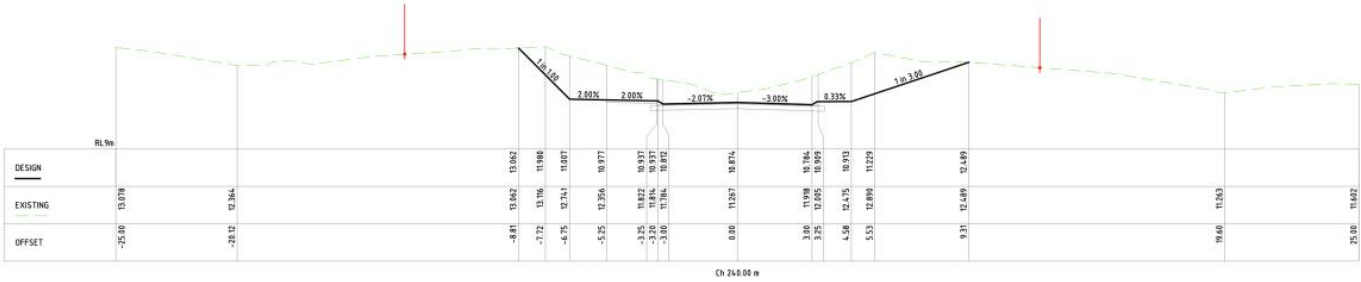
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

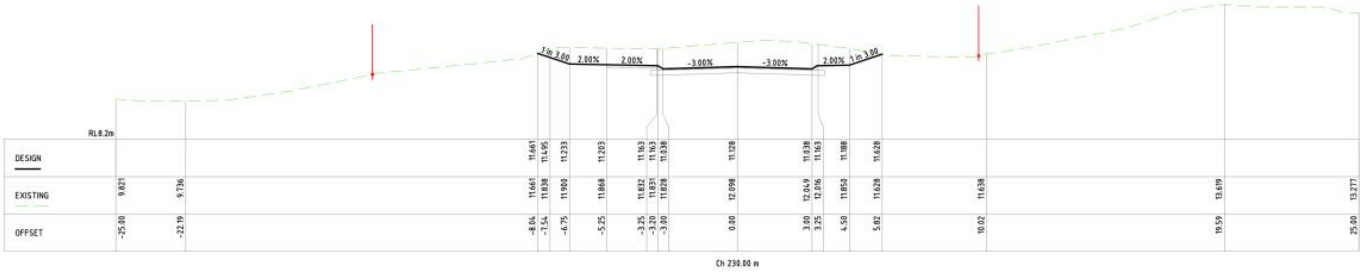
CROSS SECTIONS

SHEET 6 OF 13

DRAWING No. 3786-20-0
SHEET
REVISION
ORIGINAL DRG. SIZE A1







SCALE H 1:100
V 1:100

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)
DATUM: LOCAL
SHEET: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN
AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
PWD No.: 20009
PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

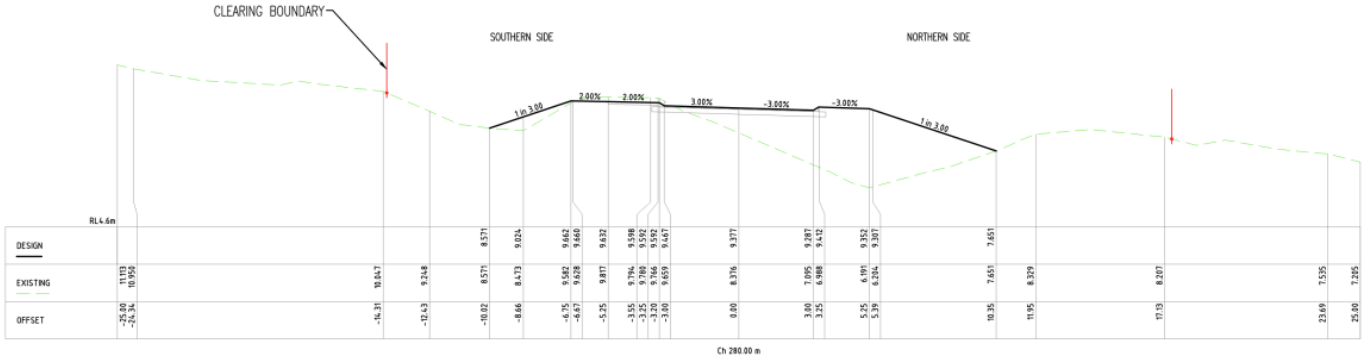
TWO ROCKS ROAD

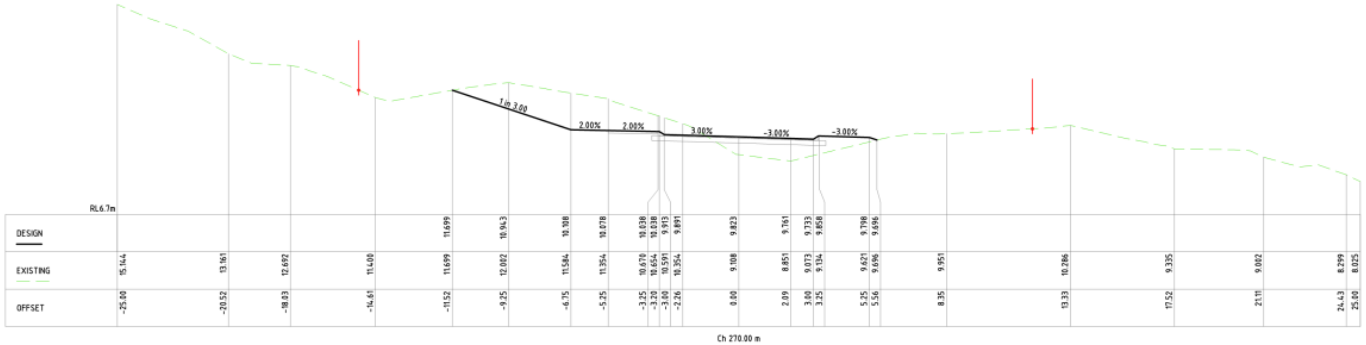
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

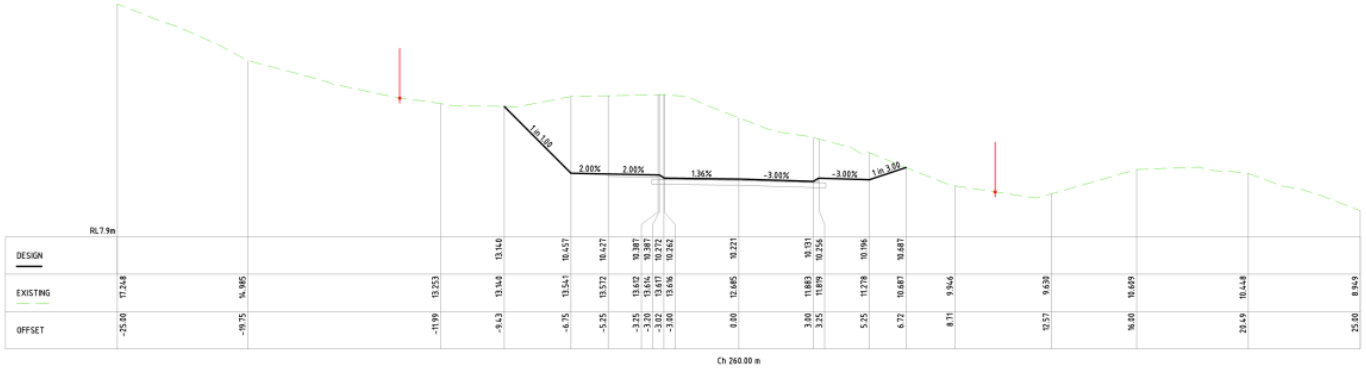
CROSS SECTIONS

SHEET 7 OF 13

DRAWING No.: 3786-21-0
SHEET
REVISION
ORIGINAL DRG. SIZE: A1







SCALE H 1:100
V 1:100

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)
DATUM: LOCAL
SHEET: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN
AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
PWD No.: 20009
PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

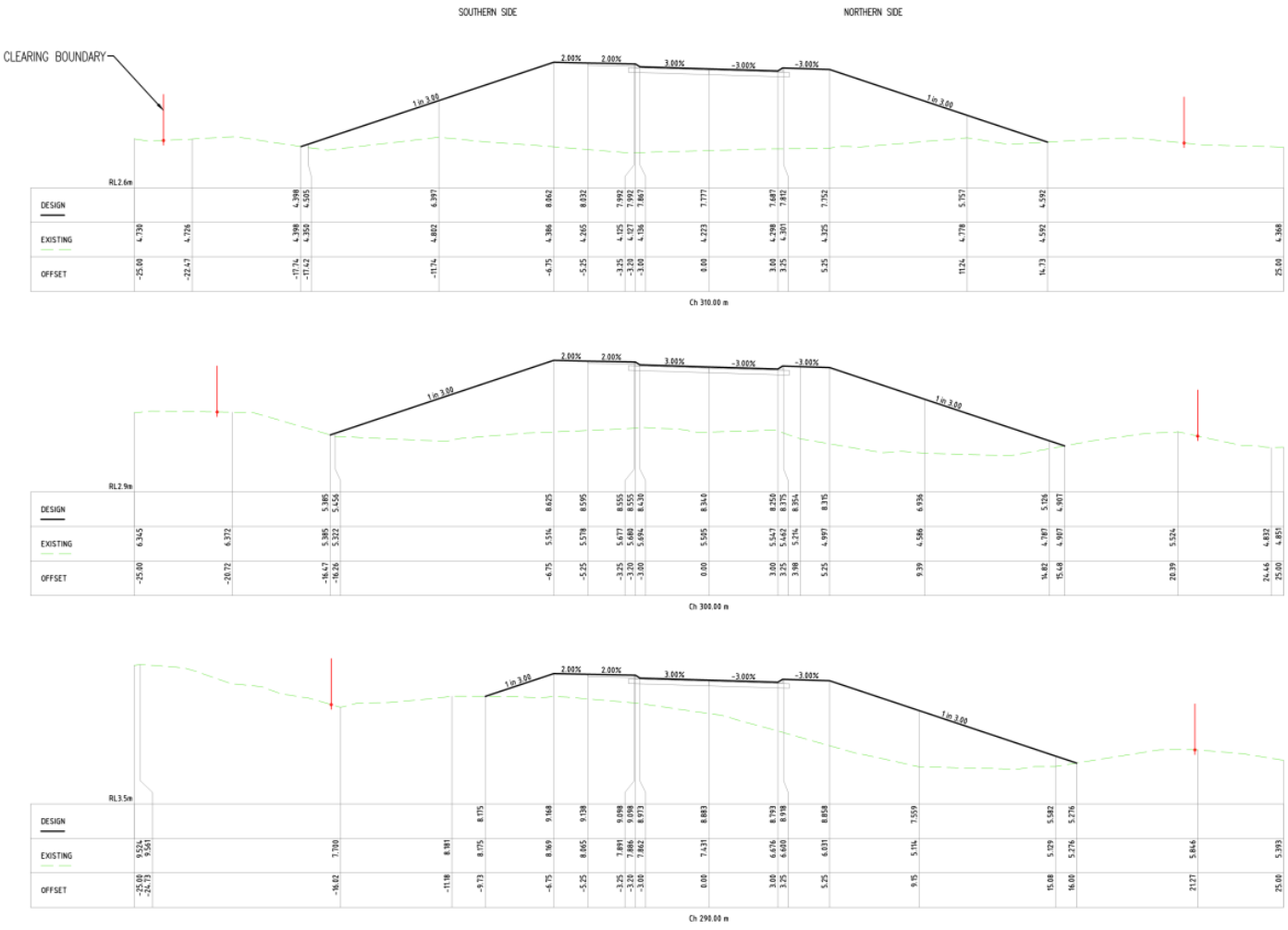
TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CROSS SECTIONS

SHEET 8 OF 13

DRAWING No.: 3786-22-0
SHEET / REVISION: A1
ORIGINAL DRG. SIZE



SCALE H 1:100
V 1:100

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN
AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
PWD No.: 20009
PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

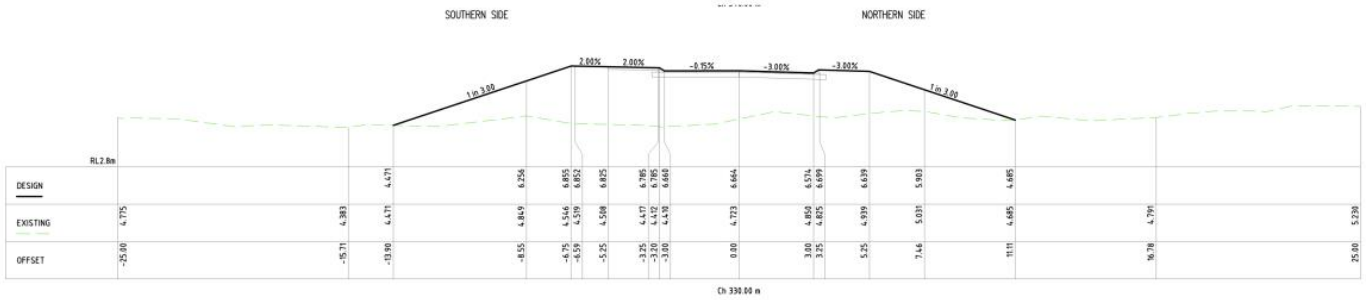
TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CROSS SECTIONS

SHEET 9 OF 13

DRAWING No. 3786-23-0
SHEET
REVISION
ORIGINAL DRG. SIZE A1



SCALE H 1:100
V 1:100

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)

DATUM: LOCAL | GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR

DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER

DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER

CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN

AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS

APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672

PWD No.: 20009
PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

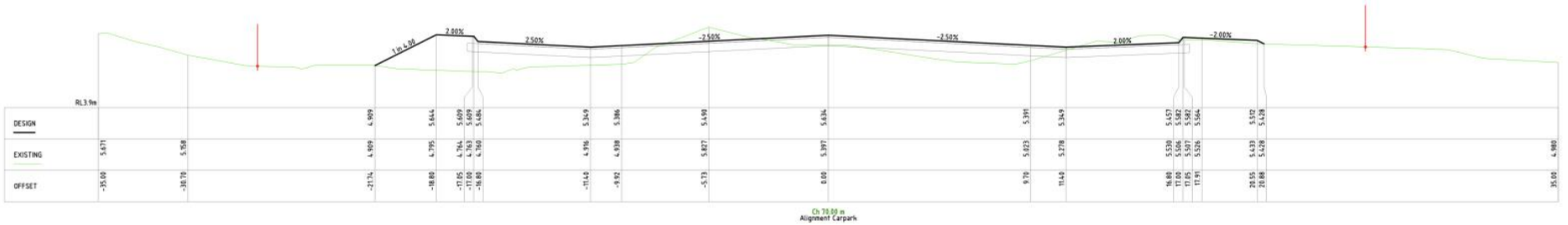
TWO ROCKS ROAD

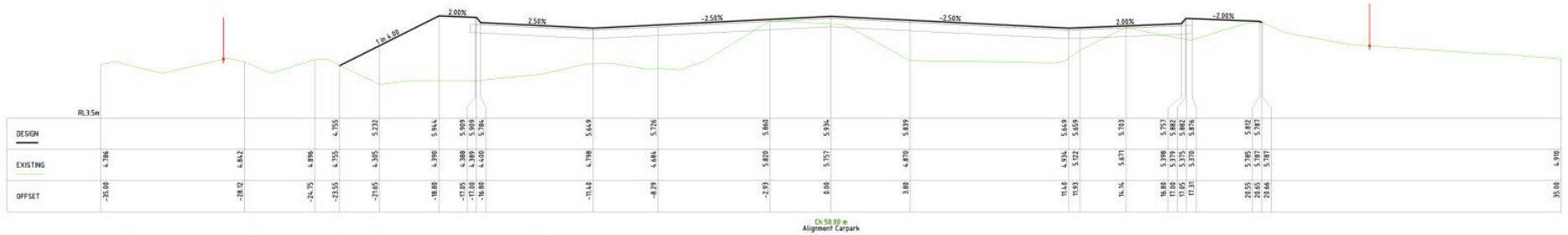
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

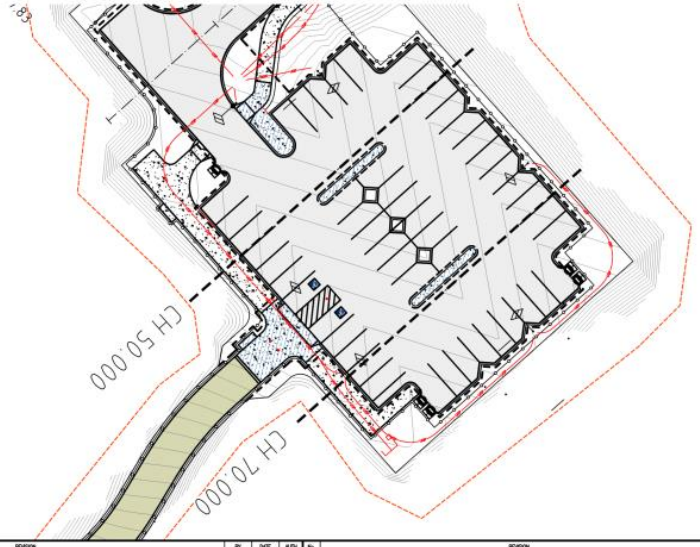
CROSS SECTIONS

SHEET 10 OF 13

DRAWING No. 3786-24-0 | SHEET | REVISION | ORIGINAL DRG. SIZE A1







REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR:
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN
AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
PWD No.: 20009
PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

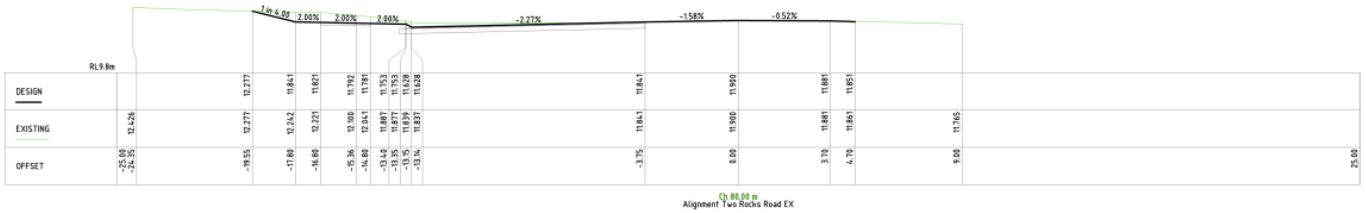
TWO ROCKS ROAD

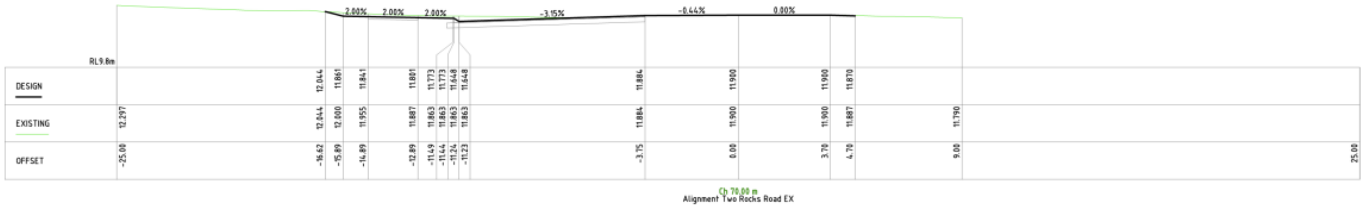
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

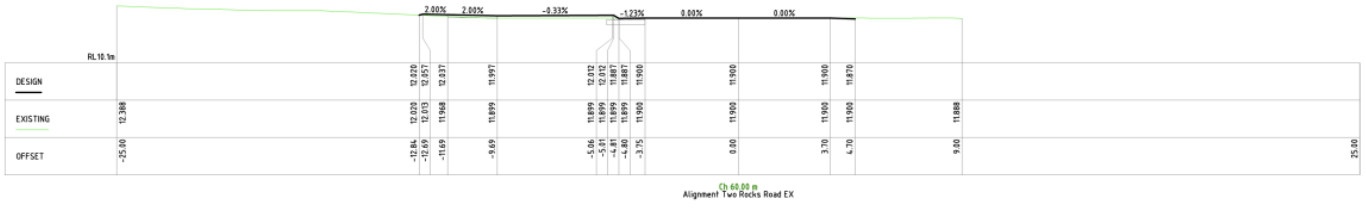
CROSS SECTIONS

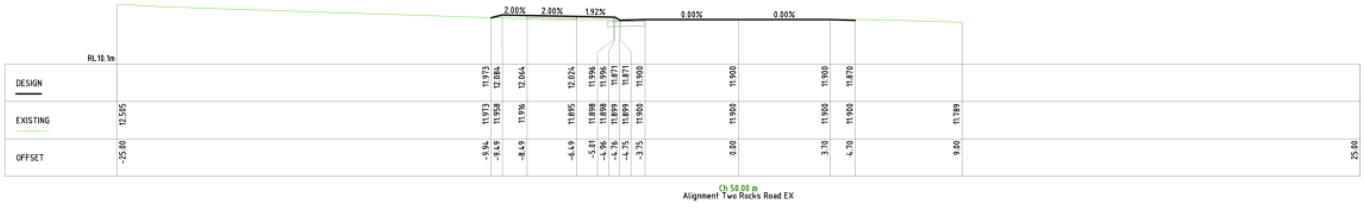
SHEET 11 OF 13

DRAWING No.: 3786-25-0
SHEET
REVISION
ORIGINAL DRG. SIZE: A1









REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)

DATUM: LOCAL | GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR

DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER

DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER

CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN

AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS

APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672

PWD No.: 20009
PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

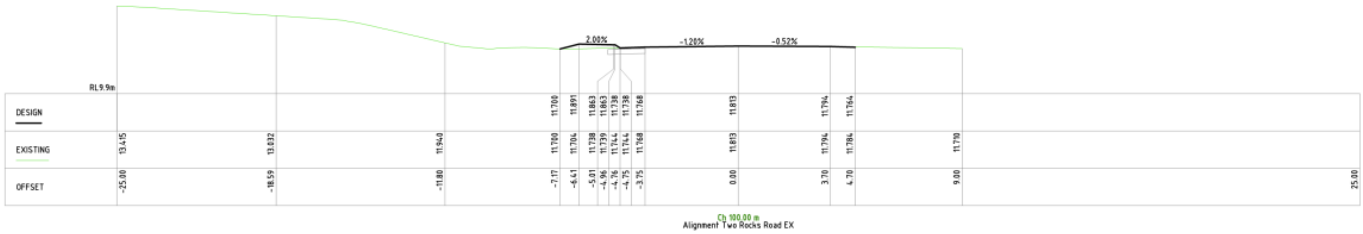
TWO ROCKS ROAD

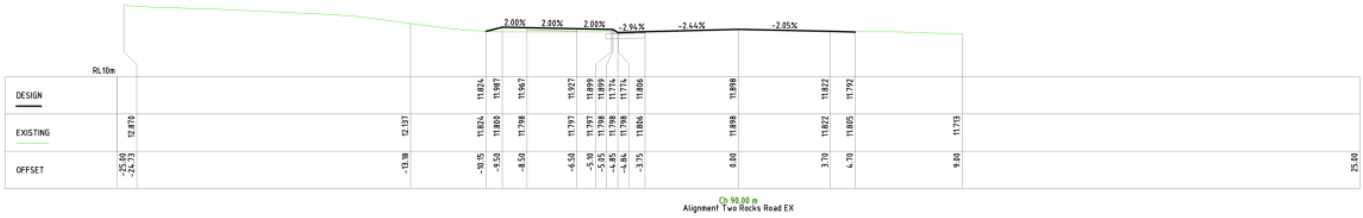
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CROSS SECTIONS

SHEET 12 OF 13

DRAWING No. 3786-26-0 | SHEET | REVISION | ORIGINAL DRG. SIZE A1





SCALE H 1:100

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METRES)

DATUM: LOCAL | SHEET: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR

DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER

DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER

CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN

AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS

APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS

FINANCE CODE: PR-4234

DRAWING SET REF: 21/561672

PWD No.: 20009

PWD CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

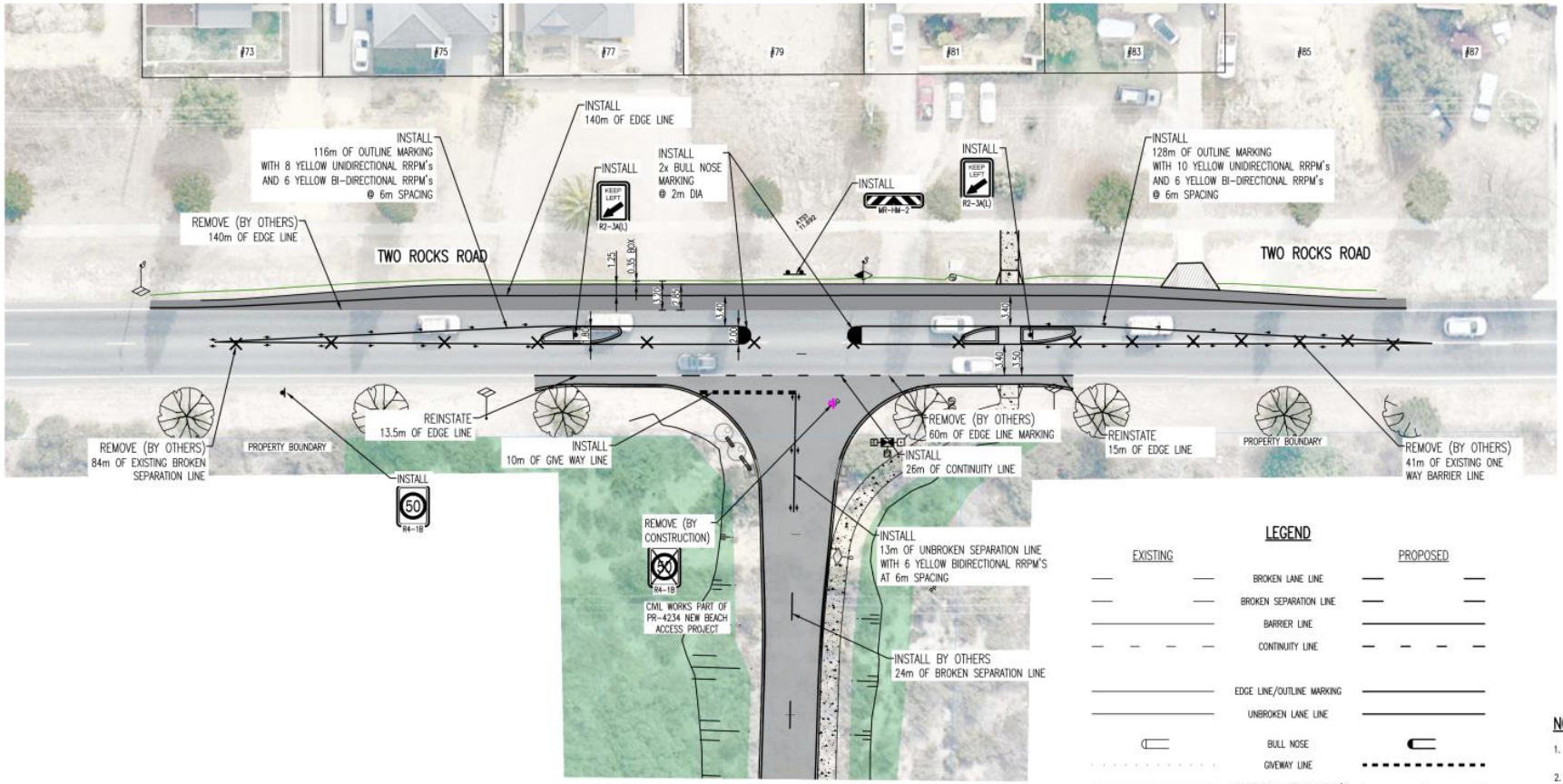
TWO ROCKS ROAD

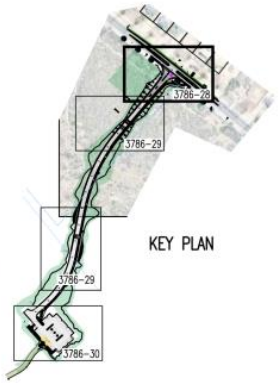
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

CROSS SECTIONS

SHEET 13 OF 13

DRAWING No. 3786-27-0 | SHEET | REVISION | ORIGINAL DRG. SIZE A1





LEGEND

EXISTING		PROPOSED
	BROKEN LANE LINE	
	BROKEN SEPARATION LINE	
	BARRIER LINE	
	CONTINUITY LINE	
	EDGE LINE/OUTLINE MARKING	
	UNBROKEN LANE LINE	
	BULL NOSE	
	GIVEWAY LINE	
	UNIDIRECTIONAL YELLOW RRPM'S	
	BI-DIRECTIONAL YELLOW RRPM'S	
	UNIDIRECTIONAL WHITE RRPM'S	
	ROUNDABOUT EXIT LINE	
	SINGLE POST SIGN	

PAVEMENT MARKINGS TO BE GROUND OFF AND ANY RRPM'S TO BE REMOVED BY COW

NOTES:

1. CADASTRAL INFORMATION APPROXIMATE ONLY.
2. X DENOTES EXISTING LINE TO BE REMOVED BY THE CITY OF WANNEROO.
3. ALL PAVEMENT LINEMARKING LINETYPES TO CONFORM WITH MRWA DRAWING NO 9931-0198-2 AND 200331-091.
4. WHITE LINING AND SIGNAGE TO BE UNDERTAKEN BY MRWA OR ITS CONTRACTORS.

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	6/2024	
REVISION - AMENDED SIGN AND LINEMARKING AND ELECTRICAL AND LIGHTING WORKS	K.R.	1/2025	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:250 (2.5 0 2.5 5.0 7.5 10.0 12.5 SCALE IN METRES)
DATUM: LOCAL | SHEET: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR:
DESIGNED: K. RICHTER 6/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN
DRAWN: K. RICHTER 6/2024
CIVIL DESIGNER

AUTHORISED: * B. GEE 01/11/24
MANAGER ASSETS MAINTENANCE
AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS
AUTHORISED: * M. PEARCE 23/10/24
MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT
AUTHORISED: * G. CHETTLEBURGH 23/10/24
MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
FWO No.: 20009
DRAWING SET REF: 21/561672
FWO CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

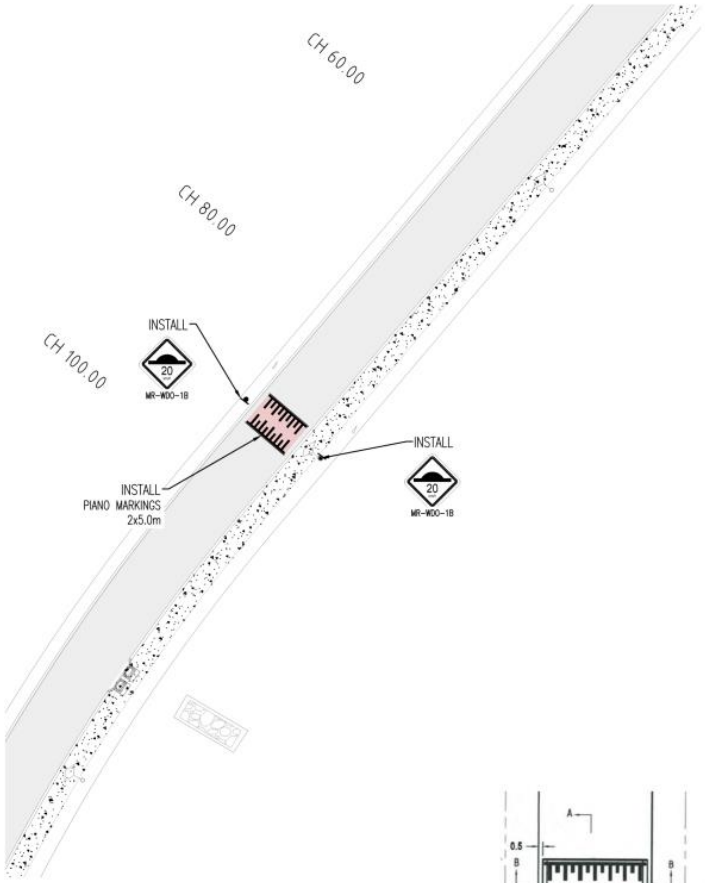
TWO ROCKS ROAD

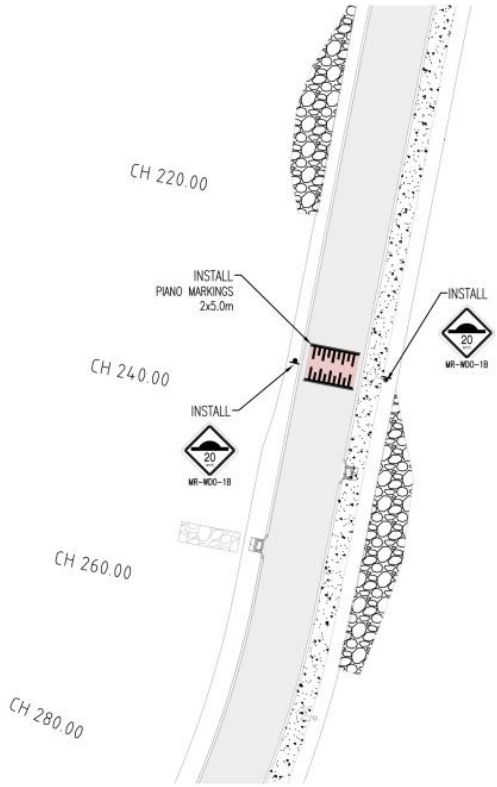
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CAR PARK
TWO ROCKS

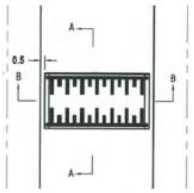
SIGN AND LINEMARKINGS

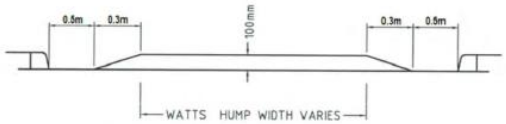
SHEET 1 OF 3

DRAWING No.: 3786-28-1
SHEET: 1
REVISION: A1
ORIGINAL DRG. SIZE

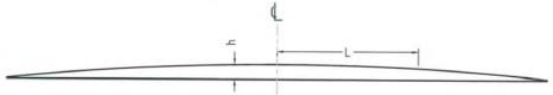






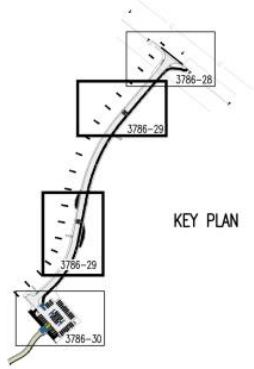


WATTS PROFILE HUMP (WITHOUT A BICYCLE BYPASS)
SECTION B-B



DISTANCE L(m)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.85
HEIGHT h(mm)	100	100	99	97	95	93	90	86	81	76	71	65	58	51	43	34	25	16	5	0

WATTS PROFILE HUMP
SECTION A-A



KEY PLAN

LEGEND

EXISTING		PROPOSED
	SINGLE POST SIGN	
	PROPOSED STREETLIGHT	

NOTES:

1. CADASTRAL INFORMATION APPROXIMATE ONLY.
2. X DENOTES EXISTING LINE TO BE REMOVED BY THE CITY OF WANNEROO.
3. ALL PAVEMENT LINEMARKING LINETYPES TO CONFORM WITH MRWA DRAWING NO 9931-0198-2 AND 200331-091.
4. WHITE LINING AND SIGNAGE TO BE UNDERTAKEN BY MRWA OR ITS CONTRACTORS.

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	

REVISION	BY	DATE	AUTH

SCALE: 1:250 (2.5 0 2.5 5.0 7.5 10.0 12.5 SCALE IN METRES)
DATUM: LOCAL
SITE: MGA 50

SURVEYED: NEARMAP 27/10/2019
SURVEYOR:
DESIGNED: K. RICHTER 8/2024
CIVIL DESIGNER
CHECKED:
COORDINATOR DESIGN
DRAWN: K. RICHTER 8/2024
CIVIL DESIGNER

AUTHORISED:
MANAGER ASSETS MAINTENANCE
AUTHORISED:
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED:
DIRECTOR ASSETS
AUTHORISED:
MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT
AUTHORISED:
MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
FWD No.: 20009
FWD CONTAINER No.: 38998

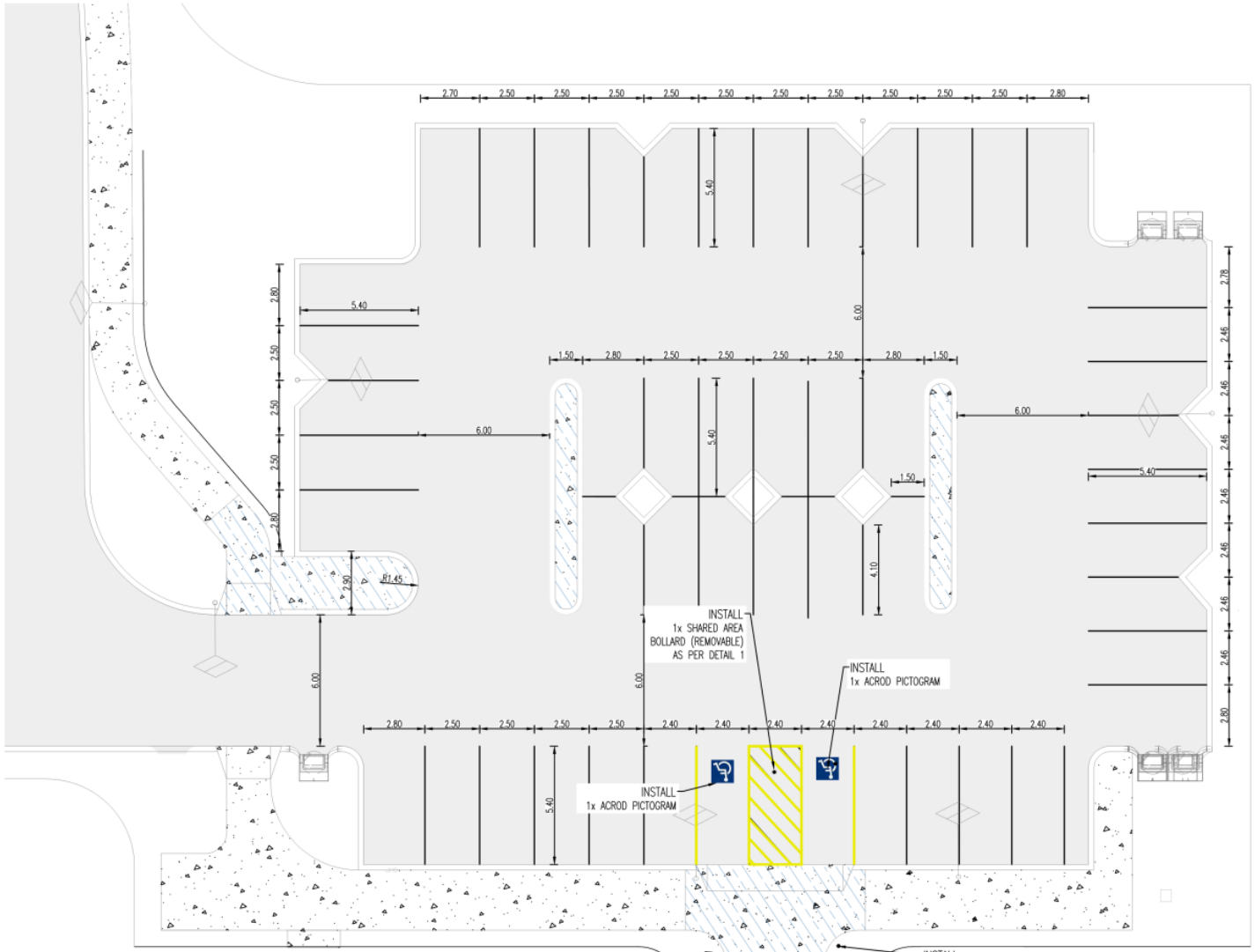
CITY OF WANNEROO
ASSETS

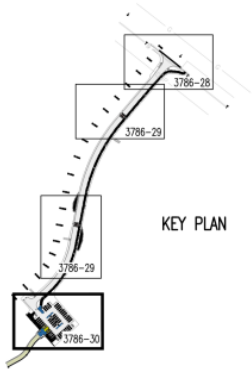
TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CAR PARK
TWO ROCKS

SIGN AND LINEMARKINGS
SHEET 2 OF 3

DRAWING No. 3786-29-0 | SHEET | REVISION | ORIGINAL DRG. SIZE A1





KEY PLAN

LEGEND

PROPOSED

CAR BAY LINEMARKING (WHITE)

ACROD BAY LINEMARKING (YELLOW)

DETAIL 1

BOLLARDS TO BE:
–1300MM HIGH STEEL
–YELLOW POWDER COATING
–CLASS 1 RED REFLECTIVE BAND

AS PER AUSTRALIAN STANDARD 2890.6–2009

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	

No.	REVISION	BY	DATE	AUTH

SCALE: 1:100 (1.0 0 1.0 2.0 3.0 4.0 5.0 SCALE IN METERS)
DATUM: LOCAL
SHEET: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 8/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 8/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
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AUTHORISED: * B. GEE 01/11/24
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DIRECTOR ASSETS
AUTHORISED: * M. PEARCE 23/10/24
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AUTHORISED: * G. CHETTLEBURGH 23/10/24
MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
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FMS No.: 20009
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CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CAR PARK
TWO ROCKS

SIGN AND LINEMARKINGS
SHEET 3 OF 3

DRAWING No. 3786-30-0
SHEET
REVISION
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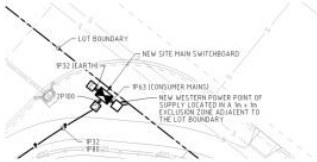
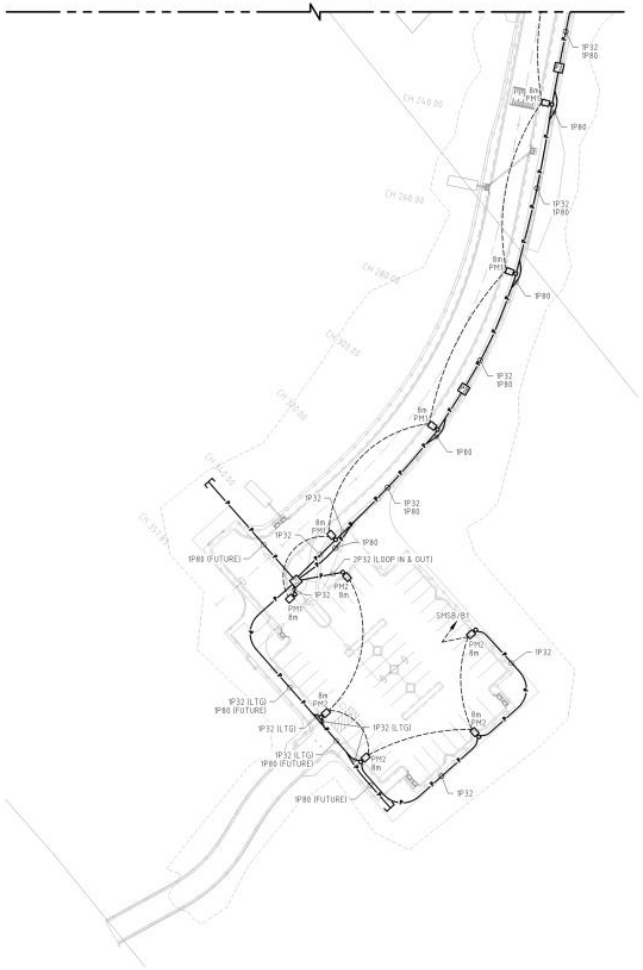


PART C SITE SERVICES LAYOUT
SCALE 1:200 @ A1

REFER PART B SITE SERVICES FOR CONTINUATION



PART A SITE SERVICES LAYOUT
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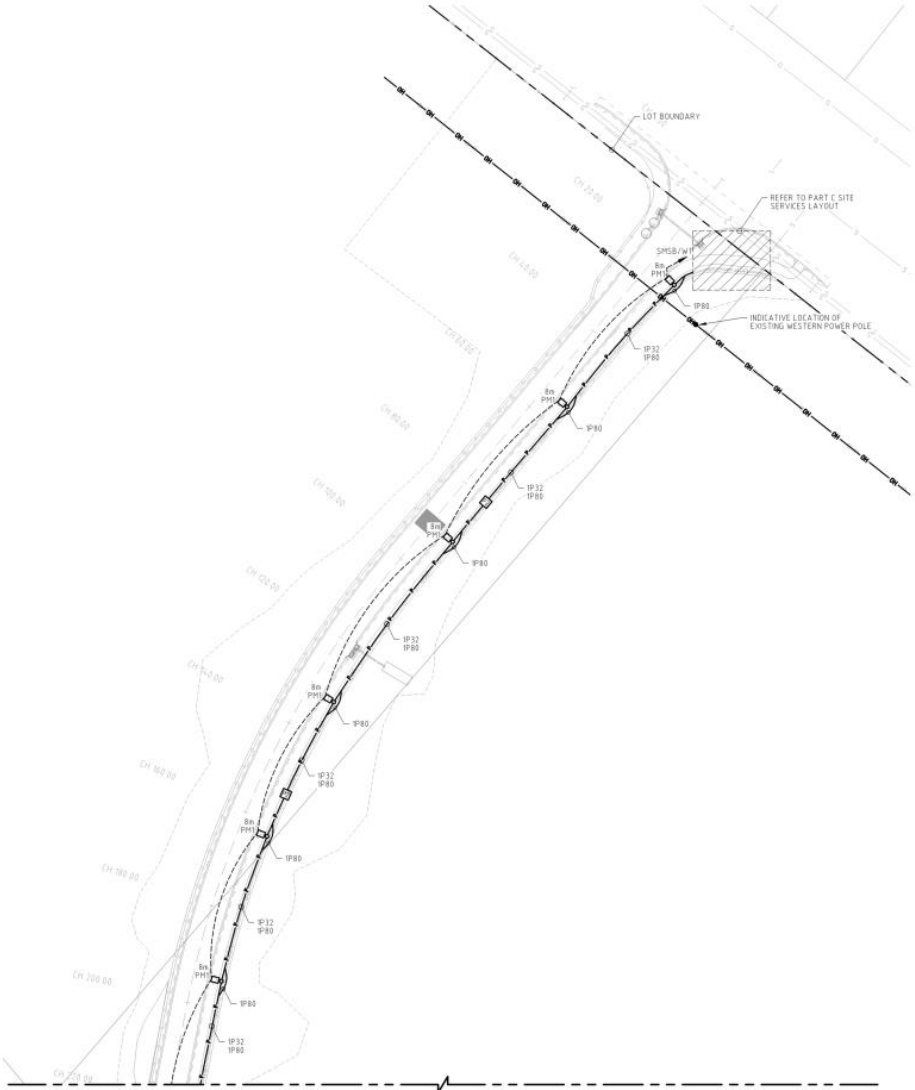


PART B SITE SERVICES LAYOUT
SCALE 1:500 @ A1

REFER PART A SITE SERVICES FOR CONTINUATION

POWER LEGEND

- SMSB — SITE MAIN SWITCHBOARD
- SUPPLY AUTHORITY POINT OF ATTACHMENT
- ELECTRICAL CABLE PIT – ACO CABLE MATE TYPE 66H WITH GALVANISED POWERLOK LID
- EARTH PIT
- UNDERGROUND POWER CONDUIT
- EXISTING OVERHEAD SERVICES CONDUCTORS
- LOT BOUNDARY
- #Px — INDICATES QUANTITY & DIAMETER OF POWER CONDUIT '#' DENOTES QUANTITY OF CONDUITS 'x' DENOTES CONDUIT DIAMETER (mm)
- E — DENOTES CONDUIT CAPPED OFF UNDERGROUND

LIGHTING LEGEND

(REFER TO THE SPECIFICATION FOR REQUIREMENTS)

- SINGLE POLE MOUNTED LUMINAIRE

SINGLE LINE LEGEND

- A/B — CIRCUIT BREAKER A = AMPS, B = # PHASES
- A/B — COMBINED RCD / MCB (RCBO) 30mA RATED UNLESS NOTED OTHERWISE A = AMPS, B = # PHASES
- D — LOAD BREAK/FAULT MAKE ISOLATOR
- A/B — HRC FUSE A = CARTRIDGE SIZE, B = FUSE RATING
- A — CONTACT NORMALLY OPEN A = RELAY OR CONTACT NUMBER
- A — CONTACT NORMALLY CLOSED A = RELAY OR CONTACT NUMBER
- SURGE DIVERTER
- TRANSFORMER
- No. — CONTACTOR COIL No. = CONTACTOR NUMBER
- MEN LINK XXX — MEN LINK
- kWH — kWH METER COMPLETE WITH FUSES SA = SUPPLY AUTHORITY MASTER METER
- DP2 — DIGITAL POWER ANALYSER
- SINGLE PHASE LINE & NEUTRAL
- THREE PHASE LINE & NEUTRAL

VARIANTS

PM POLE MOUNTED

SCALE 1:200
0 2 4 8 12 16 20
SCALE 1:500
0 5 10 20 30 40 50

ISSUED FOR TENDER
REFER TO REVISION COLUMN

FOCUSWA CONSULTING
FOCUS CONSULTING WA

CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD
94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

ELECTRICAL SERVICES
OVERALL SITE PLAN AND LEGEND

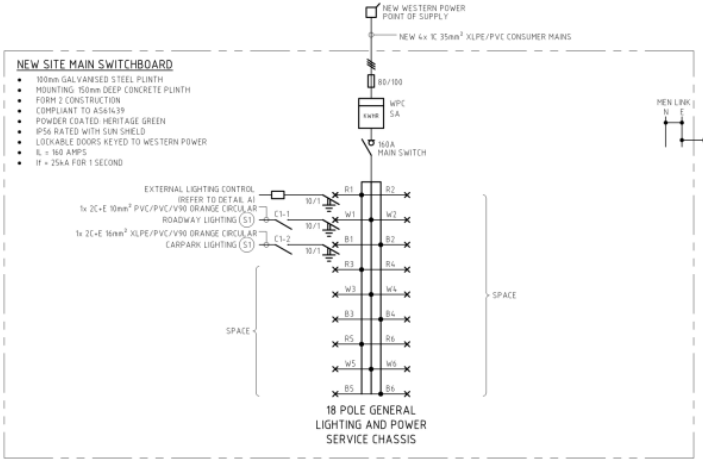
REVISION	BY	DATE	AUTH
ISSUED FOR TENDER	PAU	12.12.24	PAU

SCALE: —
DATUM: LOCAL
GRID: LOCAL
SURVEYED: N/A /2024
DESIGNED: P.JEFFS 11/2024
DRAWN: 11/2024
DESIGNER
CHECKED
COORDINATOR DESIGN
AUTHORISED: MANAGER COMMUNITY FACILITIES
AUTHORISED: MANAGER PARKS & CONSERVATION MANAGEMENT
AUTHORISED: MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: DIRECTOR ASSETS
FINANCE CODE: 00-XXXX
WO No.: XXXXXXX
DRAWING SET KEY: XX/XXXXXX
FMS CONTAINER No.: XXXXX

DRAWING No.: 3786-31-0
SHEET
REVISION
ORIGINAL DRG. SIZE: A1

3786-31-0

3786-32-0



DETAIL A - TYPICAL DISTRIBUTION BOARD AND UNDERGROUND CONTAINMENT DETAIL
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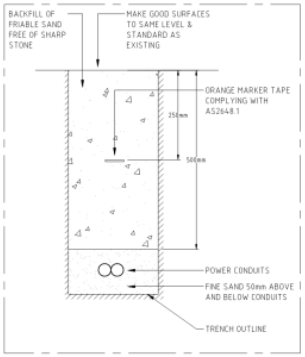

DETAIL B - TYPICAL POWER CONDUIT INSTALLATION
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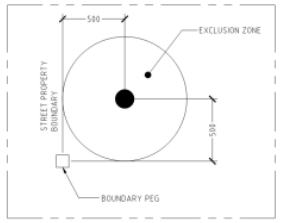
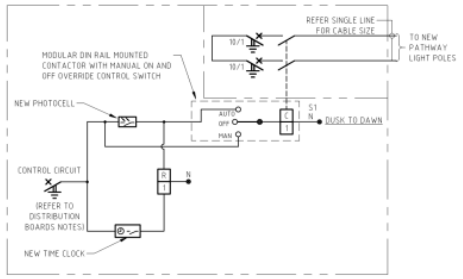
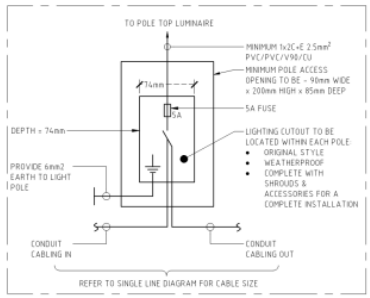


DETAIL C - POWER PILLAR EXCLUSION BOUNDARY
N.T.S.



DETAIL D - EXTERNAL LIGHTING CONTROL DETAIL
N.T.S.



DETAIL E - POLE CABLING CONNECTION DETAIL
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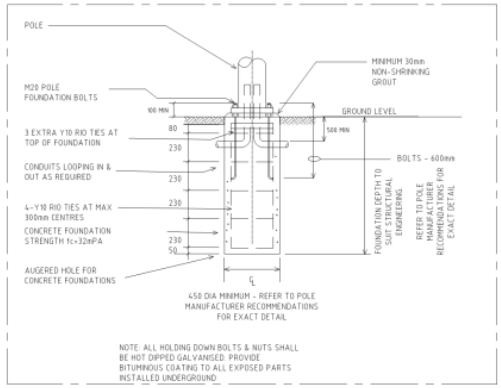


DETAIL F - TYPICAL POLE FOUNDATION - SURFACE MOUNTED- ELEVATION
N.T.S.

ISSUED FOR TENDER
REFER TO REVISION COLUMN

FOCUSWA CONSULTING
FOCUS CONSULTING WA

CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CARPARK
TWO ROCKS

ELECTRICAL SERVICES

SINGLE LINE DIAGRAM AND DETAILS

REVISION	BY	DATE	AUTH
ISSUED FOR TENDER	PRJ	12.12.24	PRJ

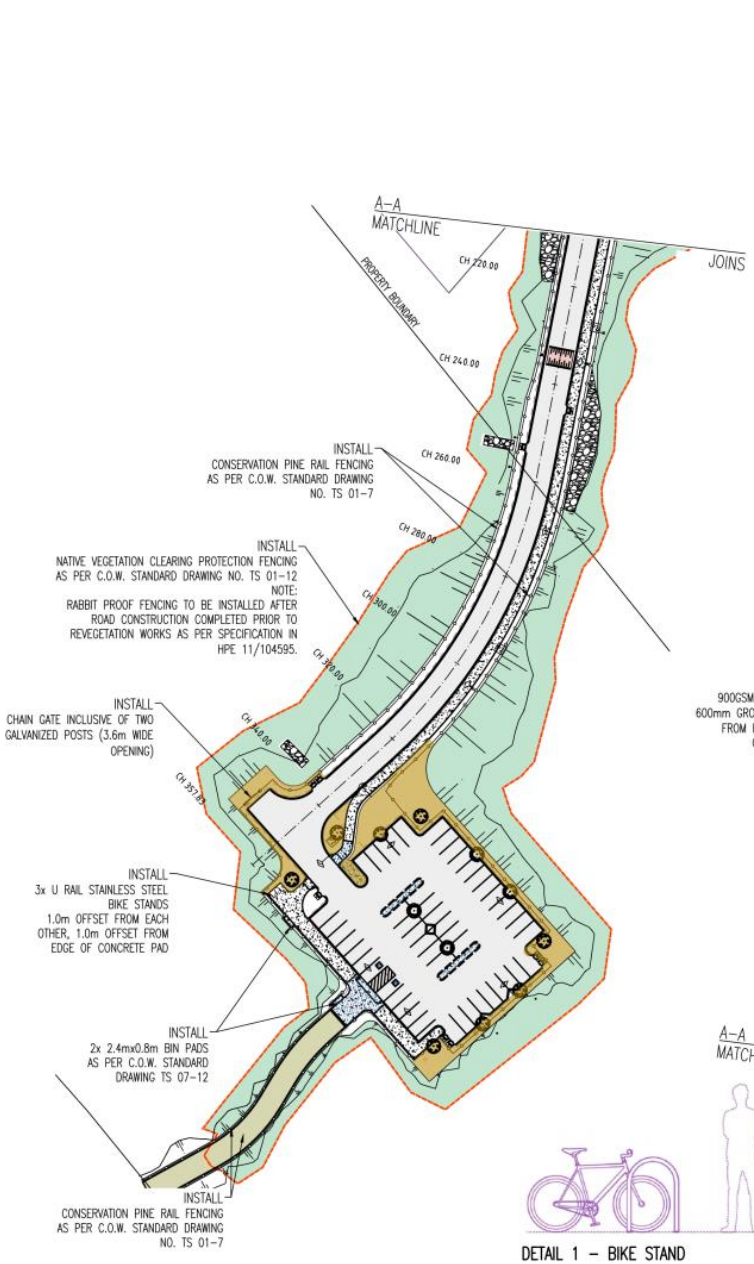
REVISION	BY	DATE	AUTH

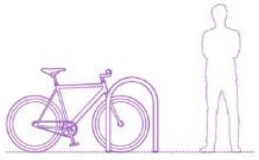
SCALE:
DATUM: LOCAL
GRID: LOCAL

SURVEYED: NA /2024
SURVEYOR
DESIGNED: P.JEFFS 11/2024
DESIGNER
DRAWN: 11/2024
DESIGNER
CHECKED:
COORDINATOR DESIGN

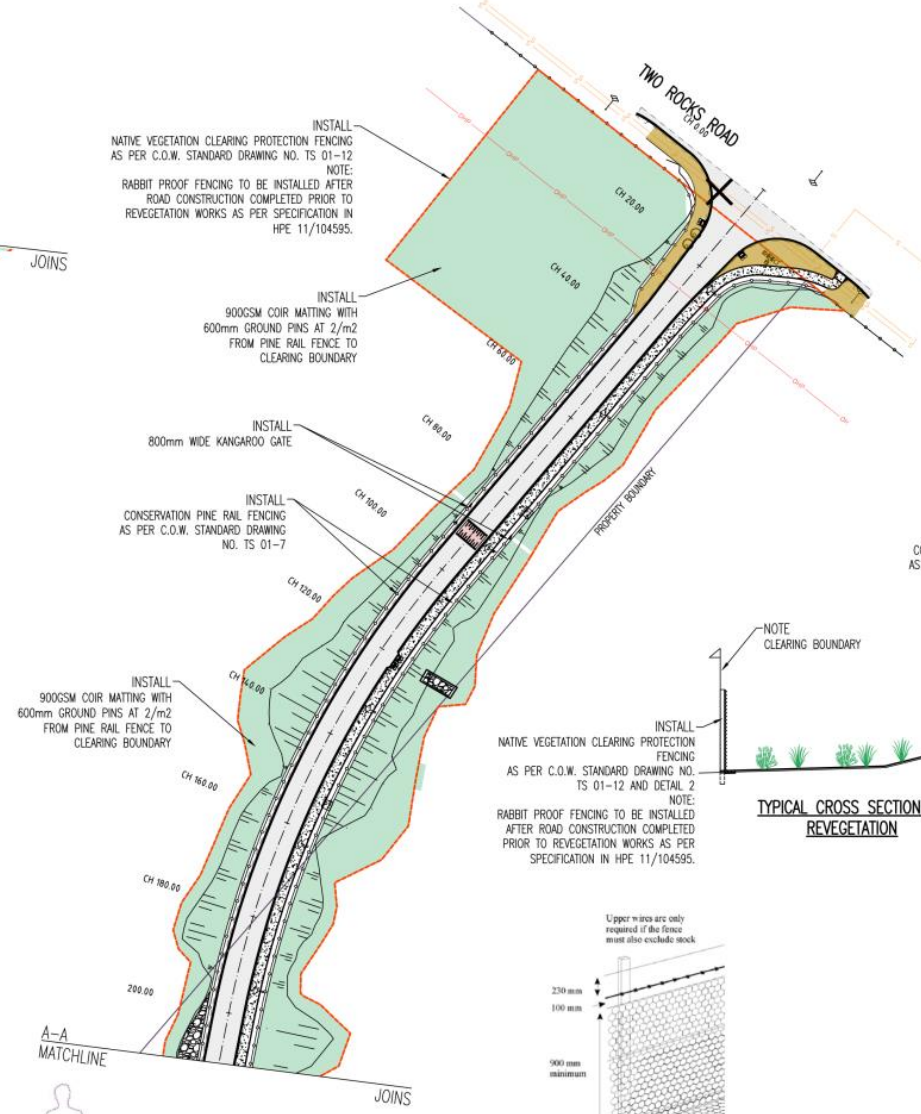
AUTHORISED: MANAGER COMMUNITY FACILITIES
AUTHORISED: MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: DIRECTOR ASSETS
AUTHORISED: MANAGER PARKS & CONSERVATION MANAGEMENT
FINANCE CODE: 00-XXXX
WO No.: XXXXXXX
DRAWING SET REF: XX/XXXXXX
WO CONTAINER No.: XXXXX

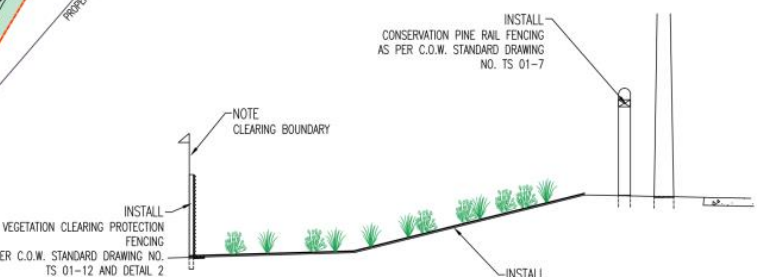
DRAWING No.: 3786-32-0
SHEET
REVISION
ORIGINAL DRG. SIZE: A1



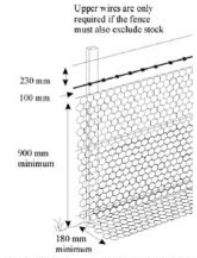


DETAIL 1 – BIKE STAND





TYPICAL CROSS SECTION OF REVEGETATION



DETAIL 2 – RABBIT PROOF FENCE

LEGEND

	PROPOSED
TREE / SHRUB	
REVEGETATION AREA/COIR MATTING	
CONSERVATION FENCE	
CLEARING BOUNDARY	
MULCH/ LANDSCAPING	

LANDSCAPING:

1. SPECIES OF PROPOSED VEGETATION AND LOCATIONS TO BE DETERMINED BY LANDSCAPE DESIGNER. PROJECT MANAGER TO LIAISE WITH ASSIGNED C.O.W. LANDSCAPE DESIGNER IN CONSTRUCTION YEAR.
2. NO IRRIGATION DESIGNED. WATERING TO BE DONE BY WATERING TRUCKS.

REVISION	BY	DATE	AUTH
DRAFT COPY			
ISSUED	K.R.	8/2024	
REVISION – AMENDED ACCESS ROAD AND CARPARK ELECTRICAL AND LIGHTING WORKS	K.R.	1/2025	

REVISION	BY	DATE	AUTH

SCALE: 1:500 (5 0 5 10 15 20 25 SCALE IN METRES)
DATUM: LOCAL
GRID: MGA 50

SURVEYED: S. BUCKLE, MNG LIDAR 10/2019
SURVEYOR
DESIGNED: K. RICHTER 8/2024
CIVIL DESIGNER
DRAWN: K. RICHTER 8/2024
CIVIL DESIGNER
CHECKED: * P. WILLIAMS 22/10/24
COORDINATOR DESIGN

AUTHORISED: * B. GEE 01/11/24
MANAGER ASSETS MAINTENANCE
AUTHORISED: * I. NICHOLSON 01/11/24
MANAGER INFRASTRUCTURE CAPITAL WORKS
APPROVED: * H. SINGH 01/11/24
DIRECTOR ASSETS
AUTHORISED: * M. PEARCE 23/10/24
MANAGER STRATEGIC LAND USE PLANNING & ENVIRONMENT
AUTHORISED: * G. CHETTLEBURGH 23/10/24
MANAGER PARKS & CONSERVATION MANAGEMENT

FINANCE CODE: PR-4234
DRAWING SET REF: 21/561672
FMS No.: 20009
FMS CONTAINER No.: 38998

CITY OF WANNEROO
ASSETS

TWO ROCKS ROAD

94 TWO ROCKS ROAD
BEACH ACCESSWAY AND CAR PARK
TWO ROCKS

LANDSCAPING AND STREET FURNITURE
SHEET 1 OF 1

DRAWING No.: 3786-34-1
SHEET
REVISION
ORIGINAL DRG. SIZE: A1

Appendix B

Coastal Aquatic Risk Assessment (SLS WA 2019)

SURF LIFE SAVING WESTERN AUSTRALIA

Coastal Aquatic Risk Assessment

Unwin Shoals

(87 Two Rocks Road)

November 2019

Prepared For:

City of Wanneroo

This information and contents used in this document has been collected and prepared by:

Primary
Chris Peck/General Manager
E: cpeck@slswa.com.au

And

Secondary
Nick Pavy/Lifesaving Coordinator;
E: npavy@slswa.com.au

08/01/2020

Signature Date

Surf Life Saving Western Australia Inc.
7 Delawney Street, BALCATTA WA 6021
PO Box 700, BALCATTA, WA 6914
T (+61 8) 9207 6666

Date	Version	Number	Author/Reviewer	Organisation	Purpose
12/11/2019	DRAFT	0.1	C.Peck/N. Pavy	SLSWA	Draft construct of report
19/11/2019	DRAFT	0.2	Mandy Pearce	City of Wanneroo	For initial comment/Feedback
08/01/2019	FINAL	1.0	C.Peck	SLSWA	Transition to final version following acceptance of Draft version 0.2 by the City of Wanneroo

Table of Contents

1. Background

Surf Life Saving WA (SLSWA) completed a Coastal Aquatic Risk Assessment for the City of Wanneroo in July 2014 covering the Two Rocks area from The Spot south of the Marina through to Durrs Beach on the northern side (Cluster 1). Since this assessment and report was completed, it is now proposed by the City of Wanneroo to undertake capital works and infrastructure program at Unwin Shoals (the 'assessment area').

As a point of reference the assessment area is effectively, the beach location that in a straight line is positioned opposite 87 Two Rocks Road TWO ROCKS.

The proposed works involves the laying of a sealed access road through the foredune that will terminate in a sealed and defined car park. Formal and defined access tracks will lead into the beach from the carpark. Other basic infrastructure such as bike racks, lighting and waste management units are proposed for installation. The infrastructure will be designed to open and provide localised access to the beach known as Unwin Shoals.

The City of Wanneroo has appointed SLSWA to undertake an assessment of the section of beach and provide recommendations regarding suitability for aquatic and recreational activities along the beach fronting the proposed works.

The findings of the assessment are to become an annexure to a previous assessment report[1] SLSWA completed on the City's beaches adjacent to this location.

SLSWA have interpreted the service brief to contain the following actions and/or outcomes.

Undertake at the subject location:

- Assessment of the modal beach hazard rating.
- Indicative assessment of beach usage levels – calculation of Facility Visitation Rates (FVR).
- Review of known incidents.
- Discovery of any known aquatic recreational related risks based on beach use and activity type.
- Development or update of the Cluster 1 report risk register and actions as they relate to aquatic risk management, beach safety signs and flags and public information signage.
- Provide a consolidated coastal risk and safety signage plan for the subject location.

[1] *SLSWA Coastal Aquatic Risk Assessment Cluster 1 Report V 1.0. 01 December 2014.*

2. Site Identification

2.1 Area Summary

SLSA ABSAMP Beach Identifier	ABSAMP Beach Number	City of Wanneroo Name
Unwin Shoals (stretch of beach between The Spot and Leeman's Landing)	WA 899	'The Spot'/Unwin Shoals

The Two Rocks area is a relatively small suburb that is set to expand with residential development occurring nearby or are planned to occur over the next few years. While smaller in population than other locales in the City of Wanneroo a review of available data indicates a population of just over 3000. However, this area is forecast to substantially grow with a projected population by 2041 of nearly 21, 000[2].

Beach visitation rates in this area are currently lower than other more developed locations likely because of the smaller population. The lower beach use in this area is also likely a result of limited formal access points through the foredune. The width of the foredune (approximately 500m) between Two Rocks Road and the beach is also likely to be to influence reduced beach visitation. With the ongoing residential developments, population growth and provisions of open formal access, beach visitation rates are likely to increase.

The assessment area sits between two beach locations that have formalised access. These locations also have infrastructure that is maintained to support use. (E.g. toilets, fencing/barriers, car parking, beach safety signage, play equipment)

2.2 Beach Descriptions

Beach WA 899 (the Spot) is south of Unwin Shoals and is effectively a single stretch of beach. WA 899 terminates at Beach WA 900 (Wreck Point). Beach WA 899 is categorised predominantly as a Low Tide Terrace beach and at times can behave as a Transverse Bar and Rip beach (refer Tables 4 and 5).

Beach **WA 899** is locally named **The Spot.** This location is a popular surfing location with slightly higher waves and a left hand break along the southern calcarenite reef. An unsealed but graded vehicle track from the Two Rocks Road runs for 500m out to the surfing break and into an unsealed carpark. The vehicle access track and car parking areas are bound by fencing that define the accessible areas. The beach extends approximately 3.2km to the north, terminating at the cuspate Wreck Point.

Unlike the southern end of the beach where reef formations provide for better and higher quality surfing waves, the assessment area on average is exposed to waves that average just over 1m along the beach. The beach usually maintains a low tide terrace, with rip currents cutting across the bar during periods of higher waves.

[2] Population and household forecasts, 2019 to 2041, prepared by the .id population experts.

Beach **WA 900** sits north of the assessment area and curves round north for 300m to the southern breakwater of Two Rocks Marina, and a second sea stack. This beach is moderately sheltered by the reefs, with lower waves breaking across the low gradient beach. Seagrass debris sometimes accumulates along the beach. There is a large car park in the adjacent Marina, and a low foredune and reserve behind the beach, which includes the Leeman's Landing Memorial. This beach is a designated dog exercise area. The presence of reef, fringe and rock formations influences the presence of strong lateral currents and rip channels can be observed in this area. This along with build-up of seagrass and inshore reef and rock formations is likely to make this section of the beach more hazardous for an average beach user. It is likely that because of these features very few users frequent this beach for aquatic recreation activities other than fishing, animal exercise or beach walking.

3. Hazard Identification and Risk Assessment

During the site inspection of the assessment area, any identified aquatic and recreational hazards inspected and assessed in terms of their individual risk to public safety. The assessment considers both the type of harm that could be sustained and the likelihood of this harm actually occurring.

In completing the identification and assessment process reference to the following information sources may be completed:

a) SLSA Australian Coastal Public Safety Guidelines (2007) 1st Edition
b) 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
c) National Coastal Safety Report 2019. Surf Life Saving Australia.
d) Coastal Safety Brief: Beaches. Surf Life Saving Australia.
e) Coastal Safety Brief: rip Currents. Surf Life Saving Australia.
f) Coastal Safety Brief: Surfing and Watercraft. Surf Life Saving Australia
g) The National Aquatic and Recreation Signage Style manual
h) 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.

4. Incident data analysis

Data relevant to the assessment that has been considered as a part of the report includes:

- News and media information,
- SLSA Incident Reporting Database,
- National Coronial Information System,
- SLSA Coastal Safety Report, and
- City of Wanneroo Ranger information.

Of the data source identified above, the following was retrieved that is specific to the assessment area:

a. City of Wanneroo Rangers
   The records maintained by the City of Wanneroo Rangers report the following incidents along the assessment area.
   - 3 x Dogs reported on the beach

- 1 x 4WD on the beach and
- 2 x Off Road vehicle on the beach

These incidents are not defined by a period.

b. SLSA Incident Report Database
Interrogation of this database does not report any known aquatic recreational incidents (rescues or major first aid) at or proximal to the assessment area.

c. National Coronial Information System
Interrogation of this database does not report any known drowning incidents (fatal or non-fatal) at or proximal to the assessment area.

d. Shark sightings
A review of available data has not revealed a trend of shark sightings or detections in the area. However, there are few initiatives (acoustic tagging stations, aerial patrols, observation towers or lifesavers) in place to support identification/detections, so it may not be reliable when assessing the frequency of sharks passing through the area.

5. Beach Hazard Ratings and Overview

The hazards present at any given beach are 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. Professor Andrew Short from the University of Sydney Coastal Studies Unit developed the ABSAMP (Australian Beach Safety and Management Program). This was a partnership project 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 the Tables 1 and 2.

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. In the case of prevailing conditions, the beach hazard rating is calculated and can be referenced in Table 2.

The beach hazard ratings presented in Table 1 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.

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

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

Table 1: ABSAMP Beach Hazard Ratings

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

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

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6. ABSAMP Beach Types and Ratings for Wanneroo Beaches

The ABSAMP Hazard Rating for the assessment area is detailed in Table 3. The table provides an ABSAMP rating and descriptive label/name type for each specific beach location.

Location Name	ABSAMP no.	ABSAMP Rating	ABSAMP type
The Spot	WA 899	**5**	Low Tide Terrace

Table 3: ABSAMP Beach Hazard Ratings – Cluster 2 Beaches

6.1 Assessment Area - ABSAMP Beach Type Characteristic Overview and Hazards

The assessment area is categorised as Low Tide Terrace beach and during higher wave periods can behave as a Transverse Bar and Rip beach.

Beach Type	Details
Low Tide Terrace	**Summary** Characteristics: Wave dominated beaches with shallow sand bars or terraces often exposed at low tide; with potential for average breaking waves of 0.5 – 1.0 meter. Hazards: Safest bathing is at low tide, deeper water and weak rips at high tide. Beach Hazard Hints: Watch for plunging waves at low tide.
	Description Low tide terrace beaches are the lowest energy intermediate beach type and the most common intermediate beach type in Western Australia. 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 seaward for 20-50m and continues alongshore, attached to the beach. It may be flat, featureless, have a lightly central crest, called a ridge and may be cut every several tens of meters by small shallow rips channels called mini rips. At high tide when waves are less than 1m, they may pass right over the bar and not break until the beach face. However, at low tide (and especially a spring low tide), the entire bar is usually exposed as a ridge or terrace running parallel to the beach. At this time, waves break by plunging heavily on the outer edge of the bar. At mid tide, waves usually break right across the shallow bar.

	Under typical mid tide conditions, waves break across the bar and low surf zone is produced. Waves are less than 1m and most water appears to head toward the shore. However, via reflection off the beach and mini rips the water is returned seaward, even if no rip channels are present. In this instance the mini rips are usually weak, brief and shallow.
	Low Tide Terrace Beach Hazards The following is a list of known and common hazards to low tide terrace beaches that are wave dominated. • High tide – deep water close to shore. • Low tide – waves may plunge heavily on the outer edge of the bar, with deep water beyond. • Mid tide – more gently breaking waves and waist deep water, however, mini rips return some water seaward. • Diving – be very careful diving into the surf as the water is usually shallow and can result in head and spinal injuries • Higher waves – mini rips increase in strength and frequency and may be variable in location. • Oblique waves – rips and channels are skewed and may shift along the beach, causing longshore and seaward drag • Most hazardous at mid to high tide when waves exceed 1m and oblique to shore, such as during a strong south westerly wind

Table 4: Table description of Low Tide Terrace

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Beach Type	Details
Transverse Bar and Rip (TBR)	**Summary** Characteristics: Consists of attached bars, rip troughs and undulating beach, 1.0 – 1.50m breakers, distinct rip troughs separated by attached bars every 150 – 300m. Hazards: Pronounced changes in depth and current between bars and rips, safest bathing is on the bars. Beach Hazard Hints: Bath on shallow sand bars adjacent to rips; however, bathers can be washed off the bars into rips, inexperienced bathers may unknowingly enter rips.
	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. **Hazards:** Transverse beaches are one of the main reasons WA beaches have good 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. • The centers of the attached bars are the best place to swim. They are shallow, furthest from the rip channels and the wave's bores move toward 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. **Summary:** It is relatively safe on the bars during low to moderate waves, but individuals must beware, as many hazards, particularly rips lurk for the young or inexperienced. Individuals are advised to stay on the bars and well away from the rips and side feeder currents.

Table 5: Table description Transverse Bar and Rip

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7. Hazards and Observations

7.1 Hazards

Due to the beach-type and environment, there are a number of identified hazards around and behind the assessment area. This is in the context of aquatic and beach recreation activity. The hazards listed below are not always permanent in location or presence, and are open to the influence of prevailing weather conditions or permitted beach access:

- Rip currents,
- Dumping waves,
- Shallow water,
- Marine Singers,
- Snakes,
- Vehicle movement (unauthorised),
- Uneven tracks, and
- Degradation of the dune environment,

7.2 Observations

Site visitations to the assessment area occurred on:

- November 5th 2019 (aerial survey), and
- November 7th 2019 (foot survey).

The length of the beach face and beach area assessed during foot survey was approximately 1200m between the marked lines shown in Figure 1.

All inspection was performed from the land, through the foredune systems, along the beach face and beach and pertinent informal access points. At no time during the inspection was the water entered.

An aerial survey was completed to compliment the foot survey and offer an alternative perspective.

The temperature, swell and wind conditions forecast during the site assessment on November 7th were:

- Wind - 17knt South-South Westerly in direction
- Waves – <1.0m South West in direction
- Tide – 0.61m

This data was retrieved from the Bureau of Meteorology web site on the 7th November 2019.

At the time of site visit on November 7, the observed average width of the foreshore area was 25-30m. This approximate measurement was taken from the base of the foredune to the beach face.

7.3 Beach Access

Formal or defined access points along Two Rocks Road are not provided through the foredune that lead into the assessment area. It was observed that several undefined 'goat tracks' have been formed over time and weave through the fore dunes and into the foreshore area. One of these undefined tracks south of the assessment area contains two sections of degraded dune (Figure 2). From this degraded area, three individual tracks have formed that lead into the foreshore area (Figure 3 and 4).

During the foot survey there appeared reasonably fresh evidence of four-wheel drive tracks through the foredune. Similar tyre tracks were also noted along the beach side of the foredune (Figure 22). Four-wheel drive access is possible from one at least two areas along Two Rock Road (near Blaxland Road intersection). There does not appear to be any barriers restricting access into the foredune system (Figure 24). The tracks in this area are sufficiently wide to allow a four-wheel drive to transit. It is not known if these tracks were made by authorised or unauthorised vehicles. The City's Ranger records indicate unauthorised access has occurred in the past.

The informal nature of all the tracks in the foredune appears largely due to the absence of fencing/barriers, from either the roadside or beach side. If access is left unrestricted, it is likely that over time as beach use in the area increases, more informal tracks will be created. This can be potentially damaging to the dune system and vegetation and resulting in further degradation. The use of these informal tracks also potentially exposes beach users to hazards such as snakes or injury due to the uneven nature of the tracks. It may also result in formal communication through beach safety signage, being missed by the beach users.

At small sections along Two Rocks Road, there is evidence of fencing/barriers to restrict access along with signage stating the area is private property – Keep Out (Figure 25). The report authors do not know it if these barriers are maintained by the City of Wanneroo or private landowners.

Installation of a fence/barrier along the edge of the Two Rocks road would help to control access and discourage use of undefined tracks. This action would also facilitate frequent use of the defined roadway, carparks and beach access tracks once installed. This action will also improve the likelihood capturing the attention of beach users to beach safety signs at formal and maintained access locations and better protect the dune system.

7.4 Description of prevailing conditions at assessment

The beach fronting the assessment area and approximately 500m to the south and north did not display hazards of a fixed nature that would present an obvious and elevated risk to the average beach user. This is not to state that no hazards are present to beach users or that some hazards may be present when the beach is observed at other times. The level of risk is also very much dependant on user competency, familiarity and experience with the area and conditions along with the activity undertaken and safeguards adopted be each individual.

At assessment, the beach section was a relatively good width that would facilitate a range of beach recreation activities. It appeared free from rock platforms or debris. There was a spread of drying seaweed on its surface and down to the beach face (Figure 16).

The attached sand bar appeared relatively even and because the tide was at its lowest point for the day the water flowing across the sand bar was quite shallow (figure 17). Waves of approximately 1.0m in height were flowing evenly across the sand bar and breaking approximately 25-30m off the shoreline (Figure 18 and 19). The observed waves could be categorised as a dumping wave. The prevailing wind direction and strength was pushing water over the sand bar quite quickly and the water was quite turbulent over the sand bar. During the assessment, three rips could be observed and they were spaced evenly along the assessment area (Figure 20 and 21).

8. Influence of hazards on beach safety

The assessment area appears to be more suitable for beach swimming and recreational activities than the beaches on its north and south. This position is consistent with information submitted in the following reports:

a. Coastal Aquatic Risk Assessment – Two Rocks Review. September 2016 (SLSWA).
b. Coastal Aquatic Risk Assessment – Cluster 1. V 1.0 (01 December 2014).

The observations during assessment are quite typical of a number of beaches along the metropolitan coastline and the City of Wanneroo. The City will have numerous beaches that match the description and rating for the assessment area. These similar beaches will have formalised and maintained access points that are utlised by the public and generally without incident.

The assessment area with an assigned beach hazard rating of five (5) does not appear to be more hazardous than many other beaches. The assessment area may increase in hazard rating on any given day and this will be influenced by swell, wave, wind and tide conditions. As identified in section 5 of this report, the level of risk is then dependant on the capabilities of each individual, the activity they are participating, their experience and their familiarity with that particular beach environment and the prevailing conditions. Based on all available information individuals must assess their own risk threshold to participate in aquatic recreation.

Aerial visuals appear to show the inshore are is free of rocks, rock platforms and reefs. The pictures show a small wave breaking close to the shoreline with a series of small short currents. (Figures 3 and 4)

The beaches with formalised access north and south of the assessment area considered inferior as swimming beaches. The Spot (WA 899) is backed and fringed by reef and produces a higher wave under higher swell conditions. Surfers also frequent this area and many of them are using hard fibreglass type equipment. Generally, this equipment and activity is considered incompatible to beach swimming.

To the north, Wreck Point (WA 900) has the presence of rock and reef formations close to shore. Along with these hazards is fast moving water back out to sea especially between the rock formations and the southern break wall of the Two Rocks marina. This location is also a designated animal exercise area. To reduce the likelihood of conflict between users as far as practical these uses should be separated from general beach swimming and recreation.

While the detection/identification of shark hazards in the assessment location is not supported by data, it is not to say sharks are not present from time to time. The City of Wanneroo should consider the addition of information to beach signage that promotes Sharksmart (State Government website and app) related applications whereby up to date information can be retrieved by users to assist them in making informed decision on beach use and behaviour. The SharkSmart WA website and app is a key platform in the State Government 'Sea Sense' campaign and its features include:

- Explore shark activity information and beach safety features along the WA coast;
- Discover the locations of shark monitoring receivers, beach enclosures, Surf Life Saving WA (SLSWA) patrols and Beach Emergency Numbers (BEN) signage;
- Users can select their favourite locations to receive personalised notifications for shark activity as it happens;

- Information of shark activity, including current alerts and warnings. Information is prioritised into Nearby, Your Favourites and Other Locations providing the most relevant information for the user; and
- User can use the location detail provided while at the beach to report shark sightings or whale carcasses to Water Police as soon as possible.

The City may also choose to consider the addition of the shark hazard symbol to static beach safety signs at the assessment area. However, this will need to be considered in the context of the broader beach safety signs already in location along the coast and maintained by the City. This may include a decision to upgrade all signs and retro fit with a shark hazard symbol or only upgrade as signage as it being replaced through life cycle need or from other damage.

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9. Recommendations

RECOMMENDATION 1
The City of Wanneroo should consider formalising the new access track with barrier/fencing to ensure beach users only use the designated carpark and access tracks. This will prevent the creation of more informal tracks through the dunes and prevent further erosion of dunes.

RECOMMENDATION 2
The City of Wanneroo to consider installing fencing/barriers along Two Rocks Road that will restrict access to undefined tracks by walkers or unauthorised vehicles that will to mitigate the potential exposure to hazards and better protect the dune system

RECOMMENDATION 3
The City of Wanneroo install and maintain beach safety signage relative to the infrastructure installed and assessed against the current version of local laws. (Refer appendix XX).

RECOMMENDATION 4
The City of Wanneroo to consider the application of Shark Hazard symbols to its beach safety signage at the assessment area. The City should consider this action in line with any potential impacts to of the City's broader inventory of beach safety signs already in situ.

RECOMMENDATION 5
The City of Wanneroo should consider application to beach safety signs that reference the State Governments Sharksmart website and app.

RECOMMENDATION 6
The City of Wanneroo should consider the introduction of the State Government Beach Emergency Numbering (BEN) system that compliments any of the existing or new beach safety signs. Information regarding the BEN system has been furnished to the City's Officers.

RECOMMENDATION 7
The City of Wanneroo should consider follow up review of the beach safety signage plan with SLSWA once the final design of the roadway, carpark and beach access tracks have been determined. This review should also consider the permissible use of the assessment area.

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10. References

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- 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)
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Appendix A – Assessment Area Overview

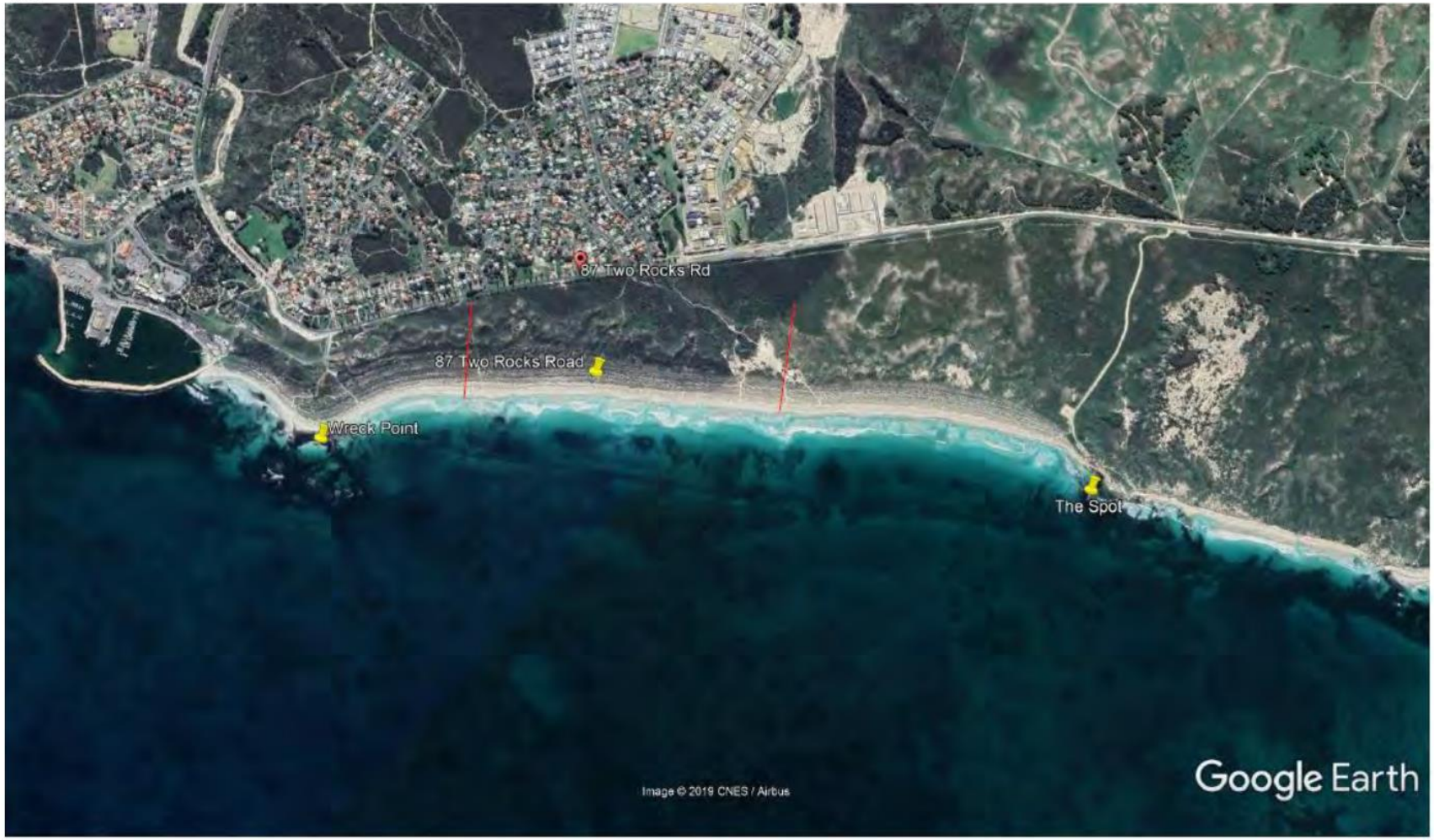

Figure 1: Overview of study area with approximate north and south limits marked in red. (Google Earth)

Appendix B: Graphical Observations – 5th November, 2019

Figure 2 – Aerial view of length of assessment area including degraded dune areas

Figure 3 – Northern aerial view of assessment area foreshore and beach face

Figure 4 – View of beach face, sandbar and surf break

Figure 5 – Southern view showing of foredune, beach, beach face and sandbar

Figure 6 – Southern view showing no evidence of rocks/reef in sandbar or surf zones

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Appendix B.1: Graphical Observations – 7th November 2017

Figure 7 – Example of informal access (goat track) through the foredune adjacent to Gage Road

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Figure 8 – Open Access signage at entry point to informal access adjacent to Gage Road

Figure 9 – Widening section of informal access further into the foredune adjacent to Gage Road

Figure 10 – Open Access sign leading into informal access track adjacent to Whitfield Road

Figure 11 – Example of informal access track showing half covered and half degraded

Figure 12 – Evidence of track use and self-installed infrastructure further into the foredune along informal access track

Figure 13 – Evidence of use and self-installed infrastructure further into the foredune along informal access track

Figure 14 – Evidence of use of tracks further into the foredune along informal access track

Figure 15 – Evidence of use along informal access track with footprints just prior to opening into the foreshore.

Figure 16 – Representation of state of foreshore area with healthy beach width

Figure 17 – Representation of shallow and relatively even sand bar with some smaller cuts in the bar

Figure 18 – Representation of wave height and distance breaking from shore line and over the sand bar

Figure 19 – Representation of wave type (dumping wave)

Figure 20 – Evidence of a rip channel forming and moving water back out to sea

Figure 21 – Evidence of a rip channel forming and moving water back out to sea

Figure 22 – Evidence of vehicle movement along the assessment area

Figure 23 – Evidence of marine stingers

Figure 24 – Evidence of unrestricted access by vehicles into the dune system and informal tracks

Figure 25 – Evidence of barriers restricting access into foredune

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Appendix C: Hazard Identification and Assessment

Ref	Hazard Description (location)	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	Uneven surfaces (Informal tracks)		Slips, trips, falls	Minor	Possible	Medium	Beach users	Level 3 Open Access Sign	Install barriers to restrict access to informal tracks Install formal access tracks	**Low**

Ref	Hazard Description (location)	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				
2	Dumping waves Shallow sand bar		Spinal Injury Non-fatal drowning	Extreme	Possible	Extreme	Weak Swimmers Children Elderly	Level 3 Open Access Sign	Awareness/Education Programs Periodic monitoring based on beach population loading Beach Emergency Number signage	**High**

Ref	Hazard Description (location)	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				
3	Dune erosion		Environmental damage Vehicle collision	Minor	Likely	Medium	Beach users/walkers Unauthorised vehicles	None	Signage Install formal access tracks Barrier restrictions/fence Dune restoration/revegetation	**Medium**

Ref	Hazard Description (location)	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				
4	Dune degradation		Environmental damage	Minor	Likely	Medium	Beach users	None	Signage Install formal access tracks Barrier restrictions/fence Dune restoration/revegetation	**Medium**

Ref	Hazard Description (location)	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				
5	Rip Current		Non-fatal/fatal drowning	Extreme	Possible	Extreme	Weak Swimmers Children Elderly	Level 3 Open Access Sign	Awareness/Education Programs Periodic monitoring based on beach population loading Beach Emergency Number signage	**High**

Ref	Hazard Description (location)	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				
6	Snakes	No Photo	Poisonous bite	Extreme	Unlikely	High	Walkers through foredune	Open Access Sign	Restrict access/barriers Formalised access tracks	**Moderate**

Ref	Hazard Description (location)	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				
7	Marine Stingers		Stings	Minor	Likely	Moderate	Swimmers Surfers Children	Level 3 Open Access Sign	Beach Emergency Number sign	**Moderate**

Ref	Hazard Description (location)	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				
8	Vehicle movement		Collision	Extreme	Unlikely	High	Beach users/walkers Sunbathers	Level 3 Open Access Sign	Barrier restrictions/fence Beach Emergency Number sign Install formal access tracks	**Moderate**

Appendix D: Facility Visitation Rating

The Facility Visitation Rate (FVR) is a term, which has been developed to provide a quantitative assessment that can be used to determine the most appropriate beach safety signage schedule for a facility (venue or location).

The FVR is a calculated using data collected during the assessment process and includes site population use, and frequency of use. As the FVR calculation is used to determine aquatic recreational warning signage requirements the figures used are those of the peak period of beach usage. The following calculation is derived using:

I. Stakeholder observation, consultation and feedback relative to the table values outlined , and;
II. Utilisation of the Facility Visitation Rate (FVR) formula, where:

Facility Visitation Rate = (ABSAMP Rating x Population) + Frequency

.

LOCATION NAME	ABSAMP RATING	*	POPULATION	+	FREQUENCY	=	FVR
Unwin Shoals	5	*	2	+	4	=	**14**

This score assigned of **fourteen (14)** is based on an assessed current low population loading although it appears the area is used in a limited way at least daily. The readers of this report must acknowledge that these values will change according to the level of accessibility and infrastructure provided to the beach user and the level of consistency applied in collecting data to continually validate the scores.

FVR Score between 11 and 15

This score would generally indicate that *where access cannot be controlled*, entrances to the beach should have signage and spaced no greater than 500 metres apart around the beach perimeter.

Additionally the signage should contain the following:

- The name of the beach,
- Emergency location identifier,
- Hazards rated from medium to high should be identified on the sign and listed in order from highest to lowest hazardous,
- All council ordinances that apply to the venue should appear on the sign as prohibition or permission pictograms; and
- Nearest lifesaving services and other information.

Facility Visitation Rating (FVR) Reference Tables

ABSAMP Beach Hazard Rating

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

Population Use
A typical population use within a facility/beach maintained by a Land Manager. It is important that the Land Manager's analysis reflect as accurately as possible its actual situation.

Rating	Population Use
1	Less than 5 people at a time
2	5 to 50 people at a time
3	50 to 100 people at a time
4	100 to 500 people at a time
5	Greater than 500 people at a time

Frequency of Use
Suggested Frequency of use rating for a Facility/Beach.

Rating	Frequency of Use
1	An annual activity or event in held at the facility
2	An activity event takes place in the facility on a monthly basis
3	An activity event takes place in the facility on a weekly basis
4	An activity event takes place in the facility on a daily basis
5	The facility is in continuous use for the majority of the day

Appendix E – 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 coastal 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 information is based on modal data for peak visitation during the busiest season(s). Appendix C of this report is site/hazard specific and will give greater detail for local control measures best suited to local requirements, including factors such as; weather, seasonal adjustments, times, activities etc.

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)
4. Access Rating (AR)

Australian Beach Safety & Aquatic Management Program Rating (ABSAMP Rating)

Location Name	ABSAMP no.	ABSAMP Rating	ABSAMP type
Unwin Shoals	WA 899	**5**	Low Tide Terrace

Local Population Rating

The Local Population Rating (LPR) expands on the information obtained from the Facility Visitation Rating. 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) is 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 Assessment Score
Unwin Shoals	3

Human/Activity Interaction Rating

The Human/Activity Interaction Rating (HAIR) identifies any conflicts present at the coastal 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 Assessment Score
Unwin Shoals	1	1	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 any 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 Assessment Score
Unwin Shoals	**2**

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 zero to 60.

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)
Unwin Shoals	10	6	8	4	**28**

Key to Action Planning Priority	High 40+	Medium 31-40	Low 21-30	Very Low 0-20

Currently access to this assessment area is restricted to informal tracks through the foredune or from the north at Leeman's Landing. Along the tracks and the foreshore, 4WD tracks are evident as are human footprints. The population in vicinity of this beach is smaller and the limited and lengthy access via the foredune along Two Rocks Road, generally results in low human activity rating. Therefore, at this time a 'very low' priority action score is assigned to the assessment area.

If the proposal proceeds and open access is provided the City will should consider the need to collect a consistent data set so that the values can be reassessed. This will assist to validate if current risk mitigation initiatives are effective and efficient or whether further investment in alternative initiatives are required.

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Appendix F: Recommended Signage

While the structure plan through the foredune is detailed on Figure 13 from the Emerge Associates Feasibility Study, it indicates a section of the beach to the North of the assessment area is designated to be an animal exercise area. It is not yet clear if or when this designation will occur. Prior to manufacture and installation of beach safety signs, the City will need to confirm this outcome and determine if the appropriate prohibition or permission symbols are included to the sign face.

The sign tables below and draft plan account for the area north being permissible for animal exercise.

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Table A1

Example Only

Location Identification:	
Beach Name:	Unwin Shoals
Site Reference:	87 Two Rocks Road. In case of emergency dial '000'
Sign Type:	**Level 3 - Open Access Sign**
GPS Location:	TBA – Based on final design and location of carpark and access track.
Location Description and Siting:	TBA – Based on final design and location of carpark and access track.

Hazards and Warnings:

No Lifesaving Service

NARSSM WS,15

Dangerous Current

NARSSM WS,29

Shallow Water

AS/NZS: 2416.1 WSW006

Dumping Waves

NARSSM WS,41

Snakes

NARSSM WS,10

Sharks

WS, 12

Information:

NARSSM IS, 1

Yanchep Lagoon (Yanchep SLSC) is patrolled only when red and yellow flags are displayed. *6.3km South.
Refer www.beachsafe.org.au or sharksmart.com.au or www.wanneroo.wa.gov.au.
*Approximate assessment

Keep children under supervision at all times
AS/NZS 2416.1
WSW002

Regulations:

No vehicles on beach
NARSSM
RS, 3

No Trail bikes on beach
NARSSM
RS, 4

No Littering
NARSSM
RS, 10

Camping Prohibited
NARSSM
RS, 43

General Notes on location:

1. Directional arrow for Lifesaving Service required.
2. Distance to patrolled beach is required to be assessed accurately
3. Place sign on the left of the main access path to beach.
4. Check prohibitions reflect current Regulations.

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. ISO 7010: 2011. Graphical symbols – Safety colours and safety signs – Registered safety signs
3. National Aquatic and Recreational Style Guide Manual (Version 3. July 2006). (NARSSM)
    a. Use this manual to guide the development of the sign style.

Table A2

Example Only	**Location Identification:**	
	**Beach Name:**	Unwin Shoals
	Site Reference:	87 Two Rocks Road. In case of emergency dial '000'
	Sign Type:	**Level 3 - Access Sign: Type A (defined access)**
	GPS Location:	TBA – Based on final design and location of carpark and access track.
	Location Description and Siting:	TBA – Based on final design and location of carpark and access track.

Hazards and Warnings:

				
No Lifesaving Service NARSSM WS,15	Dangerous Current NARSSM WS,29	Dumping Waves NARSSM WS,41	Snakes NARSSM WS,10	Sharks WS, 12

Information:

	Yanchep Lagoon (Yanchep SLSC) is patrolled only when red and yellow flags are displayed. *6.3km South. Refer www.beachsafe.org.au or sharksmart.com.au or www.wanneroo.wa.gov.au. *Approximate assessment	 Keep children under supervision at all times AS/NZS: 2416.1 WSM002	.
NARRSSM IS, 1			

Regulations:

				
Dogs Allowed North only	No Littering	No vehicles on beach	No Trail bikes on beach	No camping
NARSSM P, 2	NARSSM RS, 10	NARSSM RS, 3	NARSSM RS, 4	NARSSM RS 43

General Notes on location:

1. Directional arrow for Lifesaving Service required.
2. Distance to patrolled beach is required to be assessed accurately
3. Place sign on the left of the main access path to beach.
4. Check prohibitions reflect current Regulations.

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. ISO 7010: 2011. Graphical symbols – Safety colours and safety signs – Registered safety signs
3. National Aquatic and Recreational Style Guide Manual (Version 3. July 2006). (NARSSM)
    a. Use this manual to guide the development of the sign style.

Table A2.a

<table>
<tr><td rowspan="6">Example Only
  </td><td colspan="2">Location Identification:</td></tr>
<tr><td>Beach Name:</td><td>Unwin Shoals</td></tr>
<tr><td>Site Reference:</td><td>87 Two Rocks Road.
In case of emergency dial ‘000’</td></tr>
<tr><td>Sign Type:</td><td>Level 3 - Access Sign: Type A (defined access)</td></tr>
<tr><td>GPS Location:</td><td>TBA – Based on final design and location of carpark and access track.</td></tr>
<tr><td>Location Description and Siting:</td><td>TBA – Based on final design and location of carpark and access track.</td></tr>
<tr><td colspan="3">Hazards and Warnings:</td></tr>
<tr><td colspan="3"> 
No Lifesaving Service

NARSSM WS,15

Dangerous Current

NARSSM WS,29

Dumping Waves

NARSSM WS,41

Snakes

NARSSM WS,10

Sharks

WS, 12</td></tr>
<tr><td colspan="3">Information:</td></tr>
<tr><td> 
NARRSSM

IS, 1</td><td>Yanchep Lagoon (Yanchep SLSC) is patrolled only when red and yellow flags are displayed.
*6.3km South.
Refer
www.beachsafe.org.au/sharksmart.com.au or
www.wanneroo.wa.gov.au.
*Approximate assessment</td><td> 
Keep children under supervision at all times

AS/NZS: 2416.1
WSM002</td></tr>
</table>

Regulations:

				
No Dogs South	No Littering	No vehicles on beach	No Trail bikes on beach	No camping
ISO 7010 PO21	NARSSM RS, 10	NARSSM RS, 3	NARSSM RS, 4	NARSSM RS 43

General Notes on location:

1. Directional arrow for Lifesaving Service required.
2. Distance to patrolled beach is required to be assessed accurately
3. Place sign on the left of the main access path to beach.
4. Check prohibitions reflect current by-laws.

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. ISO 7010: 2011. Graphical symbols – Safety colours and safety signs – Registered safety signs
3. National Aquatic and Recreational Style Guide Manual (Version 3. July 2006). (NARSSM)
    a. Use this manual to guide the development of the sign style.

Table A3

Example Only	**Location Identification:**	
	**Beach Name:**	**Unwin Shoals**
	Site Reference:	In case of emergency dial '000'
	Sign Type:	**Individual Sign – Level 3**
	GPS Location:	TBC
	Location Description and Siting:	TBC

Hazards and Warnings:

Information:

Regulations:

Dogs Allowed
North only

NARSSM
P, 2

Reference:

1. AS/NZS: 2416.1. 2010. Water safety signs and beach safety flags. Specifications for water safety signs used in workpla 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 A3.a

Example Only	**Location Identification:**	
	**Beach Name:**	**Unwin Shoals**
	Site Reference:	In case of emergency dial '000'
	Sign Type:	**Individual Sign – Level 3**
	GPS Location:	TBC
	Location Description and Siting:	TBC

Hazards and Warnings:

Information:

Regulations:

No Dogs

ISO 7010
PO 21

General Notes on location:

Reference:

1. AS/NZS: 2416.1. 2010. Water safety signs and beach safety flags. Specifications for water safety signs used in workpla 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.

Appendix C

Dust Risk Assessment

Appendix 1: Site risk assessment/classification for activities generating uncontaminated dust

Sheet 1: Site classification assessment chart

Part A. Nature of site

Item	Score options				Allocated score
1. Nuisance potential of soil, when disturbed	Very low……..…..**1**	Low…….....**2**	Medium……✓……..**4**	High…….**6**	4
2. Topography and protection provided by undisturbed vegetation	Sheltered and screened.....**1**	Medium screening....**6**	Little screening…✓.**12**	Exposed and wind prone……**18**	12
3. Area of site disturbed by the works	Less than 1ha……..**1**	Between 1 and 5ha ✓ **3**	Between 5 and 10ha.....**6**	More than 10ha…….**9**	3
4. Type of work being done	roads or shallow trenches……**1**	roads, drains and medium depth sewers…....**3**	Roads, drains, sewers and partial earthworks…..✓……**6**	Bulk earthworks and deep trenches……...**9**	6
				TOTAL score for Part A	25

Part B. Proximity of site to other land uses

Item	Score options				Allocated score
1. D istance of other land uses from site	More than 1km…….**1**	Between 1km and 500m……..**6**	Between 100m and 500m……..**12**	Less than 100m.✓…**18**	18
2. Effect of prevailing wind direction (at time of construction) on other land uses	Not affected……..…..**1**	Isolated land uses affected by one wind direction……..…..**6**	Dense land uses affected by one wind direction……✓……..**9**	Dense/sensitive land uses highly affected by prevailing winds……**12**	9
				TOTAL score for Part B	27

SITE CLASSIFICATION SCORE (A X B) =	675

Sheet 3: Notes relating to 'site assessment classification chart'

1. The site assessment chart is used to differentiate between Classifications 1, 2, 3 and 4, as defined within these guidelines. Classifications 2 and 3 are subject to Note 4, below.

2. Sites may be divided into two or more classifications depending mainly on the proximity of existing land uses.

3. In assessing the relevant score level, the 'effect of prevailing winds' must be carefully considered. While houses, commercial areas, market gardens, schools and factories have high sensitivity ratings, roads, parks and recreational areas have lower sensitivity ratings.

4. Construction during dry period (1 October – 31 March).

(a) Where other land uses are within 100 metres of the site:

(i) sites assessed as Class 3 will automatically become Class 4, and

(ii) sites assessed as Class 2 will automatically become Class 3.

(b) Where other land uses are situated between 100 metres and 500 metres from the site, an on-site re-evaluation of Class 3 sites shall be conducted by the engineer for the developer, the local government or the DEC to determine the extent of additional Class 4 requirements considered necessary (if any).

Sheet 4: Dust management and monitoring requirements for each site classification score

Based on the total score obtained from the 'SITE CLASSIFICATION ASSESSMENT CHART' and notwithstanding any allowance for special site conditions during the dry period, (refer to Note 4, Appendix 1) the following site classification will apply:

Site classification 1 — under 199;

Site classification 2 — 200 to 399;

Site classification 3 — 400 to 799, and

Site classification 4 — over 800.

Note: • Unique sites may need special assessment.
• It is essential that any contracts for construction work on site include the relevant contingency arrangements appropriate for the site classification.

- **Classification 1 (score under 199, considered negligible risk)**

Provisions:
• None required.
Contingency arrangements:
• None required.

- **Classification 2 (score between 200 and 399, considered low risk)**

Provisions:
• The developer shall supply a contingency plan to the local government, which shall detail the activities to be undertaken should dust impacts occur.

Contingency arrangements:
• Include an allowance for water-cart operation, wind fencing and surface stabilisation during the construction period for the purposes of dust suppression.
• All areas of disturbed land should be stabilised to ensure that the disturbed area exposed at any time is kept to a practical minimum.

Monitoring requirements:
• Complaints management system in place (complaints recorded and acted on promptly).
• Notice to be erected at the site, providing contact details of the person to be contacted and works.

- **Classification 3 (score between 400 and 799, considered medium risk)**

Provisions:
- Appropriate wind fencing of a length specified in the air quality management programme needs to be stored on site or available within one hour of being required by the engineer for the developer/local government/DEC.
- All areas of disturbed land should be stabilised to ensure that the disturbed area exposed at any time is kept to a practical minimum to prevent exceedence of dust standards (see Section 4.4.2).
- The engineer for the developer shall maintain close control of works with dust creating potential (for example, allowable length of open trenching).
- After all siteworks are completed, and before the contractor has vacated the site, the developer should ensure that the entire site is stable. The developer then retains responsibility for site stability until change of ownership/control takes place. After the change of ownership/control has taken place, the new owner or controlling party will inherit responsibility for site stabilisation.

Contingency arrangements:
- Suitable water-carts in good working condition and of not less than 10,000 litres capacity per 7.5 hectares of disturbed site, or other suitable alternatives, shall be available to commence watering on the site within 18 hours of being required to do so by the engineer for the developer/local government/DEC.
- Surface stabilisation equipment shall be available to commence operation on site within 48 hours of being required to do so by the engineer for the developer/local government/DEC and with sufficient capacity to cover the disturbed site area within a further 48 hours.
- Wind fencing shall be erected within 18 hours of the contractor being required to do so by the engineer for the developer/local government/DEC. Dust generating works on the site shall cease in the interim.
- If dust-related complaints are generated due to activities on the site, the developer may be required by the local government or an authorised DEC officer to distribute advisory notices to adjoining land occupiers within 48 hours. A notice form is provided in Sheet 5 of Appendix 1.
- If dust-related complaints are generated due to material which has been excavated for trenching, the developer shall ensure this material is stabilised within 48 hours of being requested to do so by the engineer for the developer, local government or an authorised DEC officer.
- Include an allowance for water-cart operation, wind fencing and surface stabilisation during the construction period for the purposes of dust and wind-borne material suppression.
- Include an allowance for surface stabilisation for the purposes of dust and wind-borne material suppression to be maintained after the construction period and until change of ownership/control takes place.

Monitoring requirements
- Site dust management system in place.
- On-site dust monitoring against short term criteria.
- Off-site (compliance) dust monitoring at site boundary (if close to sensitive receptors) or at sensitive receptors. See Section 4 and Appendix 4.
- Complaints management system in place (complaints recorded and acted on promptly).
- Exceedences to be reported to the relevant authority – DEC, Local Government or DOH.
- Notice to be erected at the site, providing contact details of the person to be contacted regarding the works.

Classification 4 (score over 800, considered high risk)

Provisions:
- Advisory notices shall be issued to adjoining land occupiers, the local government and the DEC at least 48 hours before site works commence. The notices shall include the name of the developer, engineer for the developer, contractor/s, contract period, contact telephone numbers of the site engineer and local government environmental health officer as detailed in Sheet 5 of Appendix 1.
- Fencing to the extent and in locations agreed to by the developer and local government shall be erected before any part of the site surface is disturbed.

Note: This provision does not necessarily mean that the total site boundary is to be fenced. The fence is to be installed to an extent which will protect adjacent land uses and in most cases should be erected on the edge of the area which will be disturbed rather than on the site boundary.
- An amount of wind fencing of a length specified in the air quality management programme needs to be stored on site or available within one hour of being required by the engineer for the developer/local government/DEC.
- The nominated wind fencing is to remain in position until the disturbed surface is stable.
- Surface stabilisation is to be applied to the disturbed area of each section of the site upon completion of the works in that section.
- The engineer for the developer shall maintain strict control of works with dust-creating potential. Material which has been excavated for trenching shall be stabilised if the trench is to be left exposed for longer than 72 hours.
- After all siteworks are completed, and before the contractor has vacated the site, the developer should ensure that the entire site is stable. The developer then retains responsibility for site stability until change of ownership/control takes place. After the change of ownership/control has taken place, the new owner or controlling party will inherit responsibility for site stabilisation.

Contingency arrangements:
- Suitable water-carts in good working condition and of not less than 10,000 litres capacity per 5 hectares of disturbed site, or an appropriate alternative, shall be available to commence immediate watering on the site.
- Surface stabilisation equipment shall be available to commence operation on site within 48 hours of being required to do so by the engineer for the developer/local government/DEC and with sufficient capacity to cover the disturbed site area within a further 48 hours.
- Additional wind fencing shall be erected within 18 hours of the contractor being required to do so by the engineer for the developer/local government/DEC. Dust generating works on the site shall cease in the interim.
- Include an allowance for water-cart operation, wind fencing and surface stabilisation during the construction period for the purposes of dust and wind-borne material suppression.
- Include an allowance for surface stabilisation for the purposes of dust and wind-borne material suppression to be maintained after the construction period and until change of ownership/control takes place.

Monitoring requirements
As for Classification 3.

Sheet 5: Notice to residents

Land development is being carried out in your area by:

_____ (Name of developer)

The development commencement date is: _____

Completion date is expected to be: _____

A site risk assessment has been conducted in consultation with your local

government:_____

It has been agreed by all parties concerned that the:

_____
(Project type - land development project, site remediation works etc.)

must adopt adequate measures to prevent the generation of unacceptable levels of dust. You are advised that the developer of the site has agreed to implement the provisions as outlined in the Department of Environment and Conservation's '*A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities*' (A copy of this guideline may be obtained from your local government). Should you feel that excessive dust or other air pollutants are being generated due to the site works, you are advised to contact the site engineer for the developer:

_____(Name of engineer) by

telephoning _____ to discuss the issue.

Compliance Services at the City of Wanneroo

may be contacted on:_____

Appendix D

Flora and Vegetation Survey – Detailed and Targeted (One Tree Botanical 2019)

Two Rocks Beach Access Way

Flora and Vegetation Survey - Detailed and Targeted

Prepared for the City of Wanneroo

DECEMBER 2019

ONE TREE
BOTANICAL

PO Box 118
MAYLANDS WA 6931
Phone: (08) 9371 9491
ABN: 15 159 204 976

Project: P1904: Two Rocks Beach Access Way
Version History:
Draft 1.0 (**Issued**: 02 December 2019) **Prepared by:** KM **Reviewed by:** XX)
Final 1.0 (**Issued**: XX December 2019 **Prepared by:** KM)

CONTENTS

Figures

Tables

Appendices

1. EXECUTIVE SUMMARY

The City of Wanneroo proposes to construct a car park, access road and beach access within the Two Rocks Beach Access Way study area footprint (the 'study area') (Figure 1). The study area is approximately 13 hectares in size and includes portions of foreshore reserve in Two Rocks south of the Marina, bound by the Indian Ocean to its west and Two Rocks Road to its east.

This report presents a botanical assessment that is consistent with Technical Guide Flora and Vegetation Surveys for Environmental Impact Assessment; Targeted and Detailed Surveys (EPA, 2016).

1.1 FLORA

A total of 158 taxa were recorded from the study area, of which 99 or 63% were natives.

A DBCA Threatened Species and Communities Branch species database search did not identify any records of state listed TF or PF as being previously known from within the study area boundaries.

A search of the *EPBC Act* Protected Matters Search Tool (Department of Environment and Energy, 2019) listed nine Threatened Flora (TF) as potentially occurring in the region. None of these species have previously been recorded from within the study area.

No Threatened Flora (TF) species as listed under the *Biodiversity Conservation Act 2016* were recorded during the field survey. No TF under the *Environmental Protection and Biodiversity Conservation Act 1999* were recorded.

Three Priority Flora species were recorded from the study area. A Priority 1 species *Leucopogon maritimus* and two Priority 3 species *Beyeria cinerea* subsp*. cinerea* and *Stylidium maritimum*.

Leucopogon maritimus (Priority 1) is a low spreading shrub to 40cm tall by 60cm wide from the heath family (Ericaceae). There are 17 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) known from a small range in a narrow coastal band from Alkimos to north of Two Rocks. During the survey approximately 13 individuals were recorded from the study area (Figure 2). The distribution of this plant in the study area was restricted to Vegetation Type C (Figure 3).

Beyeria cinerea* subsp. *cinerea (Priority 3) is an open, erect to spreading shrub (Plate 3) to 70cm tall from the spurge family (Euphorbiaceae). There are 51 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between Mandurah and Port Gregory. During the survey 490 individuals were recorded from the study area (Figure 2). The distribution of this plant in the study area was restricted to Vegetation Type C (Figure 3).

Stylidium maritimum (Priority 3) is a perennial herb to 70cm tall, with tufted linear strappy grass-like leaves from the triggerplant family (Stylidiaceae). There are 42 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between Mandurah and Leeman. During the survey 35 individuals were recorded from the study area (Figure 2). The distribution of this plant in the study area was restricted to Vegetation Type C (Figure 3).

Of the 59 species of weed recorded in the study area, nine were given a High rating for invasiveness and spread as environmental weeds under the Western Australian Environmental Weed Strategy (WAEWS) (Department of Conservation and Land Management, 1999) (Table 16). Twenty-nine weeds recorded in the study area were given a Moderate rating.

1.2 VEGETATION

The study area is in the Interim Biogeographical Regionalisation of Australia (IBRA) region of the Swan Coastal Plan (SCP) in sub-region SWA2: Perth (Thackway and Cresswell, 1995) (Department of Environment and Heritage, 2000).

According to 1:250,000-scale vegetation mapping by Heddle *et al.* (1980), the study area is in vegetation complex 55: Quindalup. The original extent of Quindalup Complex within the IBRA region of Swan Coastal Plain has been calculated as 54,573.87 hectares, of which 33,011.637 hectares or 60.49 % remains (Government of Western Australia, 2019a).

Beard (1979) mapped the study area as occurring within Vegetation Association 1007: "Coastal heath and thicket on recent dunes".

Vegetation Association 1007 is described as originally consisting of 30,408 hectares of which 20,691 hectares or 68% remains. Of what remains, 2,755 hectares or 13.31% is protected or proposed for protection (Government of WA, 2019b). The Bush Forever portion of the study area would represent a part of those areas protected or proposed for protection.

With the exception of the northern corner, the study area is within Bush Forever Site 397: "Coastal Strip from Wilbinga to Mindarie". Bush Forever Site 397 is approximately 400 hectares in size in total.

Inferred Floristic Community Types present at Bush Forever Site 397 are listed as:

- Supergroup 2: Seasonal Wetlands:
  - FCT 16: Highly saline seasonal wetlands (*Frankenia pauciflora* on Tamala Limestone Cliffs)
- Supergroup 4: Uplands centred on Quindalup and Spearwood Dunes
  - FCT 29a: Coastal shrublands on shallow sands
  - FCT 29b: *Acacia* shrublands on taller dunes
  - FCT S11: Northern *Acacia rostellifera – Melaleuca systena* shrublands
  - FCT S13: Northern *Olearia axillaris – Scaevola crassifolia* shrublands
  - FCT S14: *Spinifex longifolius* grasslands and low shrublands

Six vegetation types were identified within the study area:

A LOW-LYING PRIMARY DUNES ON UNCONSOLIDATED SAND

A1: Incipient Foredune (younger): Uniform regrowth of Grassland *Spinifex longifolius*.

A2: Established Foredune (older): Sparse Shrubland *Olearia axillaris* over Grassland *Spinifex longifolius*.

A3: Beach-ridge Plain: Open Shrubland *Olearia axillaris, Rhagodia baccata* subsp. *baccata* and **Pelargonium capitatum* over Sparse Grassland Spinifex longifolius and Sparse Vineland *Cassytha flava* var. *flava*.

B: TALL SECONDARY DUNES ON UNCONSOLIDATED SAND

B1: Shrubland dominated by *Acacia cyclops, Scaevola crassifolia, Spyridium globulosum, Santalum acuminatum, Myoporum insulare, Olearia axillaris, Rhagodia baccata* subsp. *baccata* and *Acanthocarpus preissii*, Sparse Vineland *Hardenbergia comptoniana* and *Cassytha flava* var. *flava*. Over Forbland dominated by *Senecio pinnatifolius* var. *latilobus*.

C: LOW DUNES ON SEMI-CONSOLIDATED SAND

C1: Species rich low Shrubland dominated by *Melaleuca systena* and species rich Forbland dominated by *Lomandra maritima* and Sparse Sedgeland *Lepidosperma calcicola* and Sparse Rushland *Desmocladus asper*.

D: LOW RISES WITH LIMESTONE OUTCROPPING

D1: Closed Shrubland Melaleuca cardiophylla with other typical shrubs *Melaleuca huegelii, Acacia xanthina* and *Dodonaea aptera* with Sparse Vineland *Cassytha aurea* var. *aurea* over Forbland of native and introduced herbs.

E: CLEARED AREAS

E1: Historically cleared areas; informal walking paths, informal vehicular sand tracks (unused and partially overgrown).

See Figure 3 for a map of vegetation type. See Figure 4 for a map of vegetation condition.

No TECs protected under the *BC Act 2016* or the *EPBC Act 1999* were recorded in the study area.

Two Priority 3 PECs were recorded in the study area:

Priority Ecological Community (PEC) SWAN 21: "Coastal shrublands on shallow sands, southern Swan Coastal Plain". Described as heaths on shallow sands over limestone close to the coast, with no single dominant but including *Spyridium globulosum, Rhagodia baccata* and *Olearia axillaris* (DBCA, 2019). Also known as Floristic Community Type (FCT) 29a (Gibson *et al.* 1994). Represented in Vegetation Types A3, B1 and D1 (Figure 3).

Priority Ecological Community (PEC) SWAN 26: Northern Spearwood shrublands and woodlands. Also known as Floristic Community Type (FCT) 24 (Gibson *et al.* 1994). Described by DBCA (2019) as "Heaths with scattered Eucalyptus gomphocephala occurring on deeper soils north from Woodman Point. Most sites occur on the Cottesloe unit of the Spearwood system." This PEC is associated with the Tuart Woodlands TEC however no Tuart was observed within or adjacent to the study area. Likely to represent an unusual subtype, due to its extreme westerly distribution and three Priority Flora forming a substantial component of species assemblage of the vegetation. Represented in Vegetation Type C1 (Figure 3).

2. PROJECT

The City of Wanneroo proposes to construct a car park, access road and beach access within the Two Rocks Beach Access Way study area footprint (the 'study area') (Figure 1).

The study area includes portions of foreshore reserve in Two Rocks south of the Two Rocks Marina. This area is bound by the Indian Ocean to its west and Two Rocks Road to its east.

The land is owned by the Western Australian Planning Commission (WAPC) and the Crown and includes:

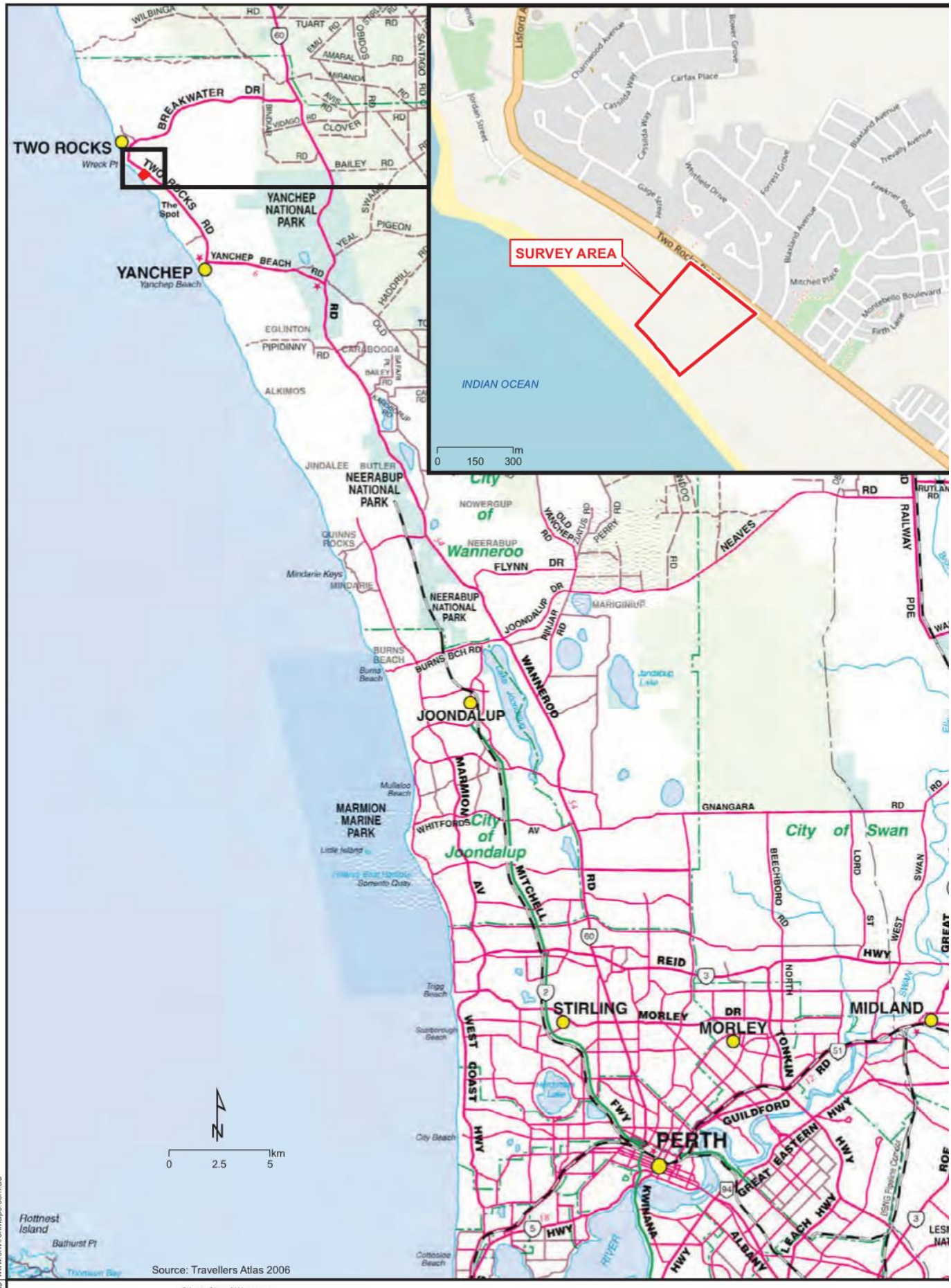
- The entire Lot 8613 of Deposited Plan 213232 (94 Two Rocks Road, Two Rocks);
- Part Lot 8989 of Deposited Plan 213232 owned by the WAPC, located adjacent to Lot 8613; and
- Part Lot 15452 of Deposited Plan 40341 of Foreshore Reserve managed by the City, located adjacent to Lot 8613.

The study area is approximately 13 hectares in size. It encompasses part of Bush Forever Site 397.

2.1 SCOPE

This report presents the findings of botanical assessment that are consistent with Technical Guide Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016) survey types:

- Targeted Survey; and
- Detailed Survey.



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Client: City of Wanneroo
Job: P1904 - Two Rocks
Date: 21/11/2019

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FIGURE 1

TWO ROCKS BEACH ACCESS WAY LOCALITY MAP

C:\GIS\Jobs\One Tree Botanical\P1904 - City of Wanneroo - Two Rocks\Figures\P1904_2Rocks_F01 Two Rocks Beach Access Way Locality Map_191121.mxd

3. BACKGROUND

3.1 GEOLOGY LANDFORMS AND SOIL

The study area is a part of the Swan Coastal Plain, a sedimentary plain of largely aeolian deposits approximately 20-30km wide between the Darling Scarp in the east and the Indian Ocean in the west. The sedimentation consists of aeolian deposits formed into a series of sand dunes. Churchward and McArthur (1980) describe the dune systems of the Swan Coastal Plain as arranged in an age sequence from east to west. The Bassendean Dunes are the oldest in the east, the Spearwood then the Quindalup the youngest dunes closest to the coast in the west. The study area is in the Quindalup Dunes, which is described as calcareous sands formed into parabolic dunes and beach ridge plains.

Quindalup Dunes can then further be divided into four age profiles. Q4 dunes (Vegetation Type A Figure 3) are the youngest and least extensive of the four phases and occur on the seaward margin of the Quindalup Dunes. Where Q4 consist of low dune systems, further inland Q3 dunes (Vegetation Type B) are taller and steeper. These are also not extensive as Q1 and Q2 further inland. Both Q3 and Q4 are characterised by unconsolidated sandy soil that has little organic matter. Q3 dunes (Vegetation Type C and D) occur further inland again and extend up to 4km. These and are the most widespread in the Quindalup Dune system. They are taller dunes with consolidated sand at their core, with an organic rich soil profile (Gozzard, 2007). Q1 dunes are the oldest and furthest inland. These sit lower in the landscape and also consist of consolidated sand with an organic rich soil profile.

Gozzard (2007) further describes the coastal landforms as including Tamala Limestone, extensive but discontinuous pockets of limestone described as “cemented coastal sand dunes” and “calcreted surfaces (beach rock), karstic features (sinkholes, caves), raised beaches, and elevated shoreline platforms”.

It is worth noting what Gozzard (2007) states about beach ridge plains in the Perth region:

> *“The relict cuspate beach-ridge plains dominate the coast south of the Swan River. At Woodman Point and between Kwinana and Mandurah, these plains extend inland beyond the general trend of the coast. Less obvious examples are to be seen north of the river at Whitfords, Burns Beach, Quinns Rock and Two Rocks. In most cases these plains are asymmetric in shape, and abandoned shoreline positions are marked by relict beach ridges.”*

3.2 LAND USE HISTORY

The study area consisted of a relatively intact area of natural vegetation. An old vehicle track is present surrounded by comparatively disturbed vegetation. It is possible that pastoral activities have occurred in the past or the area provided access prior to construction of Two Rocks Road. A corridor had historically cleared for a powerline. An informal pedestrian track is present from Two Rocks Road to the beachfront. The beachfront is currently utilised for recreational purposes.

3.3 CLIMATE AND SEASONAL CONDITIONS

The closest Bureau of Meteorology (BoM) weather recording station with long term data is Wanneroo (Site No. 009105) (Latitude: 31.73° S, Longitude: 115.79° E). The mean annual rainfall between 1905 and 2018 for Wanneroo is 795.8mm (BoM, 2019). Most rainfall (724.4mm) occurs between the months of April and October.

Rainfall for the months of April to September 2019 leading up to the field survey was 517.2mm. This is compared to 113-year average for Wanneroo over the same period of 677.5mm. This represented a 23% rainfall shortfall from the long-term mean.

3.4 PREVIOUS STUDIES

3.4.1 Interim Biogeographical Regionalisation of Australia (IBRA) Region

The study area is in the Interim Biogeographical Regionalisation of Australia (IBRA) region of the Swan Coastal Plan (SCP) in sub-region SWA2: Perth (Thackway and Cresswell, 1995) (Department of Environment and Heritage, 2000).

3.4.2 Vegetation Complexes (Heddle *et al.*, 1980)

According to 1:250,000-scale vegetation mapping by Heddle *et al.* (1980), the study area is in vegetation complex 55: Quindalup.

The vegetation is described as being restricted to coastal dunes that can be divided into two alliances:

- The foredunes and beach strand which contain *Angianthus cunninghamii, *Trachyandra divaricata, *Arctotheca populifolia, Atriplex isatidea, *Cakile maritima, Leucophyta brownii, Carpobrotus virescens, *Pelargonium capitatum, Senecio lautus, Acites megalocarpus, Spinifex longifolius* and **Tetragonia decumbens* and *T. implexicoma.*
- Mobile and stable dune alliance which contains *Acacia cyclops, Anthocercis littorea, Lepidosperma gladiatum, Myoporum insulare, Nitraria billardierei, Olearia axillaris, Scaevola crassifolia, S. nitida, Spyridium globulosum, Westringia dampieri and Wilsonia backhousei,* with the composition depending on the degree of protection from salt laden winds. Other variations include *Eucalyptus foecunda, Santalum, acuminatum, Exocarpos sparteus* and *Acacia rostellifera*. Small localised pockets of *Melaleuca lanceolata* and *Callitris preissii* occur, uncommon but were once more widespread along the coast.

The original extent of Quindalup Complex within the IBRA region of Swan Coastal Plain has been calculated as 54,573.87 hectares, of which 33,011.637 hectares or 60.49 % remains (Government of Western Australia, 2019a).

16.16% of what remains of the Quindalup Complex is located within the City of Wanneroo LGA boundary. Within the City of Wanneroo, the original extent of the Quindalup Complex was 8,818.26 hectares of which 5,352.77 hectares or 60.70% remains (Government of Western Australia, 2019a).

These figures do not take into account fully the condition of the remaining areas or rarer vegetation types that constitute the complex.

Nomenclature and taxonomy used in these descriptions has been updated from that used in the original publication.

3.4.3 Vegetation Survey of Western Australia (Beard, 1979)

Beard (1979) mapped the study area as occurring within Vegetation Association 1007: “Coastal heath and thicket on recent dunes”. This is within the Guilderton System, which is the vegetation of the Quindalup Dunes between Fremantle to Green Head.

Beard (1979) describes the narrow beach strand as being colonised by **Cakile maritima* and **Arctotheca calendula*, *Spinifex hirsutus* and *S. longifolius* with **Ammophila arenaria* and **Tetragonia decumbens*. Sheltered hollows behind the foredunes are described as supporting **Tetragonia decumbens*, *Ficinia nodosa, Leucophyta brownii, Carpobrotus* sp. and *Spinifex longifolius*.

On the crests of taller dunes, the vegetation becomes thicker and includes shrubs *Myoporum insulare, Scaevola crassifolia, Olearia axillaris, Acacia cyclops* and *Lepidosperma gladiatum*. Shrubs are wind pruned on the windward side and taller and more luxuriant on the sheltered landward side. Further inland on stable dunes sheltered from the wind are low dense thicket of *Olearia axillaris, Melaleuca systena* and *Acacia lasiocarpa*. Taller thickets to low forests can form, but are frequently destroyed by fire, with taller species including *Callitris preissii* (now uncommon and possibly the apex community) and *Acacia rostellifera* (most common). The latter often occurs with *Melaleuca huegelii, Acacia cyclops, A. cochlearis* and *Dodonaea aptera*. Fire is described as returning the apex community to the *Melaleuca systena/Acacia lasiocarpa* low dense thicket.

Vegetation Association 1007 is described by Government of WA (2019b) as "Mosaic: Shrublands; *Acacia lasiocarpa & Melaleuca acerosa (M. systena)* heath/Shrublands; *Acacia rostellifera* & *Acacia cyclops* thicket".

Vegetation Association 1007 is described as originally consisting of 30,408 hectares of which 20,691 hectares or 68% remains. Of what remains, 2,755 hectares or 13.31% is protected or proposed for protection (Government of WA, 2019b). The Bush Forever portion of the study area would represent a part of those areas protected or proposed for protection.

It is worth noting that while these mapped units are described as 'vegetation associations', they actually represent broader groupings of a number of vegetation associations. Which means that extent remaining figures in that context can be misleading in terms of accurately reflecting how much of an individual vegetation association remains.

Nomenclature and taxonomy used in these descriptions has been updated from that used in the original publication.

3.4.4 Flora of the Quindalup Dunes (Griffin, 1993)

Griffin (1993) surveyed the Quindalup Dunes between the Irwin and Swan Rivers. The methodology used was similar to that used in this survey in terms of collecting floristic data within plant communities. While this current study used 100m^2 bounded quadrats, they used unmeasured quadrats that approximated 100m^2. They referred to them as relevés (although strictly speaking in vegetation science, a relevé is a measured quadrat).

Griffin described the difficulty in defining vegetation of the Quindalup Dunes in traditional sense. They investigated several methods including analysing presence/absence and cover of relevé data. Their conclusion was that floristic presence/absence was the most useful parameter to use across such a large geographical area.

Table 1 presents perhaps the most contextually useful grouping of relevé data in the context of this study.

Table 1: Four Broad Groupings of Relevés Across Quindalup Dunes Between Irwin and Swan Rivers (Griffin, 1993)

1: Incipient Foredunes	**Mainly on very young land surfaces.** Usually dominated by *Spinifex longifolius* and **Tetragonia decumbens*, but also in places *Spinifex hirsutus, Atriplex isatidea* or *A. cinerea*.
2: Foredunes & Young Beach Ridge Plains	**Mainly on very young land surfaces.** Usually dominated by *Olearia axillaris* and *Scaevola crassifolia* but also important in some were *Myoporum insularis, Rhagodia baccata* and *Acanthocarpus preissii*.
3: Plains	**Variable depending on age and land surface:** **3a:** More or less bare. Important species were variable but included one or several of the following*; Leucophyta brownii, Opercularia vaginata, Hibbertia racemosa* and *Scaevola crassifolia*. **3b:** Very young. Dominance generally was low but main species usually were *Allocasuarina lehmanniana, Spyridium globulosum, Gastrolobium capitatum* or *Banksia sessilis.* **3c:** Young. Similar species to 3b above usually quite dominant but also important were *Acrotriche cordata* or *Acacia truncata*. **3d:** Older. Tended to be dominated by *Melaleuca systena* and *M. huegelii* or *M. cardiophylla* or *Thryptomene baeckeacea* or *Banksia sessilis*.
4: Inland Dunes	**Variable depending partly on age:** **4a:** Younger. Tending to be dominated by *Acacia rostellifera* and in some cases *Melaleuca huegelii* or *M. cardiophylla* tall shrublands, with *Acanthocarpus preissii*; and **4b:** Older. With much less *Acacia rostellifera* but with *Melaleuca systena* usually dominant with combinations of *Desmocladus flexuosus* (would include *D. aspera*) and *Lomandra maritima*.

Nomenclature and taxonomy used in these descriptions has been updated from those used in the original publication.

3.4.5 Bush Forever

With the exception of the northern corner, the study area is within Bush Forever Site 397: "Coastal Strip from Wilbinga to Mindarie". This site is approximately 400 hectares in size.

No detailed survey was completed for this site (Government of WA, 2000). Multiple part-surveys have been completed. A part-survey by Robinson (1995) of coastal reserves north of Quinns Rocks indicated that there were 83 native flora and 23 weed flora present, representing >60% of the expected flora.

Inferred Floristic Community Types present at Bush Forever Site 397 are listed as:

- Supergroup 2: Seasonal Wetlands:
  - FCT 16: Highly saline seasonal wetlands (*Frankenia pauciflora* on Tamala Limestone Cliffs)
- Supergroup 4: Uplands centred on Quindalup and Spearwood Dunes
  - FCT 29a: Coastal shrublands on shallow sands
  - FCT 29b: Acacia shrublands on taller dunes
  - FCT S11: Northern Acacia rostellifera – Melaleuca systena shrublands
  - FCT S13: Northern Olearia axillaris – Scaevola crassifolia shrublands
  - FCT S14: *Spinifex longifolius* grasslands and low shrublands

3.5 LEGISLATION AND GUIDELINES

3.5.1 Planning and Development Act 2005

Bush Forever sites have some protection under State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region under the *Planning and Development Act 2005*. There are a number of specific requirements for Environmental Impact Assessment (EIA) when a Bush Forever site is involved.

3.5.2 Western Australian *Environmental Protection Act 1986*

The *Environmental Protection (EP) Act 1986* is the guiding legislation for EIA in Western Australia. Formal assessments for projects that are likely to have significant impacts are completed by the Environmental Protection Authority (EPA) under this legislation.

Environmental Protection (Clearing of Native Vegetation) Regulations 2004

The *EP Act* includes the *Clearance of Native Vegetation Regulations 2004* under which clearing permits are required to clear native vegetation. The permit system is administered by either the Western Australian Department of Water and Environmental Regulation (DWER), or for exploration activities, the Department of Mines, Industry Regulation and Safety (DMIRS).

Technical Guidance under the *EP Act 1986*

The EPA's Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016) outlines the supporting information required for botanical assessments under the *EP Act 1996*.

EPA (2016) replaced the EPA's Guidance Statement 51.

3.5.3 Western Australian *Biodiversity Conservation Act 2016*

As of January 1st 2019, the *Biodiversity Conservation (BC) Act 2016* replaced the *Wildlife Conservation Act 1950* in Western Australia.

The *BC Act 2016* introduces the protection of state listed Threatened Ecological Communities (TECs) in addition to Threatened Flora (TF). Threatened Flora were previously known as Declared Rare Flora (DRF).

There are substantially higher and broader ranging fines, up to $500,000 for individuals and $2,500,000 for corporate entities for 'taking' TECs and TF. Additionally, there are substantial fines to individuals and organisations for failing to report matters of environmental significance.

3.5.4 Federal *Environmental Protection Biodiversity Conservation Act 1999*

Threatened Ecological Communities (TECs) as well as Threatened Flora (TF) listed as Matters of National Environmental Significance (MNES) are protected under the Commonwealth *Environmental Protection Biodiversity Conservation (EPBC) Act 1999*.

3.5.5 Flora

All native flora species are protected under the *BC Act 2016*. Flora cannot be taken without a permit.

Threatened Flora (TF) (Western Australia)

Additionally, the Western Australian Minister for Environment can declare any species thought 'rare' an extra level of protection. Species on this list are referred to as Threatened Flora (TF) (Table 2) (previously referred to as DRF or Declared Rare Flora). Each TF species is also given a rank consistent with IUCN Red List criteria.

The TF list is regularly reviewed with updates published in the Government Gazette. The TF status of species is also published on Florabase (WAH, 1998-).

Table 2: Definition of Threatened Species (Flora) (DBCA, 2019a)

T: Threatened species	Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). ***Threatened flora*** is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below: **CR: Critically Endangered** Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*". **EN: Endangered** Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*". **VU: Vulnerable** Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".
X: Presumed extinct species	**EX Extinct species** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora. **EW Extinct in the wild species** Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Priority Flora (PF) (Western Australia)

A supplementary Priority Flora (PF) list is maintained by the Department of Biodiversity Conservation and Attractions (DBCA). Species on the PF list are not specifically protected under current legislation however they are closely considered in environmental impact assessment processes. They are listed in EPA (2016) as flora of 'other' conservation significance.

Priority 1 to 3 flora are species that are awaiting assessment for Threatened Flora (TF) status but which do not currently have enough information to enable that assessment. The three categories represent the order of priority for assessment.

Priority 4 species are those species that are adequately known, rare but not threatened and which require regular monitoring.

The four categories of PF are defined in Table 3. The status of PF are regularly updated and published on Florabase (WAH, 1998-).

Table 3: Priority Flora Conservation Codes and Definitions (DBCA, 2019a)

P1: Priority One: Poorly-known species	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2: Priority Two: Poorly-known species	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3: Priority Three: Poorly-known species	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4: Priority Four: Rare, Near Threatened and other species in need of monitoring	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Threatened Flora (TF) (Federal)

Some flora species have additional protection under the *Commonwealth Environmental Protection Biodiversity Conservation Act, 1999 (EPBC Act).* There is significant overlap in that state-listed TF are largely the same as TF listed under the federal *EPBC Act*.

There are six categories of Threatened Flora under the *EPBC Act* (Table 4).

Table 4: Categories of Threatened Flora Species under the *EPBC Act 1999* (IUCN-Equivalent Status)

EX: Extinct	No reasonable doubt that the last member of the species has died.
EW: Extinct in the Wild	Species known only to survive in cultivation, in captivity or as a naturalised population well outside its past range or it has not been recorded in its known habitat in an appropriate season anywhere in its past range despite exhaustive surveys.
CR: Critically Endangered	Species is considered to be facing an extremely high risk of extinction in the wild.
EN: Endangered	Species is not critically endangered; and it is facing a very high risk of extinction in the wild in the near future
VU: Vulnerable	Species is not critically endangered or endangered; and it is facing a high risk of extinction in the wild in the medium-term future
CD: Conservation Dependent	Species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered.

3.5.6 Vegetation

Threatened Ecological Communities (TECs) (Western Australia)

In Western Australia, Threatened Ecological Communities (TECs) are protected under the *BC Act 2016*. There are four criteria for state listed TECs (Table 5).

Currently there are 69 TECs that have been endorsed by the Western Australian Minister for Environment of which 20 are Critically Endangered, 17 are Endangered, 28 are Vulnerable and 4 Presumed Destroyed (DBCA, 2018).

Table 5: Criteria for Western Australian Threatened Ecological Communities (TECs) (DEC, 2013)

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

	C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): **A)** The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short-term future (within approximately 20 years); ii) modification throughout its range is continuing such that in the short-term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. **B)** Current distribution is limited, and one or more of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short-term future (within approximately 20 years); ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii) there may be many occurrences, but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. **C)** The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium (within approximately 50 years) to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): **A)** The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. **B)** The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. **C)** The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long-term future because of existing or impending threatening processes.

Priority Ecological Communities (PECs) (Western Australia)

In Western Australia, potential TECs that do not meet criteria or that are not adequately defined or do not have adequate information are added to the Priority Ecological Community (PEC) List as Priority 1, 2 or 3 (Table 6). Communities that are rare but not threatened and are adequately known, or that have been recently removed from the threatened list, are placed in Priority 4 for regular monitoring purposes. Conservation dependent communities are placed in Priority 5 (DEC, 2013).

As of January 2019, there were 393 PECs listed by the DBCA Threatened Species and Communities Branch (DBCA, 2019B).

Table 6: Priority Ecological Communities (PECs) Definitions and Criteria (DEC, 2013)

Priority One: Poorly-known ecological communities	Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two: Poorly-known ecological communities	Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority Three: Poorly known ecological communities	i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: ii) Communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approx. 10 years), or; iii) Communities made up of large, and/or widespread occurrences, that may or may 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, inappropriate fire regimes, clearing, hydrological change etc. 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.	i) 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. ii) 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 a higher threat category. iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five: Conservation Dependent ecological communities	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Threatened Ecological Communities (TECs) (Federal) (EPBC Act)

The *Environmental Protection Biodiversity Conservation Act 1999 (EPBC Act)* provides legislative protection for Threatened Ecological Communities (TECs).

The criteria for listing of TECs under the *EPBC Act* are presented in Table 7.

Table 7: Threatened Ecological Communities (TECs) Definitions and Criteria (EPBC Act Regulations, 2013)

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

3.5.7 Weeds

Environmental Weeds

There is currently no coordinated approach to prioritising and managing environmental weeds in Western Australia.

Under the Western Australian *Conservation and Land Management Act 1984*, the state environmental agency the Department of Biodiversity Conservation and Attractions (DBCA) is required to monitor and manage weeds. As a part of this responsibility, the Western Australian Environmental Weed Strategy (WAEWS) (Department of CALM, 1999) was developed, which presents a list of environmental weeds and gives each a rating (Table 9) depending on its invasiveness, distribution and environmental impact (Table 8).

The purpose of this publication was also to eventually tie into the Weeds of National Significance (WONS) project (CALM, 1999 p58), providing a compatible rating system to be applied to Western Australian environmental weed species. The idea was also to eventually provide a regionally based rating system, using the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995) regions. None of this has been completed, and the list is out of date in some respects, however it still provides a good general idea of what serious environmental weeds are present in a study area.

Table 8: Criteria of Weeds under WAEWS (Department of CALM, 1999)

Invasiveness	Ability to invade bushland in good to excellent condition or ability to invade waterways.
Distribution	Wide current or potential distribution including consideration of known history of widespread distribution elsewhere in the world.
Environmental Impact	Ability to change the structure, composition and function of ecosystems, in particular an ability to form a monoculture in a vegetation community.

Table 9: Rating of Weeds under WAEWS (Department of CALM, 1999)

H: High	A weed species that scores 'yes' for all three criteria. Rating a weed species as High would indicate prioritising this weed for control and/or research i.e. prioritising funding to it.
Mo: Moderate	A weed species would have to score 'yes' for two of the above criteria. Control or research effort should be directed to it if funds are available, however it should be monitored (possibly a high level of monitoring).
Mi: Mild	A weed species scoring 'yes' for one of the criteria. A Mild rating would indicate monitoring of the weed and control where appropriate.
L: Low	A weed species would score none of the criteria. A Low ranking would mean that this species would require a low level of monitoring.

Biosecurity and Agriculture Management Act 2007 (BAM Act)

This act replaces amongst other related legislation, the *Agriculture and Related Resources Protection Act 1976*, which legislated for the control of Declared Plants in Western Australia (Sandy Lloyd DAFWA, pers. comm.). The *BAM Act* represents the only legally binding requirement for weed control and/or eradication in Western Australia.

Under the under the *BAM Act* the "Declared Plants" list has been replaced by the Western Australian Organism List (WAOL). The WAOL is administered by the Western Australian Department of Agriculture and Food (Department of Primary Industries and Regional Development, 2019). There are three categories of Declared Pest on the WAOL list (Table 10).

This list is more relevant to agricultural than environmental weeds.

Table 10: Categories of Declared Pest under the *BAM Act 2007* (DPIRD, 2019)

The C1 category (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
The C2 category (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
The C3 category (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area, which currently is free of that pest.

Weeds of National Significance (WONS)

The Weeds of National Significance (WONS) (Department of Environment and Energy, 2019) project is an initiative of the Commonwealth in collaboration with state governments aimed at establishing a national prioritisation process for environmental weeds. Thirty-two species of WONS have currently been prioritised, based on invasiveness, potential for spread and environmental, social and economic impacts. Their ability to be managed was also taken into account. This programme is in the early stages of development and is a work in progress. It only includes an extremely limited subset of environmental weeds.

4. METHODS

4.1 FIELD SURVEY

The field survey consisted of a Detailed Survey and a Targeted Survey (EPA, 2016 p. 5). Sampling techniques consisted of Traverses, Quadrats, Opportunistic Sampling and Vegetation Condition Rating (EPA, 2016 p. 7).

4.1.1 Traverses

Traverses were conducted on foot at 20m intervals across all vegetated areas to record:

- Priority, Threatened and other flora of conservation significance (as defined by EPA, 2016);
- Weed species;
- Vegetation type and condition boundaries; and
- Any matters of interest e.g. including but not limited to rubbish, vegetation, condition.

4.1.2 Quadrats

Quadrat sizes were 10m x 10m in line with established methodology for the Swan Coastal Plain. An area surrounding the quadrat was also surveyed to record other species typical of the vegetation type.

The information recorded for each quadrat included:

- AMG Coordinates in WGS84 datum (accuracy <3m) for all four corners of quadrat (Appendix D);
- All flora species present (floristics) in quadrat and their height and cover/density (structure) (Appendix B). Percentage cover refers to the foliage cover (as required by EPA, 2016) of each species within the 100m^2 quadrat (1m^2 cover = 1% cover). Species that overhung the quadrat were included;
- Description of vegetation and documentation of vegetation structure based on National Vegetation Information System (NVIS) (ESCAVI, 2003) (as required by EPA, 2016);
- Photographs of vegetation (taken from NW corner of quadrat);
- Habitat information including but not limited to landform, aspect and soil and leaf litter; and
- A condition rating was given according to the condition scale(s) in Table 9.

Quadrats were permanently marked, with all four corners pegged with wooden stakes (visible approximately 15cm above the soil surface).

4.1.3 Opportunistic Sampling

Any points of interest were recorded using a GPS with an accuracy of <3m.

4.1.4 Condition Assessment and Mapping

As requested by the City of Wanneroo the Bush Forever (Government of WA, 2000) condition scale was used. This was to ensure that condition mapping was consistent with historical mapping.

EPA (2016) provides a condition scale to be used in EIA. While it is not referenced, this condition scale originated in Bush Forever.

On comparing the two scales it was found that they are almost identical. This is demonstrated in Table 11. Condition mapping will therefore still be consistent with the requirements of EPA (2016).

Table 11: Vegetation Condition Rating for the South West Botanical Province (EPA, 2016) and Bush Forever Condition Scale (Keighery, 1994 from Govt. of WA, 2000)

Condition		EPA (2016) Condition Scale	Bush Forever (Govt. of WA, 2000) Condition Scale
P	**Pristine**	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	Pristine or nearly so, no obvious signs of disturbance.
E	**Excellent**	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.	Vegetation structure intact, disturbance affecting individual species; weeds are non-aggressive species.
VG	**Very Good**	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
G	**Good**	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
D	**Degraded**	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	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.
CD	**Completely Degraded**	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

The original scale was developed by Bronwen Keighery (Keighery, 1994) which was modified from a scale developed by Malcolm Trudgen (Trudgen, 1991).

4.1.5 Licencing

The survey was completed by botanist Kelli McCreery under Licence for Scientific or Other Prescribed Purposes No. SL012488 and Permit to Take Threatened Flora No. 27-1920.

Written permission to conduct a survey was obtained from land managers, the City of Wanneroo and the WA Planning Commission.

4.2 FLORA IDENTIFICATIONS, TAXONOMY AND NOMENCLATURE

Flora identifications were completed by a survey botanist with 23 years experience on the Swan Coastal Plain (SCP). Flora were identified using the taxonomic, reference material and other resources of the WA Herbarium.

Priority Flora were confirmed by the duty botanist at the WA Herbarium.

Nomenclature was based on Florabase (Western Australian Herbarium, 1998-). All taxa were cross-referenced against Florabase to ensure that names were current at the time of publication.

4.3 DATA ANALYSIS

Numerical analyses were conducted on quadrat data collected during the survey. Data was analysed using a two-way multivariate analysis run on the programme 'R' (R Development Core Team, 2007). The agglomerative methods used were Bray-Curtis distance and Ward's clustering. Other clustering methods were also run to test possible alternative groupings.

The results were used as a tool to aid in defining the vegetation types present in the study area. Different parameters were tested, presence-absence (floristic) data was compared to foliar cover weighted data (floristics plus structure).

These methods were used in the context of not necessarily providing an absolute result, but as a powerful tool to aid in defining vegetation types present within the study area. Only quadrat data collected in the study area was used in this stage, as the contextual regional data available in Western Australia is not currently in a form suitable to attempt a more meaningful region-wide contextual analysis.

4.3.1 Floristic Community Type Analysis

The 15 quadrats recorded as a part of this survey were also then compared to quadrats surveyed as a part of A Floristic Survey of the Southern Swan Coastal Plain (Gibson *et al.,* 1994). Many TECs and PECs were originally defined on the basis of the floristic analysis in Gibson *et al.* (1994). Therefore the aim of this methodology was to help quantify the presence or otherwise of TECs and PECs.

Only presence-absence data was used in this analysis as this is the form the original data is in. To ensure the datasets were as compatible as possible the nomenclature and taxonomy of flora was reverted back to what it would have been in 1994. To test for any methodological differences in the parameters set for the multivariate analysis, a test run was completed first, using only the SCP dataset to ensure that the results for the grouping were consistent with the original findings of that study. Then the quadrats recorded in this survey were run one at a time against the SCP dataset. The aim was to see which Gibson *et al.* (1994) quadrats the study area quadrats were most floristically similar to.

This was a floristic analysis based on presence-absence of flora species within a 10m x 10m quadrat.

The agglomerative methods used were Bray-Curtis distance and Ward's clustering as this was found to most closely replicate the results of the original study.

4.3.2 Vegetation Mapping

Polygons were drawn using a combination of the most current aerial photography available at the time of the survey (Nearmaps orthophoto updated 25 May 2018) and field observations. Some boundaries were defined using GPS coordinates recorded during on-ground surveys.

Simon Crofts from Environmaps provided high resolution field maps and produced the mapping presented in this report.

Vegetation type within each polygon was defined on the basis of a wide range of information. In particular the statistical analysis of quadrat data, previous studies, field observations and generalised post-survey analysis of data. Both structural and floristic characteristics of the vegetation were taken into account. Descriptions of vegetation type used NVIS (ESCAVI, 2003) structural formation terminology as per the requirements of the EPA (2016).

4.4 DESKTOP ASSESSMENT

A search of the Department of Biodiversity Conservation and Attractions (DBCA) Species and Communities Branch database was completed in September 2019. This was to identify any Western Australian listed Threatened (TF) or Priority (PF) Flora previously known from the study area or surrounds. Summary results are presented in Table 14.

A search of the Department of Biodiversity Conservation and Attractions (DBCA) Species and Communities Branch database was completed in September 2019. This was to identify any Threatened (TECs) and/or Priority Ecological Communities (PECs) previously known from the study area or surrounds. Summary results are presented in Table 18.

A search of the *EPBC Act 1999* Protected Matters Search Tool (Department of Environment and Energy, 2017) was also completed in November 2019 to identify any federally listed Threatened Flora (Table 14) or Threatened Ecological Communities (Table 18) likely to occur in the vicinity of the study area.

All searches were based on a search area bounded by the coordinates:

-31.784° 115.732°
-31.762° 115.781°
-31.310° 115.530°
-31.332° 115.478°

A review of previous studies relevant to the study area was completed, including but not limited to those studies summarised in Section 3.4. A variety of resources were accessed as otherwise described in this report. Naturemap (DBCA, 2019) was used to identify and expected species list ahead of the field survey. NationalMap (Government of Australia, 2019) was used to check planning boundaries and other relevant spatial information.

4.5 CONSERVATION SIGNIFICANCE ASSESSMENT

Conservation significance was assessed based on the following criteria.

4.5.1 Threatened Species and Communities

Assessment of the conservation significance of flora and vegetation recorded during the survey involved cross-referencing all taxa recorded against criteria for significance under state and federal legislation and guidelines (Section 3.5). This included Threatened Flora and Threatened Ecological Communities under the Western Australian *Biodiversity Conservation Act 2016* and the Federal *Environmental Protection Biodiversity Conservation Act 1999*.

4.5.2 Flora of 'Other' Conservation Significance (EPA, 2016)

Species other than those listed under state and federal legislation and guidelines e.g. Threatened Flora, may have conservation significance. These are defined by the EPA (2016) as those species that may include but not be limited to those that have or are:

- Priority flora species;
- Locally endemic or associated with a restricted habitat type;
- New species or anomalous features that indicate a potential new species;
- Representation of a species range (extensions, edges of ranges or an outlier population);
- Unusual species including restricted sub-species, varieties or naturally occurring hybrids; and/or
- Relictual status, representative of taxonomic groups no longer in the broader landscape.

For range implications, the geographic distributions of all flora species recorded were checked using the map-based resources of the Australian Virtual Herbarium (Council of Heads of Australasian Herbaria, 2013) and Florabase (Western Australian Herbarium, 1998-).

4.5.3 Vegetation of 'Other' Conservation Significance (EPA, 2016)

Vegetation other than that listed under state and federal legislation and guidelines e.g. TECs, may have conservation significance. This is defined by the EPA (2016) that which may include but not be limited to vegetation that:

- Represents a Priority Ecological Community (PEC);
- Has a restricted distribution;
- Has implications due to historical impacts;
- Has a role as a refuge; and/or
- Provides a function required to maintain the ecological integrity of a significant ecosystem.

5. RESULTS

5.1 FLORA

5.1.1 Statistics

A total of 158 taxa were recorded from the study area, of which 99 or 63% were natives.

The 158 taxa represented 53 different plant families and 128 plant genera. The families represented by the largest number of species are shown in Table 12. The genera represented by the largest number of species are shown in Table 13.

See Appendix A for a full list of species recorded for the study area.

Table 12: Dominant Vascular Plant Families Recorded in the Study Area

Family	Common Name	Native	Introduced	Total
POACEAE	Grasses	5	16	**21**
ASTERACEAE	Daisies	8	8	**16**
FABACEAE	Peas, Wattles	9	4	**13**
CYPERACEAE	Sedges	5	1	**6**
ERICACEAE	Heath	5	0	**5**
ORCHIDACEAE	Orchids	5	0	**5**
CARYOPHYLLACEAE	Pink family	0	5	**5**

Table 13: Dominant Vascular Plant Genera Recorded in the Study Area

Genus	Common Name	Native	Introduced	Total
Acacia	Wattles	4	0	**4**
Cassytha	Dodder Laurels	4	0	**4**
Crassula	Stonecrops	1	3	**4**
Euphorbia	Spurges	0	3	**3**
Leucopogon	Beard Heaths	3	0	**3**
Melaleuca	Paperbark, Teatree, Bottlebrush	3	0	**3**

5.1.2 Threatened and Priority Flora Database Search Results

The DBCA Threatened Species and Communities Branch species database search did not identify any records of state listed TF or PF as being previously known from within the study area boundaries.

A search of the *EPBC Act* Protected Matters Search Tool (Department of Environment and Energy, 2019) listed nine Threatened Flora (TF) as potentially occurring in the region. None of these species have previously been recorded from within the study area.

Table 14 summarises the results from both the DBCA Threatened Species and Communities Branch flora database search and the *EPBC Act* Protected Matters Report and identifies the likelihood of each occurring within the study area.

Table 14: Threatened and Priority Flora Database Search Results (DBCA and EPBC Act Protected Matters Databases)

WESTERN AUSTRALIA	CONSERVATION STATUS*			OCCURRENCE (Known/Likely/Possible/Unlikely)
	Rating	WA	EPBC	
Chorizema varium	T	EN	EN	Possible, habitat present (sand over limestone) but known from further N.
Diuris micrantha	T	VU	EN	Unlikely. Known from wetland habitats.
Diuris purdiei	T	EN	EN	Unlikely. Known from wetland habitats further S and E.
Drakaea elastica	T	CR	VU	Unlikely. Known from areas adjacent to wetlands, mostly further S and inland.
Drakaea micrantha	T	EN	VU	Unlikely. Known from further S and/or more inland.
Eleocharis keigheryi	T	VU	VU	Unlikely. Known from wetlands.
Eucalyptus argutifolia	T	VU	VU	Possible, within known distribution and habitat present (sand over limestone). Not recorded.
Marianthus paralius	T	EN	EN	Possible, within known distribution and habitat present (sand over limestone). Not recorded.
Melaleuca sp. Wanneroo (G.J. Keighery 16705)	T	EN	EN	Possible but unlikely, assumed distribution to SE.
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	P1			Possible but unlikely, limestone ridges further inland. P1 are not well understood species.
Grevillea sp. Ocean Reef (D. Pike Joon 4)	P1			Possible. Further N than recorded but habitat present (sand over limestone). Not recorded.
Haloragis sp. Parrot Ridge (G.J. Keighery 11563)	P1			Possible but unlikely, distribution limestone ridges further inland. P1 are poorly understood.
Leucopogon maritimus	P1			**Recorded during this survey.**
Acacia benthamii	P2			Possible. Not recorded.
Fabronia hampeana	P2			Moss. Outside scope of study.
Hakea oligoneura	P2			Possible. Not recorded.
Lecania turicensis var. *turicensis*	P2			Lichen. Outside scope of study.
Austrostipa mundula	P3			Possible but unlikely. Known distribution further inland and to S.
Beyeria cinerea subsp. cinerea	P3			**Recorded during this survey.**
Calandrinia oraria	P3			Possible. Coastal dunes. Not recorded.
Conostylis bracteata	P3			Possible. Not recorded.
Hibbertia spicata subsp. *leptotheca*	P3			Possible. Known from sand over limestone. Not recorded.
Lasiopetalum membranaceum	P3			Possible but unlikely. Habitat sand over limestone. Known distribution further inland.
Leucopogon sp. Yanchep (M. Hislop 1986)	P3			Possible. Within known distribution. Various coastal habitats, sand and limestone. Not recorded.
Pimelea calcicola	P3			Possible. Within known distribution. Coastal limestone ridges. Not recorded.
Sarcozona bicarinata	P3			Possible. Within known distribution. Coastal sand. Not recorded.
Sphaerolobium calcicola	P3			Tall dunes, winter-wet flats, interdunal swamps, low-lying areas
Stylidium maritimum	P3			**Recorded during this survey.**
Stylidium paludicola	P3			Unlikely. Wetland habitat.
Caladenia speciosa	P4			Possible. Known from sand over limestone. Within known distribution. Not recorded.
Conostylis pauciflora subsp. *euryrhipis*	P4			Possible. Within distribution, coastal dune habitat present. Not recorded.
Conostylis pauciflora subsp. *pauciflora*	P4			Possible. Within distribution, coastal dune habitat present. Not recorded.
Dodonaea hackettiana	P4			Possible. Not recorded.
Jacksonia sericea	P4			Possible but unlikely. A fairly common species but further N than known distribution. Not recorded.
Lepidium pseudotasmanicum	P4			Possible. Known from area on sand. Not recorded.

** See Section 3.5.5 for definitions of conservation status codes. Habitat preference information from WAH (1998-) and DBCA database search results.*

5.1.3 Conservation Significant Flora

Threatened Flora

No Threatened Flora (TF) species as listed under the *Biodiversity Conservation Act 2016* were recorded during the field survey.

No TF under the *Environmental Protection and Biodiversity Conservation Act 1999* were recorded.

Three Priority Flora species were recorded from the study area. A Priority 1 species (*Leucopogon maritimus*) and two Priority 3 species (*Beyeria cinerea* subsp. *cinerea* and *Stylidium maritimum*).

Leucopogon maritimus (Priority 1 Flora)

This plant is a low spreading shrub to 40cm tall by 60cm wide (Plate 1) from the heath family (Ericaceae). It has a fire sensitive rootstock. Flowers are small and white and clustered at the end of the branchlets (Plate 2). The flowers are white-hairy on the inside as is typical of *Leucopogon*. Flowering is documented as occurring between November and August, with the peak likely to be between April and June (Hislop, 2011). During the survey, plants were in flower in early September but had finished by the end of the month. It is an inconspicuous shrub when not in flower.

There are 17 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) known from a small range in a narrow coastal band from Alkimos to north of Two Rocks. During the survey approximately 13 individuals were recorded from the study area (Figure 2). The distribution of this plant in the study area was restricted to Vegetation Type C (Figure 3).

Priority 1 Flora are those flora species that are poorly known, from fewer than five populations and that are potentially under threat. Such species are in urgent need of further survey to enable assessment for Threatened status. See Section 3.5.5 for more detail.

Plate 1 *Leucopogon maritimus* Priority 1 Flora. Habit.

Plate 2 *Leucopogon maritimus* Priority 1 Flora. Flowering in early September 2019.

Beyeria cinerea* subsp. *cinerea (Priority 3 Flora)

This plant is an open, erect to spreading shrub (Plate 3) to 70cm tall from the spurge family (Euphorbiaceae). Its flowers are fairly inconspicuous (Plate 4) with flowering recorded in July and from

September to November. It is known from coastal heath and shrublands on sandy soil over limestone. It is differentiated from the more common *Beyeria cinerea* subsp. *borealis* by having truncate (blunt) to cuneate (wedge-shaped) rather than cordate (heart shaped) leaf bases as well as a more southerly distribution (Halford and Henderson, 2008).

There are 51 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between Mandurah and Port Gregory. During the survey 490 individuals were recorded from the study area (Figure 2). The distribution of this plant in the study area was restricted to Vegetation Type C (Figure 3).

Priority 3 Flora are those flora species that are known from several locations, and does not appear to be under immediate threat. Can be comparatively well known but still not meet survey requirements for assessment for Threatened Flora status. See Section 3.5.5 for more detail.

Plate 3 *Beyeria cinerea* subsp. *cinerea* Priority 3 Flora. Habit.

Plate 4 *Beyeria cinerea* subsp. *cinerea* Priority 3 Flora. Flowers.

Stylidium maritimum (Priority 3 Flora)

This plant is a perennial herb to 70cm tall, with tufted linear strappy grass-like leaves (Plate 5) 10-40cm long to 5.5cm wide from the triggerplant family (Stylidiaceae). Flowers are showy, in panicles on long stems, large white to purple but commonly pink triggerplant-shaped flowers (Plate 6), with flowering in September to November. Grows on sand over limestone, dunes, coastal heath and/or Banksia woodland (WA Herbarium, 1998-).

There are 42 collections of this species in the WA Herbarium (Council of Heads of Australasian Herbaria, 2013) distributed in a narrow near-coastal band between Mandurah and Leeman. During the survey 35 individuals were recorded from the study area (Figure 2). The distribution of this plant in the study area was restricted to Vegetation Type C (Figure 3).

Priority 3 Flora are those flora species that are known from several locations, and does not appear to be under immediate threat. Can be comparatively well known but still not meet survey requirements for assessment for Threatened Flora status. See Section 3.5.5 for more detail.

Plate 5 Stylidium maritimum Priority 3 Flora. Habit.

Plate 6 *Stylidium maritimum* Priority 3 Flora. Flowers.

Species of 'Other' Conservation Significance

See Section 4.5.2 for a definition of species of 'other' conservation significance.

Due to the study area being located on the western coastline of the continent, most species recorded are at the western most extent of their known range.

Only those species that have extra range implications over and above westerly extent have been listed here. Table 15 presents those species with range implications

Table 15: Species of 'Other Conservation Significance' as Defined by EPA (2016)

Species	Significance
Cassytha aurea var. *aurea*	S extent known range. 20km range extension (closest collection from Guilderton).
Melaleuca cardiophylla	Close to S extent of known range.
Stylidium hesperium	Poorly collected, only 2 records in WAH.
Stylidium maritimum (P1)	Short range endemic <50km. Endemic to SCP.

Client: City of Wanneroo
Job: P1904 - Two Rocks
Date: 2/12/2019
E: kelli@onetreebotanical.com.au
P: (08) 9371 9491
M: 0407 423 928

N

0 12.5 25 50 75 100 m

Scale: 1:2,000 @ A3
GDA 1994 MGA Zone 50

FIGUR

TWO ROCKS BEACH ACCESS W
SIGNIFICANT FLORA LOCATIONS M

5.1.4 Weeds

Environmental Weeds

Of the 59 species of weed recorded in the study area, nine were given a High rating for invasiveness and spread as environmental weeds under the Western Australian Environmental Weed Strategy (WAEWS) (Department of Conservation and Land Management, 1999) (Table 16). Twenty-nine weeds recorded in the study area were given a Moderate rating. See Section 3.5.7 for more detail on these criteria.

Table 16: Environmental Weeds High to Moderate Rating (CALM, 1999) recorded in the Study area

Species	Common Name	**Rating** (CALM, 1999)
**Brassica tournefortii*	Mediterranean Turnip	High
**Bromus diandrus*	Great Brome	High
**Eragrostis curvula*	African Love Grass	High
**Euphorbia terracina*	Geraldton Carnation Weed	High
**Hyparrhenia hirta*	Tambookie Grass	High
**Lagurus ovatus*	Hare's Tail Grass	High
**Lupinus cosentinii*	Blue Lupin	High
**Pelargonium capitatum*	Rose Pelargonium	High
**Romulea rosea*	Guildford Grass	High
**Aira cupaniana*	Silvery Hair Grass	Moderate
**Arctotheca calendula*	Cape Weed	Moderate
**Arctotheca populifolia*	Dune Arctotheca	Moderate
**Avena barbata*	Wild Oats	Moderate
**Bellardia trixago*	Bellardia	Moderate
**Briza maxima*	Blowfly Grass	Moderate
**Briza minor*	Shivery Grass	Moderate
**Cakile maritima*	Sea Rocket	Moderate
**Crassula glomerata*	(stonecrops)	Moderate
**Cuscuta planiflora*	Dodder	Moderate
**Cynodon dactylon*	Couch Grass	Moderate
**Dischisma arenarium*	-	Moderate
**Ehrharta brevifolia* var. *cuspidata*	-	Moderate
**Ehrharta longiflora*	Annual Veldt Grass	Moderate
**Euphorbia paralias*	Sea Spurge	Moderate
**Euphorbia peplus*	Petty Spurge	Moderate
**Galium murale*	Small Goosegrass	Moderate
**Gladiolus caryophyllaceus*	Pink Gladiolus	Moderate
**Heliophila pusilla*	-	Moderate
**Hypochaeris glabra*	Flatweed	Moderate
**Lysimachia arvensis*	Pimpernel	Moderate
**Melilotus indicus*	Indian Sweet-clover	Moderate
**Parentucellia latifolia*	Common Bartsia	Moderate
**Rostraria cristata*	Mediterranean Hairgrass	Moderate
**Schinus terebinthifolia*	Japanese Pepper Tree	Moderate
**Sonchus oleraceus*	Common Sowthistle	Moderate
**Tetragonia decumbens*	Sea Spinach	Moderate
**Trifolium campestre* var. *campestre*	Hop Clover	Moderate
**Vulpia myuros* forma *megaleura*	Rat's Tail Fescue	Moderate

Declared Pest Plants (BAM Act 2007)

There are 920 declared pest plant species on the WA Organism List (WAOL) under the *Biosecurity and Agriculture Management Act* 2007 for the City of Wanneroo. None of the weed species recorded in the study area were on this list.

See Section 3.5.7 for more information on Declared Pests.

Weeds of National Significance

No Weeds of National Significance (WONS) were recorded in the study area.

See Section 3.5.7 for more information on WONS.

5.2 VEGETATION

5.2.1 Vegetation Type Summary

A LOW-LYING PRIMARY DUNES ON UNCONSOLIDATED SAND

A1: **Incipient Foredune (younger):** Uniform regrowth of Grassland *Spinifex longifolius*.

A2: **Established Foredune (older):** Sparse Shrubland *Olearia axillaris* over Grassland *Spinifex longifolius*.

A3: **Beach-ridge Plain:** Open Shrubland *Olearia axillaris, Rhagodia baccata* subsp. *baccata* and **Pelargonium capitatum* over Sparse Grassland *Spinifex longifolius* and Sparse Vineland *Cassytha flava* var. *flava*.

B: TALL SECONDARY DUNES ON UNCONSOLIDATED SAND

B1: Shrubland dominated by *Acacia cyclops, Scaevola crassifolia, Spyridium globulosum, Santalum acuminatum, Myoporum insulare, Olearia axillaris, Rhagodia baccata* subsp. *baccata* and *Acanthocarpus preissii*, Sparse Vineland *Hardenbergia comptoniana* and *Cassytha flava* var. *flava*. Over Forbland dominated by *Senecio pinnatifolius* var. *latilobus*.

C: LOW DUNES ON SEMI-CONSOLIDATED SAND

C1: Species rich low Shrubland dominated by *Melaleuca systena* and species rich Forbland dominated by *Lomandra maritima* and Sparse Sedgeland *Lepidosperma calcicola* and Sparse Rushland *Desmocladus asper*.

D: LOW RISES WITH LIMESTONE OUTCROPPING

D1: Closed Shrubland *Melaleuca cardiophylla* with other typical shrubs *Melaleuca huegelii, Acacia xanthina* and *Dodonaea aptera* with Sparse Vineland *Cassytha aurea* var. *aurea* over Forbland of native and introduced herbs.

E: CLEARED AREAS

E1: Historically cleared areas; informal walking paths, informal vehicular sand tracks (unused and partially overgrown).

See Figure 3 for a vegetation type mapping. See Figure 4 for vegetation condition mapping.

5.2.2 Detailed Vegetation Type Descriptions

A LOW-LYING PRIMARY DUNES ON UNCONSOLIDATED SAND

Plant communities A1 to A3 were a continuum across a beach ridge plain system (Plate 10), young dunes that had been sequentially deposited and gradually vegetated. The vegetation was typified overall by the dominance of Grassland of *Spinifex longifolius*. All but the youngest dune was dominated by the shrub *Olearia axillaris* and the introduced forb **Pelargonium capitatum*. Species richness increased west to east.

A1: Incipient Foredune (younger): Uniform regrowth of Grassland *Spinifex longifolius* (Plate 7).

This plant community was on a recently deposited foredune. Plant growth was only very recent and was dominated by a Grassland of *Spinifex longifolius*. Other scattered species included *Spinifex hirsutus, *Cakile maritima, Atriplex isatidea* and **Arctotheca populifolia*.

There were two quadrats in this vegetation (TR04 and TR15) with an average species richness of 3.

This vegetation is equivalent to S14: *Spinifex longifolius* grasslands and low shrublands (Griffin, 1993 from Government of WA, 2000)

This vegetation was in Very Good condition due to low weed invasion at the time of the survey.

A2: Established Foredune (older): Sparse Shrubland *Olearia axillaris* over Grassland *Spinifex longifolius* (Plate 8).

Sparse Shrubland *Olearia axillaris* over Grassland *Spinifex longifolius* with Sparse Forbland of weeds **Pelargonium capitatum, *Trachyandra divaricata, *Euphorbia paralias, *Crassula glomerata.* Other scattered shrubs include *Rhagodia baccata* subsp. *baccata.* Scattered weedy grasses included **Ehrharta brevifolia* subsp. *cuspidata* and **Bromus diandrus.* Occasional sedge *Ficinia nodosa.*

There were two quadrats in this vegetation (TR01 and TR05) with an average species richness of 10.

This vegetation is equivalent to S14: *Spinifex longifolius* grasslands and low shrublands (Griffin, 1993 from Government of WA, 2000).

This vegetation was generally in Very Good condition due to low weed invasion at the time of the survey.

Plate 7 Vegetation Type A1: Young foredune with Grassland of *Spinifex longifolius.*

Plate 8 Vegetation Type A2: Established foredune with Sparse Shrubland *Olearia axillaris* over Grassland *Spinifex longifolius.*

A3: Beach-ridge Plain: Open Shrubland *Olearia axillaris, Rhagodia baccata* subsp. *baccata* and **Pelargonium capitatum* over Sparse Grassland *Spinifex longifolius* and Sparse Vineland *Cassytha flava* var. *flava* (Plate 9).

Other typical shrubs included *Leptomeria preissiana* and towards the eastern boundary of the community *Acacia cyclops, Myoporum insulare, Acanthocarpus preissii* and *Spyridium globulosum* started to appear. This progression can be seen on Plate 10. There was a weed dominated Forbland dominated by **Pelargonium capitatum* but also typically **Trachyandra divaricata, Senecio pinnatifolius* var. *latilobus, Calandrinia brevipedata, Carpobrotus virescens, Crassula colorata* var. *colorata, C. glomerata, *Dischisma arenarium*. A Sparse to Open Vineland of *Cassytha aurea* var. *aurea* was a notable feature of this vegetation, forming often robust tangles. Grass **Ehrharta brevifolia* var. *cuspidata* and tiny annual sedge **Isolepis marginata* were typical of the vegetation but at low cover.

There were two quadrats in this vegetation (TR02 and TR03) with an average species richness of 20.

This vegetation is equivalent to state listed Priority Ecological Community (PEC) SWAN 21: "Coastal shrublands on shallow sands, southern Swan Coastal Plain". Described as heaths on shallow sands over limestone close to the coast, with no single dominant but including *Spyridium globulosum, Rhagodia baccata* and *Olearia axillaris* (DBCA, 2019b). Also known as Floristic Community Type (FCT) 29a (Gibson *et al.* 1994). Floristically this vegetation type ended up being more similar to Vegetation Type B than the other quadrats in Vegetation Type A. Structurally and in terms of species richness however they were very different.

This vegetation was generally in Good to Very Good condition. It was downgraded compared to adjacent vegetation due to the relatively high cover of **Pelargonium capitatum* present at the time of the survey.

Plate 9 Vegetation Type A3: Beach ridge plain with Open Shrubland *Olearia axillaris* and **Pelargonium capitatum* over Sparse Grassland *Spinifex longifolius*.

Plate 10 Vegetation Types A1-A3: Overview showing series of low dunes that consitute a beach ridge plain.

B: TALL SECONDARY DUNES ON UNCONSOLIDATED SAND

B1: Shrubland dominated by *Acacia cyclops, Scaevola crassifolia, Spyridium globulosum, Santalum acuminatum, Myoporum insulare, Olearia axillaris, Rhagodia baccata* subsp. *baccata* and *Acanthocarpus preissii*, Sparse Vineland *Hardenbergia comptoniana* and *Cassytha flava* var. *flava*. Over Forbland dominated by *Senecio pinnatifolius* var. *latilobus* (Plates 11 and 12).

Other forbs typically included *Parietaria debilis, Calandrinia brevipedata, Carpobrotus virescens, Crassula colorata* var. *colorata, Conostylis candicans* subsp. *calcicola* and scattered weeds **Stellaria media, *Pelargonium capitatum, *Dischisma arenarium, *Brassica tournefortii* and **Crassula glomerata*. There was also a Sparse Tussock Grassland of *Poa porphyroclados*, occasional *Spinifex longifolius* and weeds **Ehrharta brevifolia var. cuspidata, *Lagurus ovatus* and **Bromus diandrus*. While *Cassytha flava* var. *flava* was the dominant vine, *C. glabella* forma *casuarinae* and *C. racemosa* forma. *racemosa* were also typical. Isolated Clumps of Sedges *Ficinia nodosa* and *Lepidosperma gladiatum* occurred across the community. On the western or windward slopes exposed to the sea breeze, wind and salt-pruning meant that vegetation was denser and shorter. On the eastern or leeward slopes, vegetation was taller and more open.

There were four quadrats in this vegetation (TR07, TR08, TR09 and TR14) which had an average species richness of 32.3 ± 3.1.

This vegetation is equivalent to state listed Priority Ecological Community (PEC) SWAN 21: "Coastal shrublands on shallow sands, southern Swan Coastal Plain". Described as heaths on shallow sands over limestone close to the coast, with no single dominant but including *Spyridium globulosum, Rhagodia baccata* and *Olearia axillaris* (DBCA, 2019). Also known as Floristic Community Type (FCT) 29a (Gibson *et al.* 1994).

This vegetation was in Very Good condition. Weeds varied between 1-5% cover, with localised patches of higher cover, particularly adjacent to tracks and towards the eastern extremity of the plant community.

Plate 11 Vegetation Type B1: Secondary Dune with Shrubland dominated by *Acacia cyclops, Scaevola crassifolium, Spyridium globulosum, Santalum acuminatum, Myoporum insulare, Olearia axillaris, Rhagodia baccata* subsp. *baccata* and *Acanthocarpus preissii.*

Plate 12 Vegetation Type B1: Secondary Dune with Shrubland dominated by *Acacia cyclops, Scaevola crassifolium, Spyridium globulosum, Santalum acuminatum, Myoporum insulare, Olearia axillaris, Rhagodia baccata* subsp. *baccata* and *Acanthocarpus preissii.*

C: LOW DUNES ON SEMI-CONSOLIDATED SAND

C1: Species rich low Shrubland dominated by *Melaleuca systena* and species rich Forbland dominated by *Lomandra maritima* and Sparse Sedgeland *Lepidosperma calcicola* and Sparse Rushland *Desmocladus asper* (Plates 13 and 14).

Taller shrubs were variably present as Isolated Clumps of Shrubs and included *Olearia axillaris, Acacia cyclops, Santalum acuminatum, Spyridium globulosum, Leucopogon parviflorus, Templetonia retusa* and *Leptomeria preissiana*. Other low shrubs typical of the species-rich low Shrubland included *Acacia lasiocarpa* var. *lasiocarpa, Beyeria cinerea* subsp. *cinerea* (P3), *Leucopogon maritimus* (P1), *L. insularis, Cryptandra mutila, Phyllanthus calycinus, Pimelea ferruginea, Hemiandra glabra, Gastrolobium nervosum, Gompholobium tomentosum* and *Acanthocarpus preissii*. The species-rich Forbland also typically included *Stylidium maritimum* (P4), *Opercularia vaginata, Conostylis candicans* subsp. *calcicola, Conostylis candicans* subsp. candicans, *Daucus glochidiatus, Dianella revoluta* var. *divaricata*, the orchids *Cyrtostylis huegelii* and *Eriochilus dilatatus* subsp. *dilatatus* and scattered but typical weeds **Crassula glomerata, *Minuartia mediterranea, *Lysimachia arvensis, *Galium murale* and **Romulea rosea*. There was a relatively species-rich Sparse Tussock Grassland of *Poa porphyroclados, Rytidosperma occidentale* and *Austrostipa flavescens* and scattered weeds **Catapodium rigidum, *Vulpia muralis, *Ehrharta brevifolia* var. *cuspidata* and **Bromus diandrus*.

There were three quadrats in this vegetation (TR10, TR12 and TR13) with an average species richness of 48 ± 8.9.

The statistical analysis indicated that this vegetation most closely grouped with FCT24 (Gibson *et al.*, 1994), with some influence from FCT29a. This was likely due to the small patch size of this community and the proximity to FCT29a vegetation types. FCT29a and FCT24 are both state listed Priority Ecological Communities (PECs). FCT24 is equivalent to state listed Priority Ecological Community (PEC) SWAN 26: Northern Spearwood shrublands and woodlands ('floristic community type 24') occurring on deeper soils north from Woodman Point. Most known occurrences occur on the Cottesloe unit of the Spearwood system (DBCA, 2019). Three species of Priority Flora formed a significant component of the structure of this vegetation, which indicates a possibility of a degree of uniqueness.

This vegetation was in Very Good to Excellent condition (Figure 4) in the eastern extent (Plate 13). The western extent was in Good condition (Plate 14) due to disturbance and higher cover of weed species.

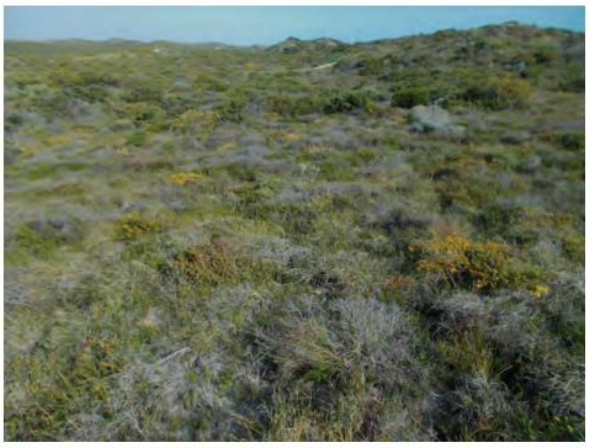

Plate 13 Vegetation Type C1: Species rich low Shrubland dominated by *Melaleuca systena* and species rich Forbland dominated by *Lomandra maritima*. Portion in Very Good to Excellent condition. Weed cover 1-2%.

Plate 14 Vegetation Type C1: Species rich low Shrubland dominated by *Melaleuca systena* and species rich Forbland dominated by *Lomandra maritima*. Portion in Good condition. Weed cover 10- 50%.

D: LOW RISES WITH LIMESTONE OUTCROPPING

D1: Closed Shrubland *Melaleuca cardiophylla* with other typical shrubs *Melaleuca huegelii, Acacia xanthina* and *Dodonaea aptera* with Sparse Vineland *Cassytha aurea* var. *aurea* over Forbland of native and introduced herbs (Plates 15 and 16).

Other typical shrubs included *Leucopogon parviflorus, L. insularis, Rhagodia baccata* subsp. *baccata*, *Spyridium globulosum, Westringia dampieri, Trymalium ledifolium* var. *ledifolium, Guichenotia ledifolia, Templetonia retusa* and/or *Leptomeria preissiana*. Forbs included *Dianella revoluta* var. divaricata, *Poranthera microphylla, Calandrinia brevipedata, Parietaria debilis, Wurmbea monantha*, orchids *Cyrtostylis huegelii* and *Caladenia latifolia*, native carrots *Trachymene pilosa, Hydrocotyle hispidula* and *Daucus glochidiatus*. Weeds had high cover in the forb strata, dominated by **Galium murale, *Crassula glomerata, *Stellaria media, *Minuartia mediterranea* and **Lysimachia arvensis*. There was a Sparse Tussock Grassland of *Austrostipa flavescens* and *Poa porphyroclados* and grass weeds **Vulpia muralis, *Catapodium rigidum, *Ehrharta longiflora* and **Bromus diandrus*.

There were two quadrats in this vegetation (TR06 and TR11) which had an average species richness of 51 ± 1.4.

This vegetation is equivalent to state listed Priority Ecological Community (PEC) SWAN 21: "Coastal shrublands on shallow sands, southern Swan Coastal Plain". Described as heaths on shallow sands over limestone close to the coast, with no single dominant but including *Spyridium globulosum, Rhagodia baccata* and *Olearia axillaris* (DBCA, 2019b). Also known as Floristic Community Type (FCT) 29a (Gibson *et al.* 1994).

This vegetation was mostly in Very Good condition with Degraded to Good areas (Figure 4) along the powerline and tracks, where clearing and regrowth had occurred historically.

Plate 15 Vegetation Type D1: Low rises with limestone outcropping with Closed Shrubland *Melaleuca cardiophylla*. Northern end of study area.

Plate 16 Vegetation Type D1: Low rises with limestone outcropping with Closed Shrubland *Melaleuca cardiophylla*. Southern end of study area.

E: CLEARED AREAS

E1: Historically cleared areas; informal walking paths, informal vehicular sand tracks (unused and partially overgrown (Plates 17 and 18).

There was very little recent clearing in the study area.

The main walking track E to W from Two Rocks Road to the beach was very narrow, with a couple of disturbed patches along its length.

An old vehicular track runs N-S through the centre of the study area. This is largely overgrown, but the track and areas adjacent show a legacy of some kind of disturbance, either historical grazing or clearing. Weeds are dominant in this area.

The powerline corridor was cleared at some point. The vegetation in this area is old regrowth, particularly between the powerline and Two Rocks Road. A track remains under the powerline (Plate 18). Weeds are dominant along this track and under and adjacent to regrowth areas.

Common track weeds included but was not limited to grasses **Bromus diandrus, *Ehrharta longiflora, *Lagurus ovatus, *Avena barbata* and *Lolium perenne and herbs **Euphorbia terracina, *E. peplus, *Brassica tournefortii, *Trachyandra divaricata, *Pelargonium capitatum* and **Gazania linearis*.

Plate 17 Vegetation Type E1: Main pedestrian track (informal) from Two Rocks Road to beach. Weeds mainly confined to track edges.

Plate 18 Vegetation Type E1: Historically cleared areas along powerline corridor showing regrowth of vegetation and weeds along an informal pedestrian track.

ONE TREE BOTANICAL

Client: City of Wanneroo

Job: P1904 - Two Rocks

Date: 2/12/2019

E: kelli@onetreebotanical.com.au

P: (08) 9371 9491

M: 0407 423 928

N

0 12.5 25 50 75 100 m

Scale: 1:2,000 @ A3
GDA 1994 MGA Zone 50

FIGUR

TWO ROCKS BEACH ACCESS W
VEGETATION TYPE M

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Job: P1904 - Two Rocks
Date: 2/12/2019
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P: (08) 9371 9491
M: 0407 423 928

Scale: 1:2,000 @ A3
GDA 1994 MGA Zone 50

FIGUR

TWO ROCKS BEACH ACCESS W
VEGETATION CONDITION M

5.2.4 Statistical Analysis of Vegetation

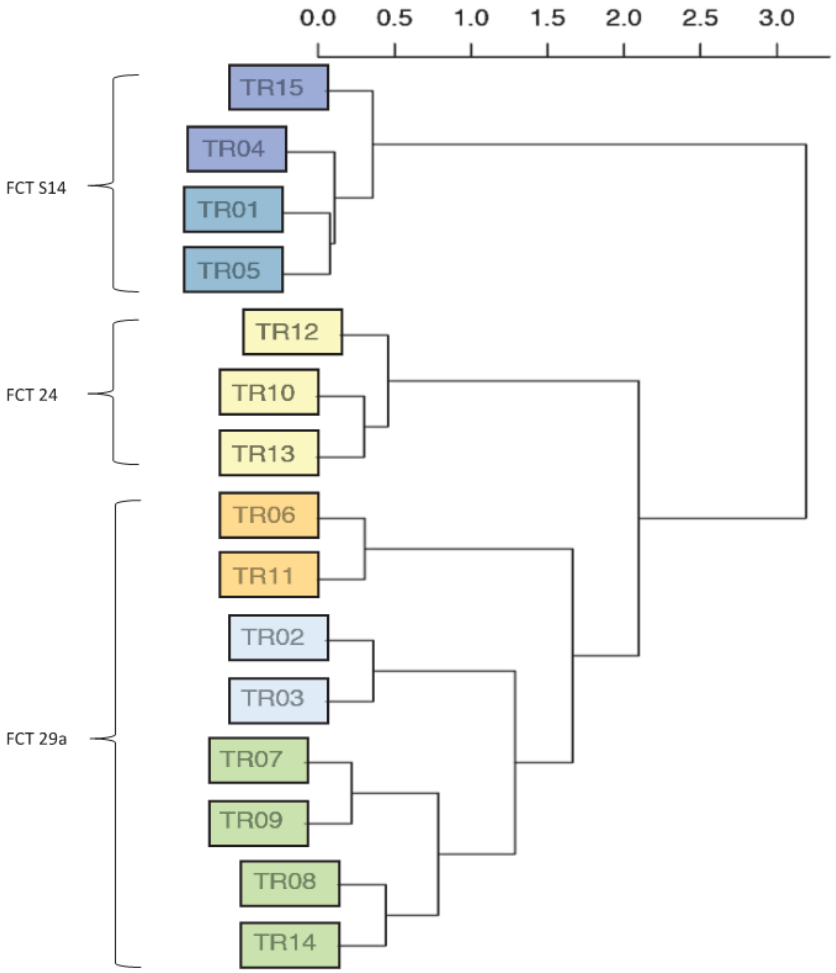
Numerical Analysis of Study Area Quadrats

A numerical analysis (multivariate) of quadrat data incorporating both floristics and structure (foliar cover %) was used to help characterise the vegetation present in the study area. The results are presented in Figure 5.

The quadrats were clustered into three main groups (Figure 5). These corresponded more or less to the Floristic Community Type analysis as described in the next section.

The results were relatively tidy however there was one result that requires explanation. Quadrats TR02 and TR03 rather than group with other Vegetation Type A quadrats (TR01, TR04, TR05 and TR15), grouped closer to Vegetation Type B quadrats (TR07, TR08, TR09 and TR14). Those two quadrats were geographically close to the boundary between the two types. Vegetation boundaries are a continuum. There is a lot of floristic overlap between those two vegetation types. The FCT analysis against Gibson *et al.* (1994) is not overly strong where near-coastal vegetation is concerned. All these factors are at play in this instance. The most notable feature of the results in terms of Vegetation Types A and B, is that grouping strongly correlated to a west to east succession of vegetation types. A decision was made to define and map TR02 and TR03 as Vegetation Type A. They were significantly less species rich, dense and complex than Vegetation Type B. They were also clearly associated with the beach ridge plain landform, while Vegetation Type B was on tall steep dunes.

Figure 5: Statistical Analysis of Study Area Quadrat Data (Bray-Ward) (floristics, foliar cover)



Corresponding Vegetation Types:

A1:	Incipient Foredune (younger): Uniform regrowth of Grassland *Spinifex longifolius*
A2:	Established Foredune (older): Sparse Shrubland *Olearia axillaris* over Grassland *Spinifex longifolius*
A3:	Beach-ridge Plain: Open Shrubland *Olearia axillaris, Rhagodia b.* subsp. *baccata* and **Pelargonium capitatum* over Sparse Grassland *Spinifex longifolius* and Sparse Vineland *Cassytha f.* var. *flava*.
B1:	Shrubland dominated by *Acacia cyclops, Scaevola crassifolia, Spyridium globulosum, Santalum acuminatum, Myoporum insulare, Olearia axillaris, Rhagodia b.* subsp. *baccata* and *Acanthocarpus preissii*, Sparse Vineland *Hardenbergia comptoniana* and *Cassytha f.* var. *flava*. Over Forbland dominated by *Senecio pinnatifolius* var. *latilobus*
C1:	Species rich low Shrubland dominated by *Melaleuca systena* and species rich Forbland dominated by *Lomandra maritima* and Sparse Sedgeland *Lepidosperma calcicola* and Sparse Rushland *Desmocladus asper*
D1:	Closed Shrubland *Melaleuca cardiophylla* with other typical shrubs *Melaleuca huegelii, Acacia xanthina* and *Dodonaea aptera* with Sparse Vineland *Cassytha a.* var. *aurea* over Forbland of native and introduced herbs.

Floristic Analysis Gibson et al. (1994)

The results of the statistical analysis were slightly ambiguous in places, which is likely to be due to the lack of Quindalup and near-coastal data in the Gibson *et al.* (1994) dataset.

Supplementary relevé data from the Quindalup Dunes between the Irwin and Swan Rivers was sourced from Griffin (1993) to attempt to remedy this. However the methodology used in that study was slightly different, in that quadrats were not measured. There were differences in survey effort which raised the statistical challenge of comparing apples with oranges. This data was however used to infer Floristic Community Types (FCTs) where these were obvious.

A summary of the results incorporating both inferred conclusions and the results of the statistical analysis is presented in Table 17.

Table 17: Floristic Community Type (FCT) Analysis Summary

Quadrat (Fig 3)	Gibson et al. (1994) Quadrats	Griffin (1993) Relevés	Geographical Distribution	Floristic Community Type
TR01	Analysis results not reliable due to lack of near-coastal quadrat data.	MI10, MI13, MI14, MI15, MI16, MI20, TR01, TR02.	Mindarie, Trigg.	**S14:** *Spinifex longifolius* grasslands and low shrublands.
TR02	GARDEN2, TRIG2, PRES1, NAVB2, BURN1, BURN2, SEAB8 (FCT29a). SEAB1 (FCT30c).	SW02, SW03, SW04, TR03 (S13).	Garden Island, Trigg, Burns Beach, Seabird, Preston.	**FCT29a:** Coastal Shrublands on Shallow Sands. **S13:** Northern *Olearia axillaris-Scaevola crassifolia* shrublands.
TR03	GARDEN2, TRIG2, PRES1, NAVB2, BURN1, SEAB8, BURN2 (FCT29a). SEAB1 (FCT30c).	SW02, SW03, SW04, TR03 (S13).	Garden Island, Trigg, Burns Beach, Seabird, Preston.	**FCT29a:** Coastal Shrublands on Shallow Sands. **S13:** Northern *Olearia axillaris-Scaevola crassifolia* shrublands.
TR04	Analysis results not reliable due to lack of near-coastal quadrat data.	MI10, MI13, MI14, MI15, MI16, MI20, TR01, TR02.	Mindarie, Trigg.	**S14:** *Spinifex longifolius* grasslands and low shrublands.
TR05	Analysis results not reliable due to lack of near-coastal quadrat data.	MI10, MI13, MI14, MI15, MI16, MI20, TR01, TR02.	Mindarie, Trigg.	**S14:** *Spinifex longifolius* grasslands and low shrublands.
TR06	GARDEN2, TRIG2, PRES1, BURN1, BURN2, SEAB8 (FCT29a). SEAB1 (FCT30c).	BU01, BU02, BU04 (FCT29a).	Garden Island, Trigg, Burns Beach, Seabird, Preston.	**FCT29a:** Coastal Shrublands on Shallow Sands.
TR07	BURN2, PRES1, GARDEN2, TRIG2 (FCT29a). SEAB1 (FCT30c).	SW02, SW03, SW04, TR03 (S13).	Garden Island, Preston, Trigg, Burns Beach, Seabird, Swanbourne.	**FCT29a:** Coastal Shrublands on Shallow Sands. **S13:** Northern *Olearia axillaris-Scaevola crassifolia* shrublands.
TR08	GARDEN2, TRIG2, BURN1, BURN2, PRES1, NAVB2, SEAB8 (FCT29a).	SW02, SW03, SW04, TR03 (S13).	Garden Island, Trigg, Burns Beach, Preston, Kwinana, Seabird.	**FCT29a:** Coastal Shrublands on Shallow Sands. **S13:** Northern *Olearia axillaris-Scaevola crassifolia* shrublands.
TR09	BURN1, BURN2, TRIG2, GARDEN2, PRES1, NAVB2, SEAB8 (FCT29a).	SW02, SW03, SW04, TR03 (S13).	Garden Island, Trigg, Burns Beach, Preston, Kwinana, Seabird.	**FCT29a:** Coastal Shrublands on Shallow Sands. **S13:** Northern *Olearia axillaris-Scaevola crassifolia* shrublands.

Quadrat (Fig 3)	Gibson et al. (1994) Quadrats	Griffin (1993) Relevés	Geographical Distribution	Floristic Community Type
	SEAB1 (FCT30c).			
TR10	NAVB3, CHIDPT1, BOLD3, BOLD4 (FCT24). TRIG1 (FCT29b).	MI23 (FCT24).	Kwinana, Chidley Point Mosman Park, Bold Park, Mindarie. Trigg.	**FCT24:** Northern Spearwood Shrublands and Woodlands. *(Possibly an unusual sub-type, usually known from Spearwood Dunes although MI23 is a near-coastal occurrence).*
TR11	GARDEN2, TRIG2, PRES1, BURN1, BURN2, SEAB8 (FCT29a). SEAB1 (FCT30c).	BU01, BU02, BU04.	Garden Island, Trigg, Preston, Burns Beach, Seabird.	**FCT29a:** Coastal Shrublands on Shallow Sands.
TR12	GARDEN2, TRIG2, PRES1, BURN1, BURN2, SEAB8 (FCT29a). SEAB1 (FCT30c).	SW02, SW03, SW04, TR03 (S13).	Garden Island, Trigg, Preston, Burns Beach, Seabird.	**FCT29a:** Coastal Shrublands on Shallow Sands. **S13:** Northern *Olearia axillaris-Scaevola crassifolia* shrublands.
TR13	NAVB3, CHIDPT1, BOLD3, BOLD4 (FCT24). TRIG1 (FCT29b).	MI23 (FCT24).	Kwinana, Chidley Point Mosman Park, Bold Park, Mindarie.	**FCT24:** Northern Spearwood Shrublands and Woodlands. *(Possibly an unusual sub-type, usually known from Spearwood Dunes although MI23 is a near-coastal occurrence).*
TR14	GARDEN2, TRIG2, BURN1, BURN2, PRES1, NAVB2, SEAB8 (FCT29a) SEAB1 (FCT30c).	SW02, SW03, SW04, TR03 (S13).	Garden Island, Trigg, Burns Beach, Preston, Kwinana, Seabird.	**FCT29a:** Coastal Shrublands on Shallow Sands. **S13:** Northern *Olearia axillaris-Scaevola crassifolia* shrublands.
TR15	Analysis results not reliable due to lack of near-coastal quadrat data.	MI10, MI13, MI14, MI15, MI16, MI20, TR01, TR02.	Mindarie, Trigg.	**S14:** *Spinifex longifolius* grasslands and low shrublands.

5.2.5 Threatened and Priority Ecological Community Search Results

The DBCA Threatened Species and Communities Branch species database search did not identify any records of state listed TECs or PECs as being previously known from within the study area boundaries.

A search of the *EPBC Act* Protected Matters Search Tool (Department of Environment and Energy, 2019) listed five TECs as potentially occurring in the region. None of these species have previously been recorded from within the study area.

Table 18 summarises the results from the database searches and identifies the likelihood of each occurring within the study area.

Table 18: Threatened and Priority Ecological Communities Database Search Results (DBCA PEC and TEC Databases and EPBC Protected Matters Database)

WESTERN AUSTRALIA	COMMONWEALTH EQUIVALENT *(EPBC Act 1999)*	CONSERVATION STATUS*			OCCURRENCE Known/Likely/Possible/Unlikely
		DBCA	*BC Act*	*EPBC Act*	
Banksia Dominated Woodlands of the Swan Coastal Plain (SCP) IBRA Region	Banksia Woodlands of the SCP.	P3		EN	Unlikely. Too close to the coast.

WESTERN AUSTRALIA	COMMONWEALTH EQUIVALENT *(EPBC Act 1999)*	CONSERVATION STATUS*			OCCURRENCE Known/Likely/Possible/Unlikely
		DBCA	*BC Act*	*EPBC Act*	
SCP20a: *Banksia attenuata* woodlands over species rich dense shrublands	Sub-type of above.		EN	EN	Unlikely. Too close to the coast.
Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the SCP.	Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the SCP.	P3		CR	Unlikely. FCT24 and FCT29a can be associated with this TEC, however no Tuart was recorded in or seen adjacent to the study area.
SCP25: Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands	Sub-type of above.	P3		CR	Unlikely. Known from further south.
SCP24: Northern Spearwood shrublands and woodlands		P3			**Probable occurrence recorded during current study.** Non-typical, some affiliation with 29b, further W than generally known, may be a atypical subtype.
SCP29a: Coastal shrublands on shallow sands		P3			**Recorded during current study.**
SCP29b: Acacia shrublands on taller dunes		P3			Possible. However statistical analysis indicated that FCT29a is present rather than FCT29b.
SCP26a: *Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges (FCT 26a as originally described in Gibson *et al.* (1994))			EN		Unlikely. Related to FCT24 but generally known from Spearwood Dunes which are usually further inland.
SCP30a: *Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, SCP.			VU		Unlikely. Known distribution further S. However thought by some to be an apex community within for example FCT29-type communities.
SCP19b: Woodlands over sedgelands in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson *et al.* (1994).	Sedgelands in Holocene dune swales of the southern SCP.		CR	EN	Beach ridge plain (Vegetation Type 1A-1C) may represent a pre-cursor potential habitat for this ecological community.
CAVES SCP01: Aquatic Root Mat Community Number 1 of Caves of the SCP.	Aquatic Root Mat Community in Caves of the SCP.		CR	EN	Unlikely. Subterranean ecology outside the scope of this assessment.
Coastal Saltmarsh	Subtropical and Temperate Coastal Saltmarsh			VU	Unlikely. An estuarine ecological community.

** See Section 3.5.6 for definitions of conservation status codes.*

No TECs listed under the *BC Act 2016* or the *EPBC Act 1999* were recorded in the study area.

Two Priority 3 PECs were recorded in the study area:

Priority Ecological Community (PEC) SWAN 21: "Coastal shrublands on shallow sands, southern Swan Coastal Plain". Described as heaths on shallow sands over limestone close to the coast, with no single dominant but including *Spyridium globulosum, Rhagodia baccata* and *Olearia axillaris* (DBCA, 2019). Also known as Floristic Community Type (FCT) 29a (Gibson *et al.* 1994). Represented in Vegetation Types A3, B1 and D1 (Figure 3).

Priority Ecological Community (PEC) SWAN 26: Northern Spearwood shrublands and woodlands. Also known as Floristic Community Type (FCT) 24 (Gibson *et al.* 1994). Described by DBCA (2019) as "Heaths with scattered Eucalyptus gomphocephala occurring on deeper soils north from Woodman Point. Most sites occur on the Cottesloe unit of the Spearwood system." This PEC is associated with the Tuart Woodlands TEC however no Tuart was observed within or adjacent to the study area. Likely to represent an unusual subtype, due to its extreme westerly distribution and three Priority Flora forming a substantial component of species assemblage of the vegetation. Represented in Vegetation Type C1 (Figure 3).

6. DISCUSSION

6.1 FLORA

A total of 158 taxa were recorded from the study area, of which 99 or 63% were natives. Near-coastal areas are usually very species poor. For a study area 13 hectares in size on the coast, this is a relatively high species diversity. This was due to the diversity of vegetation types and habitats present, which is also relatively uncommon on near-coastal areas.

No Threatened Flora listed under the Western Australian *BC Act 2016* or the Federal *EPBC Act 1999* were recorded in the study area.

Three Priority Flora were recorded from across the study area. This is an unusually high number for a very small 13 hectare near-coastal area. All three species were dominants within a small area of a single vegetation type (Vegetation Type C)(Figure 2)(Figure 3).

6.2 VEGETATION

No Threatened Ecological Communities (TECs) listed under the Western Australian *BC Act 2016* or the Federal *EPBC Act 1999* were recorded in the study area.

As discussed throughout the report, there were some challenges to assessing vegetation. The lack of a proper regional dataset of quadrat data in Western Australia is the underlying problem.

The quadrat data from this study was compared to the Gibson *et al.* (1994) dataset, which provided useful insight into the Floristic Community Types (FCTs) likely to be present. These results were then used to assess the presence or otherwise of TECs and Priority Ecological Communities (PECs) in the study area. There was slight ambiguity in results probably due to the lack of quadrat data in it from near-coastal and Quindalup Dune areas. Extra Quindalup Dune relevé data from Griffin (1993) was consulted, however due to methodological differences, no statistical analysis was completed using this data.

The vegetation in WA is much less well understood and documented than the flora is. There are many undocumented ecological communities. The Gibson *et al.* (1994) study is 25 years old. Little subsequent work has been completed to further refine and build on this study. It is treated as an end point in EIA processes, which it was never intended to be. In this context, it is inevitable that there will be plant communities that do not neatly fit within established FCT categories.

Based on the best information available, two PECs were identified for the study area; SCP24: Northern Spearwood shrublands and woodlands and SCP29a: Coastal shrublands on shallow sands.

The occurrence of SCP24 (FCT24 in Gibson *et al.,* 1994) is likely to be an uncommon subtype of this PEC. It is closer to the coast than this FCT usually occurs, it is more typical of Spearwood Dunes further inland. Three Priority Flora are dominant species within this vegetation type, which would indicate a high probability that the vegetation is unique or at least highly restricted. Priority Flora are not common in near coastal areas, and three in a single near-coastal vegetation type is unusual.

The occurrence of SCP29a (FCT29a in Gibson *et al.,* 1994) in the study area came out relatively strongly in the analysis. However it also had some similarities to S13: Northern *Olearia axillaris- Scaevola crassifolia* shrublands, which is a FCT defined from other studies and/or datasets (Government of WA, 2000) (Griffin, 1993). Most of the quadrats also had a minor secondary influence in the statistical analysis, to a single

FCT30a plot in Seabird (Table 17). FCT30a represents SCP30a: *Callitris preissii* (or *Melaleuca lanceolata*) forests and woodlands, which is a state-listed TEC. However more recent documentation (Department of Parks and Wildlife, 2014) document FCT30a as only occurring as far north as Trigg. There may have been a mis-classification in the original Gibson *et al.* (1994) study, or it was later adjusted based on further information. There is an association between FCT29a and FCT30a in that the latter as stated in Beard (1979) to likely be the apex community within other dune systems, but due to too frequent fire, the apex community was rarely manifested.

The beach ridge plain (Vegetation Type A1-A3) (Figure 3) is possibly interesting from an ecological processes and/or landform perspective. State and Federally listed TEC SCP19: "Sedgelands in Holocene dune swales of the southern Swan Coastal Plain" is found in the swales of older beach ridge plains. This ecological community forms in older beach ridge plains systems, while the example in the study area is young and still forming. It is possible however that given time, a more complex vegetation representing this TEC may form. It is a relatively rare landform in the Perth region, and the area between Two Rocks and Yanchep is a substantial sized and intact example of it. Landforms are largely beyond the scope of this study, though the EPA does consider them in EIA.

The condition of the study area has been discussed at length in the body of this report. However, it is evident that the site is very fragile in terms of its resistance to soil disturbance and weed invasion. Areas such as the foredunes are currently in remarkably good condition compared to other urban beach areas, likely due to low levels of fragmentation and activity. With increased access to these areas as well as fragmentation from the proposed infrastructure, the condition is likely to decline. It would be worthwhile considering this in project design.

6.3 LIMITATIONS

EPA (2016) provides a framework for identifying the limitations that may arise during a survey. These have been presented and discussed in Table 19.

Table 19: Limitations of the Assessment (EPA, 2016)

Limitation	Comment
Availability of contextual information at a regional and local scale.	Appropriate scale and up to date regional information particularly for vegetation is poor across Western Australia. To adequately assess vegetation a comprehensive consolidated and curated regional quadrat/plot database is required to complete a proper regional assessment in line with the full expectations of EPA, 2016. This is a significant limitation for all detailed vegetation surveys. Broad scale contextual information was available such as vegetation type, vegetation complex mapping etc.
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed.	A botanist with 23 years of experience in completing botanical surveys on the SCP for EIA, completed all aspects of the assessment from planning, field work, flora identifications, data analysis and reporting. The duty botanist at the WA Herbarium confirmed identifications of Priority flora species.
Proportion of flora recorded and/or collected, any identification issues.	Always difficult to estimate on a percentage value. Estimate >70% of the flora would have been recorded.

Limitation	Comment
	A total of 158 taxa were recorded from the study area, of which 99 or 63% were natives. This is high for a small 13 hectare near-coastal study area. Coverage of study area was intensive with a two-season quadrat survey and 20m traverses spread over three surveys over the peak flowering period (Sept-Oct). All vascular flora encountered at the time of the survey were recorded including weeds. Species accumulation curves are not a useful catch-all measure of overall expected species present and they weren't used. The duty botanist at the WA Herbarium confirmed identifications of Priority flora species.
Was the appropriate area fully surveyed (effort and extent)?	Coverage of study area was intensive with a two-season quadrat survey and 20m traverses spread over three surveys over the peak flowering period (Sept-Oct). Survey effort consisted of approximately 70 person hours over 13 hectares.
Access restrictions within the study area.	No access issues.
Survey timing, rainfall, season of survey.	Survey spread over three visits over the peak flowering period (Sept-Oct). Rainfall for the months of April to September 2019 leading up to the field survey was 517.2mm compared to 113-year average for Wanneroo over the same period of 677.5mm. This represented a 23% rainfall shortfall from the long-term mean.
Disturbance that may have affected the results of survey such as fire, flood or clearing.	There were disturbed areas where some extrapolation was required, but no significant barriers to assessment of site were present.

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Appendix A: Field Survey Species List – Flora

* = Indicates weed flora.

FAMILY			SPECIES
080	LAURACEAE		*Cassytha aurea* var. *aurea*
			Cassytha flava
			Cassytha glabella forma. *casuarinae*
			Cassytha racemosa forma. *racemosa*
089	JUNCAGINACEAE		*Triglochin isingiana*
			Triglochin nana
109	COLCHICACEAE		*Wurmbea monantha*
115	ORCHIDACEAE		*Caladenia latifolia*
			Cyrtostylis huegelii
			Eriochilus dilatatus subsp. *dilatatus*
			Leptoceras menziesii
			Microtis media subsp. *media*
124	IRIDACEAE	*	*Gladiolus caryophyllaceus*
		*	*Romulea rosea*
128	ASPARAGACEAE		*Acanthocarpus preissii*
			Lomandra maritima
			Thysanotus manglesianus
129	ASPHODELACEAE	*	*Trachyandra divaricata*
130	HEMEROCALLIDACEAE		*Dianella revoluta* var. *divaricata*
			Tricoryne elatior
138	HAEMODORACEAE		*Conostylis candicans* subsp. *calcicola*
			Conostylis candicans subsp. *candicans*
156	CYPERACEAE		*Carex thecata*
			Ficinia nodosa
		*	*Isolepis marginata*
			Lepidosperma calcicola
			Lepidosperma gladiatum
			Schoenus lanatus
159	RESTIONACEAE		*Desmocladus asper*
163	POACEAE	*	*Aira cupaniana*
			Austrostipa flavescens
		*	*Avena barbata*
		*	*Briza maxima*
		*	*Briza minor*
		*	*Bromus diandrus*
		*	*Catapodium rigidum*
		*	*Cynodon dactylon*
		*	*Ehrharta brevifolia* var. *cuspidata*
		*	*Ehrharta longiflora*
		*	*Eragrostis curvula*
		*	*Hyparrhenia hirta*
		*	*Lagurus ovatus*
		*	*Lolium perenne*
		*	*Rostraria cristata*
			Rytidosperma occidentale

FAMILY			SPECIES
			Spinifex hirsutus
			Spinifex longifolius
		*	*Vulpia muralis*
		*	*Vulpia myuros* forma *megaleura*
171	RANUNCULACEAE		*Clematis linearifolia*
192	CRASSULACEAE		*Crassula colorata* var. *colorata*
		*	*Crassula decumbens* var. *decumbens*
		*	*Crassula glomerata*
		*	*Crassula thunbergiana* subsp. *thunbergiana*
201	FABACEAE		*Acacia cyclops*
			Acacia lasiocarpa var. *lasiocarpa*
			Acacia rostellifera
			Acacia xanthina
			Gastrolobium nervosum
			Gompholobium tomentosum
			Hardenbergia comptoniana
			Kennedia prostrata
		*	*Lupinus cosentinii*
		*	*Medicago polymorpha*
		*	*Medicago polymorpha*
		*	*Melilotus indicus*
			Templetonia retusa
		*	*Trifolium campestre* var. *campestre*
203	POLYGALACEAE		*Comesperma confertum*
			Comesperma integerrimum
208	RHAMNACEAE		*Cryptandra mutila*
			Spyridium globulosum
			Trymalium ledifolium var. *ledifolium*
212	URTICACEAE		*Parietaria debilis*
217	CASUARINACEAE		*Allocasuarina lehmanniana* subsp. *lehmanniana*
242	EUPHORBIACEAE		*Beyeria cinerea* subsp. *cinerea* (P3)
		*	*Euphorbia paralias*
		*	*Euphorbia peplus*
		*	*Euphorbia terracina*
247	PHYLLANTHACEAE		*Phyllanthus calycinus*
			Poranthera microphylla
274	GERANIACEAE	*	*Pelargonium capitatum*
			Pelargonium littorale
281	MYRTACEAE		*Melaleuca cardiophylla*
			Melaleuca huegelii subsp. *huegelii*
			Melaleuca systena
298	ANACARDIACEAE	*	*Schinus terebinthifolia*
299	SAPINDACEAE		*Dodonaea aptera*
309	MALVACEAE		*Guichenotia ledifolia*
			Thomasia triphylla
311	THYMELACEAE		*Pimelea ferruginea*
332	BRASSICACEAE	*	*Brassica tournefortii*
		*	*Cakile maritima*
		*	*Heliophila pusilla*
336	OLACACEAE		*Olax benthamiana*

FAMILY			SPECIES
338	SANTALACEAE		*Exocarpos sparteus*
			Leptomeria preissiana
			Santalum acuminatum
346	DROSERACEAE		*Drosera macrantha*
			Drosera ?ramellosa (sterile, immat.)
355	CARYOPHYLLACEAE	*	*Cerastium glomeratum*
		*	*Minuartia mediterranea*
		*	*Petrorhagia dubia*
		*	*Silene gallica* var. *gallica*
		*	*Stellaria media*
358	CHENOPODIACEAE		*Atriplex isatidea*
			Rhagodia baccata subsp. *baccata*
			Threlkeldia diffusa
364	AIZOACEAE		*Carpobrotus virescens*
		*	*Tetragonia decumbens*
374	MONTIACEAE		*Calandrinia brevipedata*
392	PRIMULACEAE	*	*Lysimachia arvensis*
403	ERICACEAE		*Acrotriche cordata*
			Leucopogon insularis
			Leucopogon maritimus (P1)
			Leucopogon parviflorus
			Lysinema pentapetalum
409	RUBIACEAE	*	*Galium murale*
			Opercularia vaginata
410	GENTIANACEAE		*Schenkia australis*
411	LOGANIACEAE		*Phyllangium divergens*
416	CONVOLVULACEAE	*	*Cuscuta planiflora*
427	PLANTAGINACEAE	*	*Plantago lanceolata*
428	SCROPHULARIACEAE	*	*Bellardia trixago*
		*	*Dischisma arenarium*
			Eremophila glabra subsp. *albicans*
			Myoporum insulare
432	LAMIACEAE		*Hemiandra glabra*
			Westringia dampieri
435	OROBANCHACEAE	*	*Parentucellia latifolia*
450	CAMPANULACEAE		*Isotoma hypocrateriformis*
452	STYLIDIACEAE		*Stylidium hesperium*
			Stylidium maritimum (P3)
458	GOODENIACEAE		*Scaevola crassifolia*
			Scaevola thesioides subsp. *thesioides*
460	ASTERACEAE	*	*Arctotheca calendula*
		*	*Arctotheca populifolia*
		*	*Gazania linearis*
			Hyalosperma cotula
		*	*Hypochaeris glabra*
			Leptorhynchos scaber
			Millotia myosotidifolia
			Olearia axillaris
		*	*Osteospermum ecklonis*
			Pithocarpa cordata

FAMILY			SPECIES
			Podotheca gnaphalioides
		*	*Reichardia tingitiana*
			Rhodanthe citrina
			Senecio pinnatifolius var. *latilobus*
		*	*Senecio vulgaris*
		*	*Sonchus oleraceus*
467	CAPRIFOLIACEAE	*	*Scabiosa atropurpurea*
472	ARALIACEAE		*Trachymene pilosa*
474	APIACEAE		*Daucus glochidiatus*
		*	*Foeniculum vulgare*
			Hydrocotyle hispidula
			Hydrocotyle pilifera var. *glabrata*
	AGAVACEAE	*	*Yukka aloeifolia* (Garden escape)

Appendix B: Flora and Vegetation Species by Site Table

H = Height (cm); C = Cover (% of quadrat area); X = outside quadrat but within 10m of quadrat boundary; CR = creeper; * = introduced flora.

SPECIES	TR01		TR02		TR03		TR04		TR05		TR06		TR07		TR08		TR09		TR10		TR11		TR12		TR13		TR14		TR15		OPPORTUNISTIC
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	
Acacia cyclops			X	X									X	X	120	3	70	1	100	2					300	0.1	160	5			Primary Dune
Acacia l. var. *lasiocarpa*																			30	3			X	X	40	3					
Acacia rostellifera																							X	X							
Acacia xanthina											140	1									100	1	X	X	X	X	X	X			Powerline 15% cover
Acanthocarpus preissii					40	0.1							50	10	50	10	50	10	30	0.1	X	X	30	5			50	5			Primary dune, Powerline
Acrotriche cordata																															50J 366609 6513503
**Aira cupaniana*																															50J 366533 6513515
Allocasuarina l. subsp. *lehmanniana*																															50J 366614 6513504
**Arctotheca calendula*																															Powerline, Main Path
**Arctotheca populifolia*							20	0.1																					X	X	Primary Dune
Atriplex isatidea							X	X																					X	X	Primary Dune
Austrostipa flavescens											60	0.3			X	X	X	X	70	1	90	1	60	2	50	1					Powerline
**Avena barbata*											70	0.1									70	0.1	60	0.1	70	0.1					Powerline, Main Path
**Bellardia trixago*																									2	0.1					
Beyeria c. subsp. *cinerea* (P3)																			30	12			40	3	20	2					
**Brassica tournefortii*													20	0.1	30	0.2	20	0.1	20	0.1					20	0.1					Powerline, Main Path
**Briza maxima*											30	0.1									X	X									Powerline
**Briza minor*											10	0.1													10	0.1					Powerline 0-3% cover
**Bromus diandrus*	30	0.1	20	0.1							40	0.1	30	0.5	30	1	30	0.2			30	0.2	30	3	30	0.3	40	1			Powerline, Main Path
**Cakile maritima*	20	0.1					20	1																					30	0.5	Primary Dune
Caladenia latifolia											10	0.1									2	0.1									
Calandrinia brevipedata			3	0.1	2	0.2					5	0.1	3	0.5	3	1	10	1			3	0.1	5	0.1							Secondary Dune
Carex thecata																					30	0.1									
Carpobrotus virescens			20	0.1	10	1							20	1	20	1	20	2					20	1			30	1			Primary Dune 2
Cassytha aurea var. *aurea*			CR	5	CR	4					CR	2	CR	5	CR	4	CR	3	CR	1	CR	4					CR	2			Primary Dune 2, Powerline
Cassytha flava																							CR	0.1	CR	0.1					
Cassytha glabella forma. *casuarinae*													CR	2			CR	0.1							CR	1					
Cassytha r. forma. *racemosa*													CR	2													CR	3			
**Catapodium rigidum*											10	0.2			10	0.2			10	0.2	5	0.1	20	0.1	10	0.1					
**Cerastium glomeratum*																	5	0.1													
Clematis linearifolia											X	X									CR	0.1									Powerline
Comesperma confertum																			20	0.1											
Comesperma integerrimum											X	X									CR	0.1									
Conostylis candicans subsp. *calcicola*																	30	0.5	30	2					20	0.1	20	0.5			

SPECIES	TR01		TR02		TR03		TR04		TR05		TR06		TR07		TR08		TR09		TR10		TR11		TR12		TR13		TR14		TR15		OPPORTUNISTIC
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	
Conostylis c. subsp. *candicans*																							40	3							
Crassula c. var. *colorata*			2	0.2	2	0.1									2	0.1					2	0.1	3	0.1			3	0.1			Primary Dune 2
**Crassula d.* var. *decumbens*															3	0.3	3	0.1													
**Crassula glomerata*	3	0.1	3	0.2	3	1			3	0.1	3	0.1	3	0.2					3	0.1	3	0.5	3	0.1	3	0.1	3	2			Powerline, Main Path
**Crassula t.* subsp. *thunbergiana*																	3	0.5					3	0.1							
Cryptandra mutila																			30	3					30	1					
**Cuscuta planiflora*																							X	X							Primary Dune, Main Path
**Cynodon dactylon*																															Road, Main Path
Cyrtostylis huegelii											10	2							1	0.1	0	0.1			1	0.1					
Daucus glochidiatus											10	3			5	0.1			10	0.1	3	1			10	0.1					
Desmocladus asper																			15	10	15	1	10	4	15	8					
Dianella revoluta var. *divaricata*											50	0.5							40	0.2	70	0.1	60	0.1	X	X	50	0.5			Powerline
**Dischisma arenarium*			10	0.2	5	1			5	0.1			5	0.2	3	0.5	5	0.1			5	0.1	5	0.5			5	0.1			Primary Dune, Main Path
Dodonaea aptera											120	4									90	10			X	X					Powerline
Drosera ?ramellosa (sterile)																									1	0.1					
Drosera macrantha																			CR	0.1					CR	0.1					
**Ehrharta brevifolia* var. *cuspidata*			20	0.3	30	0.3			20	0.1			20	0.1	30	2	20	0.1					20	0.1			20	0.1			Main Path
**Ehrharta longiflora*											20	0.1	40	0.1	20	0.1					10	0.5	40	0.1	30	0.2	30	3			Powerline
**Eragrostis curvula*																															Access Track, Powerline
Eremophila glabra subsp. *albicans*																			X	X											
Eriochilus d. subsp. *dilatatus*																			5	0.1											
**Euphorbia paralias*	20	2							20	0.1																					
**Euphorbia peplus*																					10	0.5			10	0.1					Powerline, Main Path
**Euphorbia terracina*																					20	0.1									Main Path
Exocarpos sparteus																											X	X			Primary Dune, Powerline
Ficinia nodosa									40	0.1			70	0.5	50	0.1	20	0.1									X	X			Primary, Secondary Dune
**Foeniculum vulgare*																															Road, 366667 6513487
**Galium murale*											3	10	3	0.1					5	0.1	3	6			3	2					Powerline 0-10%
Gastrolobium nervosum																			30	1					20	0.1					
**Gazania linearis*																															Powerline, Main Path
**Gladiolus caryophyllaceus*																															Access Track
Gompholobium tomentosum																			30	2			30	0.1	30	2					
Guichenotia ledifolia																					100	0.1									Powerline.
Hardenbergia comptoniana													CR	8	CR	2	CR	8					CR	1			CR	1			Powerline
**Heliophila pusilla*											10	0.1							15	0.1											
Hemiandra glabra													60	0.1					30	1			20	3							
Hyalosperma cotula																			10	0.2											50J 366609 6513503
Hydrocotyle hispidula											2	0.2									3	0.2									
Hydrocotyle pilifera var. *glabrata*																									3	0.1					
**Hyparrhenia hirta*																															Main Path, 366716 6513327
**Hypochaeris glabra*																															Main Path

SPECIES	TR01		TR02		TR03		TR04		TR05		TR06		TR07		TR08		TR09		TR10		TR11		TR12		TR13		TR14		TR15		OPPORTUNISTIC
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	
**Isolepis marginata*			5	0.1	5	2					5	0.1					3	0.1													Secondary, Primary Dune
Isotoma hypocrateriformis																			20	0.1	X	X									
Kennedia prostrata																							X	X							
**Lagurus ovatus*					20	0.1					20	0.1	10	0.1	30	0.1	10	0.1			20	0.2	10	0.5							Powerline, Main Path
Lepidosperma calcicola																			15	5	30	0.1	20	2	30	5					Powerline
Lepidosperma gladiatum																	80	1													
Leptoceras menziesii											1	0.1																			
Leptomeria preissiana					90	1					100	2	X	X					100	1	X	X	100	1							Primary Dune
Leptorhynchos scaber											10	0.1							20	0.3											50J 366517 6513414
Leucopogon insularis											70	2							40	3	40	0.1			50	3					
Leucopogon maritimus (P1)																			20	1					30	1					50J 366603 6513478
Leucopogon parviflorus											50	0.1					X	X	50	0.1	70	1	X	X	50	0.1					
**Lolium perenne*													15	0.1									20	1.5	30	0.1					Main Path
Lomandra maritima																			30	25	30	0.1	40	30	30	40					50 J 366651 6513235
**Lupinus cosentinii*																															Main Path
**Lysimachia arvensis*											10	0.1							2	0.1	10	1			10	0.2					Powerline, Main Path
Lysinema pentapetalum																			X	X					40	0.5					50J 366605 6513501
**Medicago polymorpha*																															Powerline, Main Path
Melaleuca cardiophylla											150	75									200	25									Powerline.
Melaleuca h. subsp. *huegelii*											70	1									150	4									Powerline 0-2% cover.
Melaleuca systena																			30	8	40	0.1	40	10	40	15					
**Melilotus indicus*											20	1																			
Microtis m. subsp. *media*																					50	0.1									
Millotia myosotidifolia																															50J 366523 6513482
**Minuartia mediterranea*											3	2							3	0.1	3	0.5			5	0.1					
Moss					1	2					3	10					3	5			3	5					3	2			Secondary Dune
Myoporum insulare					70	0.1					X	X	10	0.1	70	8	X	X									200	3			Secondary Dune
Olax benthamiana																			X	X											
Olearia axillaris	40	1	120	15	130	35			70	3	20	0.1	120	10	70	5	70	4	60	0.1			100	1	X	X	180	8			
Opercularia vaginata																			30	2			30	2	20	0.1					
**Osteospermum ecklonis*																															Powerline, 366801 6513362
**Parentucellia latifolia*											10	0.1																			50J 366523 6513482
Parietaria debilis													10	0.2	10	0.2	10	0.2			10	0.1					5	0.1			Secondary, Primary Dune
**Pelargonium capitatum*	40	2	30	20	30	12			30	3			40	1	70	2	50	1									20	0.1			Main Path
Pelargonium littorale											5	0.1																			
**Petrorhagia dubia*																															Powerline
Phyllangium divergens											3	0.1																			50J 366533 6513515
Phyllanthus calycinus																			20	0.1					20	1					
Pimelea ferruginea																			30	0.2					30	0.1					
Pithocarpa cordata			X	X							X	X	10	0.1	50	1	X	X									X	X			Primary Dune
**Plantago lanceolata*																															Road

SPECIES	TR01		TR02		TR03		TR04		TR05		TR06		TR07		TR08		TR09		TR10		TR11		TR12		TR13		TR14		TR15		OPPORTUNISTIC
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	
Poa porphyroclados											40	0.3	40	2	40	0.1	20	1	50	0.1			40	2	40	1	40	1			
Podotheca gnaphalioides																															50J 366515 6513501
Poranthera microphylla											3	0.1									3	0.1									Powerline
**Reichardia tingitiana*																									10	0.1					
Rhagodia b. subsp. *baccata*			30	2	40	1			30	0.1	70	1	70	3	50	5	50	4			100	2	20	2			70	1			Primary Dune, Powerline
Rhodanthe citrina																															50J 366523 6513482
**Romulea rosea*											15	0.1							15	3	15	0.2	20	2	20	2					Powerline, Main Path
**Rostraria cristata*																									10	0.1					
Rytidosperma occidentale																			40	0.1					70	0.2					Main Path Weeds
Santalum acuminatum											X	X	120	2	70	1	50	0.5	120	3	X	X	X	X	50	2	70	0.1			Powerline 0-5%
**Scabiosa atropurpurea*																															Road 366628 6513516
Scaevola crassifolia									X	X			70	50	50	7	70	40					X	X			60	4			Primary Dune, Powerline
Scaevola t. subsp. *thesioides*																			30	0.1											
Schenkia australis																			X	X	3	0.1			3	0.1					
**Schinus terebinthifolia*																															Road, 366656 6513491
Schoenus lanatus																			20	0.1					20	0.1					
Senecio pinnatifolius var. *latilobus*			30	0.5	30	0.2							30	8	40	3	30	4					20	0.1			20	0.1			
**Senecio vulgaris*											10	0.1																			
**Silene gallica* var. *gallica*											10	0.1																			
**Sonchus oleraceus*	30	0.1	10	0.1					5	0.1	10	0.1	5	0.1					5	0.1	10	0.1	5	0.1	5	0.1					
Spinifex hirsutus																													40	1	
Spinifex longifolius	70	35	60	1	70	1	40	35	70	35			90	1	X	X											X	X	50	55	
Spyridium globulosum					100	0.1					70	1	50	3	70	8	70	2	110	2	200	4	120	1	100	2	100	4			Powerline 15% cover
**Stellaria media*					10	0.1					5	0.2	10	0.2	10	0.1					10	0.2					10	0.1			
Stylidium hesperium																			X	X											
Stylidium maritimum (P3)																			30	1					30	1					
Templetonia retusa																			30	0.1	70	0.1			90	2					
**Tetragonia decumbens*													X	X																	
Thomasia triphylla											X	X																			
Threlkeldia diffusa					20	0.1							40	1	50	1	20	0.1					30	0.1			40	1			
Thysanotus manglesianus											CR	0.1					CR	0.1			X	X	CR	0.1							50J 366404 6513387
**Trachyandra divaricata*	30	1	30	2	30	1			20	0.2			20	0.5	40	1	40	2					30	0.5			30	2			Primary Dune, Main Path
Trachymene pilosa											10	0.2									3	0.1			10	0.1					50J 366533 6513515
Tricoryne elatior																															Powerline
**Trifolium c.* var. *campestre*																															Powerline
Triglochin isingiana																	3	0.1													
Triglochin nana																			6	0.1					3	0.1					
Trymalium l. var. *ledifolium*																					100	1									
**Vulpia muralis*					20	0.1					10	2	5	0.2	20	0.1	5	0.1	10	0.5	5	1			10	0.1					
**Vulpia myuros* forma *megaleura*			5	0.1																											50J 366533 6513515
Westringia dampieri											90	2							X	X	100	1	X	X	90	1					Powerline 1%

SPECIES	TR01		TR02		TR03		TR04		TR05		TR06		TR07		TR08		TR09		TR10		TR11		TR12		TR13		TR14		TR15		OPPORTUNISTIC
	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	
Wurmbea monantha											10	0.1									10	0.1									
**Yukka aloeifolia*																															Access Track

Appendix C: Vegetation Detailed Site Quadrat Data

SITE: TR01

Survey Date 1:	13 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	SE
	SW	50J 384247	6492059	**Altitude:**	7m
Landform:	Primary dune, beach ridge plain.			**Soil:**	White sand (unconsolidated)
Leaf Litter:	10% cover; 1 – 10 cm depth.			**Fire History:**	>10 years
Condition:	Very Good			**Details:**	Weeds 6%, coastal cosmopolitan.
Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**	
	G1	Grass 0.5-1m	30-70%	*Spinifex longifolius.*	
	G2	Shrubs <0.5m	0.25-5%	*Olearia axillaris, *Pelargonium capitatum.*	
	G3	Forbs <0.5m	0.25-5%	**Trachyandra divaricata, *Euphorbia paralias.*	
Species:	**Bromus diandrus, *Cakile maritima, *Crassula glomerata, *Euphorbia paralias, Olearia axillaris, *Pelargonium capitatum, *Sonchus oleraceus, Spinifex longifolius, *Trachyandra divaricata.*				

Photo (NW Corner):

SITE: TR02

Survey Date 1:	13 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	SE
	SW	50J 384247	6492059	**Altitude:**	9m
Landform:	Primary dune, beach ridge plain.			**Soil:**	White sand (unconsolidated)
Leaf Litter:	20% cover; 0-5cm depth.			**Fire History:**	>10 years
Condition:	Good			**Details:**	Weeds 23%, coastal cosmopolitan.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	M1	Shrub 1-2m	10-30%	*Olearia axillaris.*
	G1	Shrubs <0.5m	10-30%	**Pelargonium capitatum, Rhagodia baccata* subsp. *baccata.*
	G2	Grass 0.5-1m	0.25-5%	*Spinifex longifolius.*
	G3	Vine <0.5m	5-10%	*Cassytha aurea var. aurea.*

Species: **Bromus diandrus, Calandrinia brevipedata, Carpobrotus virescens, *Isolepis marginata, *Sonchus oleraceus, *Vulpia myuros* forma *megaleura, Crassula colorata* var. *colorata, *Crassula glomerata, *Dischisma arenarium, *Ehrharta brevifolia* var. *cuspidata, Senecio pinnatifolius* 4. *latilobus, Spinifex longifolius, Rhagodia baccata* subsp. *baccata, *Trachyandra divaricata, Cassytha aurea* var. *aurea, Olearia axillaris, *Pelargonium capitatum.*

Photo (NW Corner):

SITE: TR03

Survey Date 1:	13 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	Basin
	SW	50J 384247	6492059	**Altitude:**	9m
Landform:	Primary dune, beach ridge plain.			**Soil:**	White sand
Leaf Litter:	15% cover; 0 – 5 cm depth.			**Fire History:**	>10 years
Condition:	Good			**Details:**	Weeds 15%, coastal cosmopolitan.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	M1	Shrub 1-2m	30-70%	*Olearia axillaris.*
	G1	Forbs <0.5m	10-30%	**Pelargonium capitatum.*
	G2	Vine <0.5m	0.25-5%	*Cassytha aurea* var. *aurea.*

Species: *Acanthocarpus preissii, Calandrinia brevipedata, Carpobrotus virescens, Cassytha aurea* var. *aurea, Crassula colorata* var. *colorata, *Crassula glomerata, *Dischisma arenarium, *Ehrharta brevifolia* var. *cuspidata, *Isolepis marginata, *Lagurus ovatus, Leptomeria preissiana,* Moss, *Myoporum insulare, Olearia axillaris, *Pelargonium capitatum, Rhagodia baccata* subsp. *baccata, Senecio pinnatifolius* var. *latilobus, Spinifex longifolius, Spyridium globulosum, *Stellaria media, Threlkeldia diffusa, *Trachyandra divaricata, *Vulpia muralis.*

Photo (NW Corner):

SITE: TR04

Survey Date 1:	13 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	Undulating
	SW	50J 384247	6492059	**Altitude:**	7m
Landform:	Primary dune, very young.			**Soil:**	White sand (unconsolidated)
Leaf Litter:	10% cover; 1 – 10 cm depth.			**Fire History:**	>10 years
Condition:	VG			**Details:**	Weeds 6%, coastal cosmopolitan.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	G1	Grass <0.5m	30-70%	*Spinifex longifolius.*
	G2	Forbs <0.5m	0.25-5%	**Cakile maritima*

Species: *Arctotheca populifolia, Cakile maritima, Spinifex longifolius.*

Photo (NW Corner):

SITE: TR05

Survey Date 1:	13 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	N-S Dune ridge.
	SW	50J 384247	6492059	**Altitude:**	6m
Landform:	Primary dune, beach ridge plain.			**Soil:**	White sand
Leaf Litter:	20% cover; 0 – 5 cm depth.			**Fire History:**	>10 years
Condition:	Good to Very Good.			**Details:**	Weeds 4%, coastal cosmopolitan.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	G1	Shrubs 0.5-1m	0.25-5%	*Olearia axillaris,*
	G2	Grass 0.5-1m	30-70%	*Spinifex longifolius.*
	G3	Forbs <0.5m	0.25-5%	**Pelargonium capitatum*

Species: **Crassula glomerata, *Dischisma arenarium, *Ehrharta brevifolia* var. *cuspidata, *Euphorbia paralias, Ficinia nodosa, Olearia axillaris, *Pelargonium capitatum, Rhagodia baccata* subsp. *baccata, *Sonchus oleraceus, Spinifex longifolius, *Trachyandra divaricata.*

Photo (NW Corner):

SITE: TR06

Survey Date 1:	13 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	21 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	SE
	SW	50J 384247	6492059	**Altitude:**	19m
Landform:	Low hill with limestone outcrop (5%).			**Soil:**	Brown loamy sand.
Leaf Litter:	20% cover; 0 – 3 cm depth.			**Fire History:**	>10 years
Condition:	Very Good			**Details:**	Weeds 5-15%.

Vegetation	**Stratum**	**Form**	**Cover**	**Dominant Species**
NVIS:	M1	Shrubs 1-2m	70-100%	*Melaleuca cardiophylla.*
	G1	Shrubs 0.5-1m	5-10%	*Dodonaea aptera, Leptomeria preissiana, Leucopogon insularis, Westringia dampieri*
	G2	Forbs <0.5m	10-30%	**Galium murale, *Minuartia mediterranea, Daucus glochidiatus.*
	G3	Grass <0.5m	0.25-5%	**Vulpia muralis, Austrostipa flavescens, Poa porphyroclados*
	G4	Vine <0.5-1m	0.25-5%	*Cassytha aurea* var. *aurea.*

Species: *Acacia xanthina, Austrostipa flavescens, Avena barbata, *Briza maxima, *Briza minor, *Bromus diandrus, Caladenia latifolia, Calandrinia brevipedata, Cassytha aurea* var. *aurea, *Catapodium rigidum, *Crassula glomerata, Cyrtostylis huegelii, Daucus glochidiatus, Dianella revoluta* var. *divaricata, Dodonaea aptera, *Ehrharta longiflora, *Galium murale, *Heliophila pusilla, Hydrocotyle hispidula, *Isolepis marginata, *Lagurus ovatus, Leptoceras menziesii, Leptomeria preissiana, Leptorhynchos scaber, Leucopogon insularis, Leucopogon parviflorus, *Lysimachia arvensis, Melaleuca cardiophylla, Melaleuca huegelii, *Melilotus indicus, *Minuartia mediterranea, Moss, Olearia axillaris, *Parentucellia latifolia, Pelargonium littorale, Phyllangium divergens, Poranthera microphylla, Rhagodia baccata* subsp. *baccata, Romulea rosea, *Senecio vulgaris, Silene gallica, Sonchus oleraceus, Spyridium globulosum, *Stellaria media, Thysanotus manglesianus, Trachymene pilosa, *Vulpia muralis, Westringia dampieri, Wurmbea monantha.*

Photo (NW Corner):

SITE: TR07

Survey Date 1:	15 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	W (steep)
	SW	50J 384247	6492059	**Altitude:**	19m
Landform:	Secondary dune			**Soil:**	White sand (unconsolidated)
Leaf Litter:	60% cover; 0 – 5 cm depth.			**Fire History:**	>10 years
Condition:	Very Good			**Details:**	Weeds 2%. Localised weedy.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	M1	Shrubs 1-2m	10-30%	*Olearia axillaris, Santalum acuminatum.*
	G1	Shrubs 0.5-1m	30-70%	*Scaevola crassifolia, Spyridium globulosum.*
	G2	Vine 0.5-1m	10-30%	*Cassytha* spp., *Hardenbergia comptoniana.*
	G3	Forbs <0.5m	5-10%	*Senecio pinnatifolius* var. *latilobus.*
	G4	Grass <0.5m	0.25-5%	*Poa porphyroclados.*

Species: *Acanthocarpus preissii, *Brassica tournefortii, *Bromus diandrus, Calandrinia brevipedata, Carpobrotus virescens, Cassytha aurea* var. *aurea, Cassytha glabella* forma. *casuarinae, Cassytha racemosa forma. racemosa, *Crassula glomerata, *Dischisma arenarium, *Ehrharta brevifolia* var. *cuspidata, *Ehrharta longiflora, Ficinia nodosa, *Galium murale, Hardenbergia comptoniana, Hemiandra glabra, *Lagurus ovatus, *Lolium perenne, Myoporum insulare, Olearia axillaris, Parietaria debilis, *Pelargonium capitatum, Pithocarpa cordata, Poa porphyroclados, Rhagodia baccata* subsp. *baccata, Santalum acuminatum, Scaevola crassifolia, Senecio pinnatifolius* var. *latilobus, *Sonchus oleraceus, Spinifex longifolius, Spyridium globulosum, *Stellaria media, Threlkeldia diffusa, *Trachyandra divaricata, *Vulpia muralis.*

Photo (NW Corner):

SITE: TR08

Survey Date 1:	15 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat Size:**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	W (steep)
	SW	50J 384247	6492059	**Altitude:**	21m
Landform:	Secondary dune			**Soil:**	White sand
Leaf Litter:	30% cover; 0-3cm depth.			**Fire History:**	>10 years
Condition:	Very Good to Excellent (patchy)			**Details:**	Weeds 2-5%, patchy. Localised G.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	M1	Shrubs 1-2m	0.25-5%	*Acacia cyclops.*
	G1	Shrubs 0.5-1m	30-70%	*Scaevola crassifolia, Spyridium globulosum, Olearia axillaris, Myoporum insulare, Santalum acuminatum.*
	G2	Shrubs <0.5m	10-30%	*Acanthocarpus preissii, Rhagodia baccata.*
	G3	Forbs <0.5m	10-30%	*Senecio pinnatifolius* var. *latilobus, *Pelargonium capitatum, Parietaria debilis, Calandrinia brevipedata.*
	G4	Grasses <0.5m	0.25-5%	*Poa porphyroclados, *Ehrharta brevifolia* var. *cuspidata.*

Species: *Acacia cyclops, Acanthocarpus preissii, *Brassica tournefortii, *Bromus diandrus, Calandrinia brevipedata, Carpobrotus virescens, Cassytha aurea* var. *aurea, *Catapodium rigidum, Crassula colorata* var. *colorata, *Crassula decumbens var. decumbens, Daucus glochidiatus, *Dischisma arenarium, *Ehrharta brevifolia* var. *cuspidata, *Ehrharta longiflora, Ficinia nodosa, Hardenbergia comptoniana, *Lagurus ovatus, Myoporum insulare, Olearia axillaris, Parietaria debilis, *Pelargonium capitatum, Pithocarpa cordata, Poa porphyroclados, Rhagodia baccata* subsp. *baccata, Santalum acuminatum, Scaevola crassifolia, Senecio pinnatifolius* var. *latilobus, Spyridium globulosum, *Stellaria media, Threlkeldia diffusa, *Trachyandra divaricata, *Vulpia muralis.*

Photo (NW Corner):

SITE: TR09

Survey Date 1:	15 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	W (moderate slope)
	SW	50J 384247	6492059	**Altitude:**	22m
Landform:	Secondary dune.			**Soil:**	White sand (consolidated).
Leaf Litter:	35% cover; 0-3cm depth.			**Fire History:**	>10 years
Condition:	Very Good to Excellent.			**Details:**	Weeds 2%. Patchy, Good in patches.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	G1	Shrub 0.5-1m	30-70%	*Scaevola crassifolia, Olearia axillaris, Acacia cyclops, Spyridium globulosum.*
	G2	Shrubs <0.5m	10-30%	*Acanthocarpus preissii, Rhagodia baccata* subsp. *baccata, Santalum acuminatum.*
	G3	Forbs <0.5m	10-30%	*Senecio pinnatifolius* var. *latilobus, Calandrinia brevipedata, Carpobrotus virescens.*
	G4	Sedge 0.5-1m	0.25-5%	*Lepidosperma gladiatum.*
	G5	Grass <0.5m	0.25-5%	*Poa porphyroclados.*
	G6	Vine <0.5m	5-10%	*Cassytha aurea* var. *aurea, Hardenbergia comptoniana.*

Species: *Acacia cyclops, Acanthocarpus preissii, *Brassica tournefortii, *Bromus diandrus, Calandrinia brevipedata, Carpobrotus virescens, Cassytha aurea* var. *aurea, Cassytha glabella* forma. *casuarinae, *Cerastium glomeratum, Conostylis candicans* subsp. *calcicola, *Crassula decumbens* var. *decumbens, *Crassula thunbergiana* subsp. *thunbergiana, *Dischisma arenarium, *Ehrharta brevifolia* var. *cuspidata, Ficinia nodosa, Hardenbergia comptoniana, *Isolepis marginata, *Lagurus ovatus, Lepidosperma gladiatum,* Moss, *Olearia axillaris, Parietaria debilis, *Pelargonium capitatum, Poa porphyroclados, Rhagodia baccata* subsp. *baccata, Santalum acuminatum, Scaevola crassifolia, Senecio pinnatifolius* var. *latilobus, Spyridium globulosum, Threlkeldia diffusa, Thysanotus manglesianus, *Trachyandra divaricata, Triglochin isingiana, *Vulpia muralis*

Photo (NW Corner):

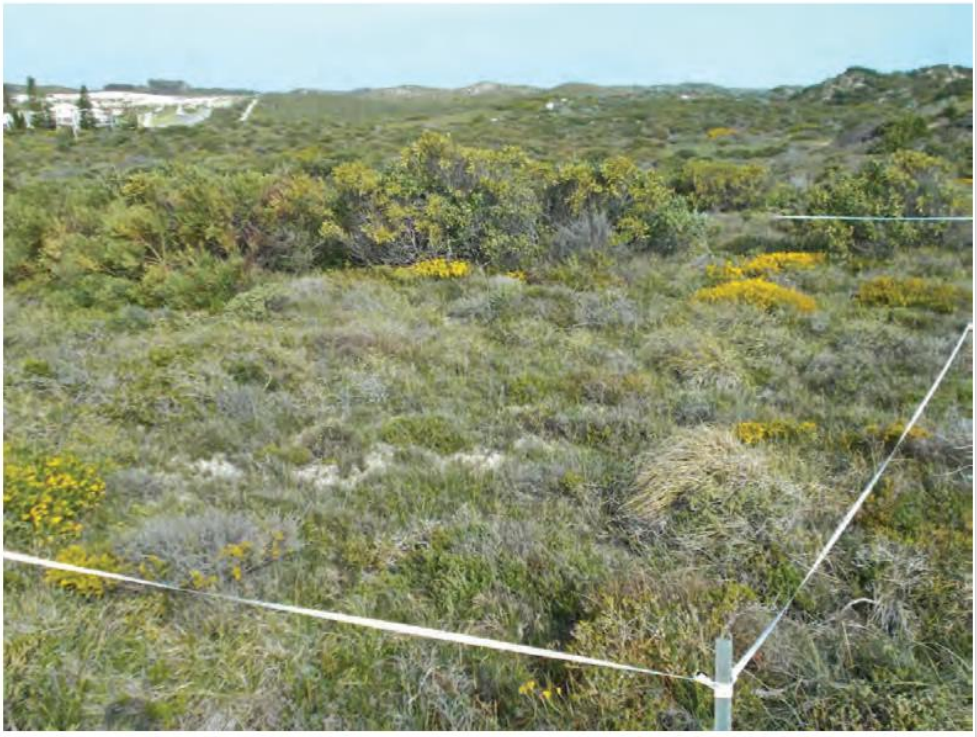
SITE: TR10

Survey Date 1:	15 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	21 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	SE
	SW	50J 384247	6492059	**Altitude:**	20m
Landform:	Low Dune.			**Soil:**	White sand (consolidated)
Leaf Litter:	10% cover; 0-3cm depth.			**Fire History:**	>10 years
Condition:	Very Good to Excellent.			**Details:**	Weeds 2%.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	M1	Shrub 1-2m	0.25-5%	*Acacia cyclops, Spyridium globulosum, Santalum acuminatum.*
	G1	Shrubs <0.5m	30-70%	*Melaleuca systena, Acacia lasiocarpa* var. *lasiocarpa, Leucopogon insularis, Beyeria cinerea* subsp. *cinerea (P3), Cryptandra mutila.*
	G2	Forbs <0.5m	30-70%	*Lomandra maritima, Conostylis candicans, Opercularia vaginata.*
	G3	Rush <0.5m	5-10%	*Desmocladus asper.*
	G4	Sedge <0.5m	5-10%	*Lepidosperma calcicola.*
	G5	Grass 0.5-1m	0.25-5%	*Austrostipa flavescens, Poa porphyroclados.*

Species: *Acacia cyclops, Acacia lasiocarpa* var. *lasiocarpa, Acanthocarpus preissii, Austrostipa flavescens, Beyeria cinerea* subsp. *cinerea* (P3), **Brassica tournefortii, Cassytha aurea* var. *aurea, *Catapodium rigidum, Comesperma confertum, Conostylis candicans* subsp. *calcicola, *Crassula glomerata, Cryptandra mutila, Cyrtostylis huegelii, Daucus glochidiatus, Desmocladus asper, Dianella revoluta* var. *divaricata, Drosera macrantha, Eriochilus dilatatus* subsp. *dilatatus, *Galium murale, Gastrolobium nervosum, Gompholobium tomentosum, *Heliophila pusilla, Hemiandra glabra, Hyalosperma cotula, Isotoma hypocrateriformis, Lepidosperma calcicola, Leptomeria preissiana, Leptorhynchos scaber, Leucopogon insularis, Leucopogon maritimus* (P1), *Leucopogon parviflorus, Lomandra maritima, *Lysimachia arvensis, Melaleuca systena, *Minuartia mediterranea, Olearia axillaris, Opercularia vaginata, Phyllanthus calycinus, Pimelea ferruginea, Poa porphyroclados, *Romulea rosea, Rytidosperma occidentale, Santalum acuminatum, Scaevola thesioides subsp. thesioides, Schoenus lanatus, *Sonchus oleraceus, Spyridium globulosum, Stylidium maritimum* (P3), *Templetonia retusa, Triglochin nana, *Vulpia muralis.*

Photo (NW Corner):



SITE: TR11

Survey Date 1:	16 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	21 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	SW
	SW	50J 384247	6492059	**Altitude:**	10m
Landform:	Low dune with limestone outcrops.			**Soil:**	Brown loamy sand (with organic matter)
Leaf Litter:	25% cover; 0-2cm depth.			**Fire History:**	>10 years
Condition:	Very Good.			**Details:**	Weeds 3-5%. Higher under thickets.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	M1	Shrub >2m	30-70%	*Melaleuca cardiophylla.*
	M2	Shrub 1-2m	0.25-5%	*Melaleuca huegelii.*
	M3	Vine 1-2m	0.25-5%	*Cassytha aurea* var. *aurea.*
	G1	Shrubs 0.5-1m	10-30%	*Dodonaea aptera, Trymalium ledifolium* var. *ledifolium, Westringia dampieri.*
	G2	Forbs <0.5m	30-70%	*Daucus glochidiatus, Hydrocotyle hispidula, *Galium murale, *Minuartia mediterranea, *Euphorbia peplus.*
	G3	Grass <0.5m	10-30%	*Austrostipa flavescens, Poa porphyroclados.*

Species: *Acacia xanthina, Austrostipa flavescens, *Avena barbata, *Bromus diandrus, Caladenia latifolia, Calandrinia brevipedata, Carex thecata, Cassytha aurea var. aurea, *Catapodium rigidum, Clematis linearifolia, Comesperma integerrimum, Crassula colorata* var. *colorata, *Crassula glomerata, Cyrtostylis huegelii, Daucus glochidiatus, Desmocladus asper, Dianella revoluta* var. *divaricata, *Dischisma arenarium, Dodonaea aptera, *Ehrharta longiflora, *Euphorbia peplus, *Euphorbia terracina, *Galium murale, Guichenotia ledifolia, Hydrocotyle hispidula, *Lagurus ovatus, Lepidosperma calcicola, Leucopogon insularis, Leucopogon parviflorus, Lomandra maritima, *Lysimachia arvensis, Melaleuca cardiophylla, Melaleuca huegelii, Melaleuca systena, Microtis media* subsp. *media, *Minuartia mediterranea,* Moss, *Parietaria debilis, Poa porphyroclados, Poranthera microphylla, Rhagodia baccata* subsp. *baccata, *Romulea rosea, Schenkia australis, *Sonchus oleraceus, Spyridium globulosum, *Stellaria media, Templetonia retusa, Trachymene pilosa, Trymalium ledifolium* var. *ledifolium, *Vulpia muralis, Westringia dampieri, Wurmbea monantha*

Photo (NW Corner):

SITE: TR12

Survey Date 1:	16 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	E
	SW	50J 384247	6492059	**Altitude:**	14m
Landform:	Low Dune.			**Soil:**	White sand (semi-consolidated)
Leaf Litter:	20% cover; 0-2cm depth.			**Fire History:**	>10 years
Condition:	Good.			**Details:**	Weeds 10%.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	G1	Shrubs 0.5-1m	0.25-5%	*Olearia axillaris, Leptomeria preissiana.*
	G2	Shrubs <0.5m	30-70%	*Melaleuca systena, Acanthocarpus preissii, Beyeria cinerea* subsp. *cinerea* (P3), *Hemiandra glabra, Rhagodia baccata* subsp. *baccata.*
	G3	Forbs <0.5m	30-70%	*Lomandra maritima, Conostylis candicans* subsp. *candicans, Opercularia vaginata.*
	G4	Rush <0.5m	0.25-5%	*Desmocladus asper.*
	G5	Sedge <0.5m	0.25-5%	*Lepidosperma calcicola.*
	G6	Grass <0.5m	5-10%	*Austrostipa flavescens, Poa porphyroclados.*

Species: *Acanthocarpus preissii, Austrostipa flavescens, *Avena barbata, Beyeria cinerea* subsp. *cinerea* (P3), **Bromus diandrus, Calandrinia brevipedata, Carpobrotus virescens, Cassytha flava, *Catapodium rigidum, Conostylis candicans* subsp. *candicans, Crassula colorata* var. *colorata, *Crassula glomerata, *Crassula thunbergiana* subsp. *thunbergiana, Desmocladus asper, Dianella revoluta* var. *divaricata, *Dischisma arenarium, *Ehrharta brevifolia* var. *cuspidata, *Ehrharta longiflora, Gompholobium tomentosum, Hardenbergia comptoniana, Hemiandra glabra, *Lagurus ovatus, Lepidosperma calcicola, Leptomeria preissiana, *Lolium perenne, Lomandra maritima, Melaleuca systena, Olearia axillaris, Opercularia vaginata, Poa porphyroclados, Rhagodia baccata* subsp. *baccata, *Romulea rosea, Senecio pinnatifolius* var. *latilobus, *Sonchus oleraceus, Spyridium globulosum, Threlkeldia diffusa, Thysanotus manglesianus, *Trachyandra divaricata.*

Photo (NW Corner):

SITE: TR13

Survey Date 1:	16 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	W
	SW	50J 384247	6492059	**Altitude:**	20m
Landform:	Low Dune.			**Soil:**	Off-white sand (consolidated)
Leaf Litter:	50% cover; 0-3cm depth.			**Fire History:**	>10 years
Condition:	Very Good to Excellent.			**Details:**	Weeds 1%.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	G1	Shrubs 0.5-1m	0.25-5%	*Spyridium globulosum, Templetonia retusa, Santalum acuminatum, Westringia dampieri.*
	G2	Shrubs <0.5m	30-70%	*Melaleuca systena, Acacia lasiocarpa, Leucopogon insularis, Gompholobium tomentosum, Beyeria cinerea* subsp. *cinerea* (P3), *Leucopogon maritimus* (P1), *Phyllanthus calycinus,*
	G3	Forbs <0.5m	30-70%	*Lomandra maritima, Stylidium maritimum* (P3), **Romulea rosea, *Galium murale,*
	G4	Rush <0.5m	5-10%	*Desmocladus asper.*
	G5	Sedge <0.5m	5-10%	*Lepidosperma calcicola.*
	G6	Grass 0.5-1m	0.25-5%	*Austrostipa flavescens, Poa porphyroclados.*

Species: *Acacia cyclops, Acacia lasiocarpa* var. *lasiocarpa, Austrostipa flavescens, *Avena barbata, *Bellardia trixago, Beyeria cinerea* subsp. *cinerea* (P3), **Brassica tournefortii, *Briza minor, *Bromus diandrus, Cassytha flava, Cassytha glabella* forma. *casuarinae, *Catapodium rigidum, Conostylis candicans* subsp. *calcicola, *Crassula glomerata, Cryptandra mutila, Cyrtostylis huegelii, Daucus glochidiatus, Desmocladus asper, Drosera ?ramellosa* (sterile), *Drosera macrantha, *Ehrharta longiflora, *Euphorbia peplus, *Galium murale, Gastrolobium nervosum, Gompholobium tomentosum, Hydrocotyle pilifera* var. *glabrata, Lepidosperma calcicola, Leucopogon insularis, Leucopogon maritimus* (P1), *Leucopogon parviflorus, *Lolium perenne, Lomandra maritima, Lysinema pentapetalum, *Lysimachia arvensis, Melaleuca systena, Minuartia mediterranea, Opercularia vaginata, Phyllanthus calycinus, Pimelea ferruginea, Poa porphyroclados, *Reichardia tingitiana, *Romulea rosea, *Rostraria cristata, Rytidosperma occidentale, Santalum acuminatum, Schenkia australis, Schoenus lanatus, *Sonchus oleraceus, Spyridium globulosum, Stylidium maritimum* (P3), *Templetonia retusa, Trachymene pilosa, Triglochin nana, *Vulpia muralis, Westringia dampieri.*

Photo (NW Corner):

SITE: TR14

Survey Date 1:	16 September 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	19 October 2019			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	SE
	SW	50J 384247	6492059	**Altitude:**	20m
Landform:	Low Dune.			**Soil:**	White sand (unconsolidated)
Leaf Litter:	50% cover; 0-3cm depth.			**Fire History:**	>10 years
Condition:	Very Good.			**Details:**	Weeds 5%.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	M1	Shrub 1-2m	10-30%	*Acacia cyclops, Myoporum insulare, Spyridium globulosum, Olearia axillaris.*
	G1	Shrubs 0.5-1m	10-30%	*Acanthocarpus preissii, Rhagodia baccata* subsp. *baccata, Scaevola crassifolia.*
	G2	Vine <0.5m	5-10%	*Cassytha aurea* var. *aurea, Cassytha racemosa* forma. *racemosa*, *Hardenbergia comptoniana*.
	G3	Forbs <0.5m	10-30%	*Conostylis candicans* subsp. *calcicola, Senecio pinnatifolius* var. *latilobus, *Crassula glomerata, *Trachyandra divaricata.*
	G4	Grass 0.5-1m	0.25-5%	*Poa porphyroclados,*Ehrharta* spp., *Bromus diandrus.*

Species: *Acacia cyclops, Acanthocarpus preissii, *Bromus diandrus, Carpobrotus virescens, Cassytha aurea var. aurea, Cassytha racemosa* forma. *racemosa, Conostylis candicans* subsp. *calcicola, Crassula colorata* var. *colorata, *Crassula glomerata, Dianella revoluta* var. *divaricata, *Dischisma arenarium, *Ehrharta brevifolia* var. *cuspidata, *Ehrharta longiflora, Hardenbergia comptoniana,* Moss, *Myoporum insulare, Olearia axillaris, Parietaria debilis, *Pelargonium capitatum, Poa porphyroclados, Rhagodia baccata* subsp. *baccata, Santalum acuminatum, Scaevola crassifolia, Senecio pinnatifolius* var. *latilobus, Spyridium globulosum, *Stellaria media, Threlkeldia diffusa, *Trachyandra divaricata.*

Photo (NW Corner):

SITE: TR15

Survey Date 1:	19 October 2019			**Surveyor:**	Kelli McCreery
Survey Date 2:	-			**Quadrat**	10m X 10m (100m^2)
Quadrat Location:	NW	50J 384244	6492066	**Datum**	WGS84
	NE	50J 384255	6492068	**Accuracy**	±3m
	SE	50J 384255	6492061	**Aspect:**	Crest.
	SW	50J 384247	6492059	**Altitude:**	9m
Landform:	Primary Dune. Very young.			**Soil:**	White sand (consolidated)
Leaf Litter:	<1% cover; 0-1cm depth.			**Fire History:**	>10 years
Condition:	Very Good.			**Details:**	Weeds 2%.

Vegetation NVIS:	**Stratum**	**Form**	**Cover**	**Dominant Species**
	G1	Grass <0.5m	30-70%	*Spinifex longifolius, Spinifex hirsutus.*
	G2	Forbs <0.5m	0.25-5%	**Cakile maritima.*

Species:	**Cakile maritima, Spinifex hirsutus, Spinifex longifolius.*
Photo (NW Corner):	

Appendix D: Flora and Vegetation Location Data

CATEGORY	FEATURE	COORDINATE (WGS84)
Quadrat Location	TR01NE	50 J 366475 6513152
Quadrat Location	TR01NW	50 J 366468 6513148
Quadrat Location	TR01SE	50 J 366480 6513145
Quadrat Location	TR01SW	50 J 366471 6513141
Quadrat Location	TR02NE	50 J 366498 6513198
Quadrat Location	TR02NW	50 J 366490 6513194
Quadrat Location	TR02SE	50 J 366503 6513190
Quadrat Location	TR02SW	50 J 366495 6513184
Quadrat Location	TR03NE	50 J 366379 6513324
Quadrat Location	TR03NW	50 J 366373 6513317
Quadrat Location	TR03SE	50 J 366388 6513318
Quadrat Location	TR03SE	50 J 366380 6513311
Quadrat Location	TR04NE	50 J 366342 6513279
Quadrat Location	TR04NW	50 J 366332 6513279
Quadrat Location	TR04SE	50 J 366342 6513270
Quadrat Location	TR04SW	50 J 366332 6513270
Quadrat Location	TR05NE	50 J 366395 6513247
Quadrat Location	TR05NW	50 J 366388 6513242
Quadrat Location	TR05SE	50 J 366401 6513237
Quadrat Location	TR05SW	50 J 366392 6513233
Quadrat Location	TR06NE	50 J 366561 6513489
Quadrat Location	TR06NW	50 J 366552 6513490
Quadrat Location	TR06SE	50 J 366564 6513480
Quadrat Location	TR06SW	50 J 366552 6513480
Quadrat Location	TR07NE	50 J 366448 6513398
Quadrat Location	TR07NW	50 J 366439 6513395
Quadrat Location	TR07SE	50 J 366452 6513387
Quadrat Location	TR07SW	50 J 366443 6513385
Quadrat Location	TR08NE	50 J 366526 6513292
Quadrat Location	TR08NW	50 J 366517 6513285
Quadrat Location	TR08SE	50 J 366532 6513283
Quadrat Location	TR08SW	50 J 366523 6513278
Quadrat Location	TR09NE	50 J 366590 6513218
Quadrat Location	TR09NW	50 J 366583 6513209
Quadrat Location	TR09SE	50 J 366595 6513212
Quadrat Location	TR09SE1	50 J 366590 6513204
Quadrat Location	TR10NE	50 J 366625 6513449
Quadrat Location	TR10NW	50 J 366616 6513444
Quadrat Location	TR10SE	50 J 366627 6513442
Quadrat Location	TR10SW	50 J 366619 6513438
Quadrat Location	TR11NE	50 J 366739 6513377
Quadrat Location	TR11NW	50 J 366730 6513376
Quadrat Location	TR11SE	50 J 366739 6513366
Quadrat Location	TR11SW	50 J 366731 6513367
Quadrat Location	TR12NE	50 J 366468 6513461
Quadrat Location	TR12NW	50 J 366463 6513453
Quadrat Location	TR12SW	50 J 366470 6513447
Quadrat Location	TR13NE	50 J 366781 6513348
Quadrat Location	TR13NW	50 J 366773 6513340
Quadrat Location	TR13SE	50 J 366784 6513338
Quadrat Location	TR13SW	50 J 366777 6513333

CATEGORY	FEATURE	COORDINATE (WGS84)
Quadrat Location	TR14NE	50 J 366596 6513328
Quadrat Location	TR14NW	50 J 366590 6513322
Quadrat Location	TR14SE	50 J 366603 6513321
Quadrat Location	TR15NE	50 J 366368 6513254
Quadrat Location	TR15NW	50 J 366360 6513248
Quadrat Location	TR15SE	50 J 366372 6513246
Quadrat Location	TR15SW	50 J 366365 6513239
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366473 6513456
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366473 6513454
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366473 6513453
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366473 6513452
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366475 6513452
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366476 6513452
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366478 6513446
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366477 6513444
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366476 6513438
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366482 6513435
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366485 6513437
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366487 6513439
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366489 6513438
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366483 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366483 6513432
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366482 6513430
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366480 6513429
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366482 6513428
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366502 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366515 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366474 6513473
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366472 6513471
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366532 6513419
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366534 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366561 6513409
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366562 6513407
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366574 6513404
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366575 6513403
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366578 6513403
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366582 6513400
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366582 6513398
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366582 6513398
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366582 6513412
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366581 6513416
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366567 6513421
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366556 6513424
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366581 6513442
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366580 6513439
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366589 6513437
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366589 6513440
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366606 6513475
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366605 6513475
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366610 6513479
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366610 6513480
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366618 6513485
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513454
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513451

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366636 6513451
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366639 6513452
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366640 6513451
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366641 6513450
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366642 6513450
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366642 6513450
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366644 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366667 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366665 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366663 6513432
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366664 6513430
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366664 6513428
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366668 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366672 6513424
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366678 6513424
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366691 6513431
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366688 6513426
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366686 6513426
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366682 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366682 6513419
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366683 6513418
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366685 6513417
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366686 6513416
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366686 6513415
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366685 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366684 6513413
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366684 6513412
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366681 6513413
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366680 6513410
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366696 6513368
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366646 6513386
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513392
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513392
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513394
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513395
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513394
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513394
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513394
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513395
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513396
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366623 6513398
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513400
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513401
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513401
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366617 6513401
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366616 6513399
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366614 6513397
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366611 6513402
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366611 6513409
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513409
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366610 6513410
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366609 6513411
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366610 6513412
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366604 6513411

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366602 6513411
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366600 6513413
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366600 6513416
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366601 6513418
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366598 6513424
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366596 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366594 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366592 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366597 6513430
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366607 6513431
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366608 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366609 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366608 6513453
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366607 6513455
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366606 6513457
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366609 6513464
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366608 6513464
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366607 6513468
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366605 6513469
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366605 6513469
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366607 6513461
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366613 6513450
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366613 6513453
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513456
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366611 6513460
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513464
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513467
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366627 6513454
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513451
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366629 6513451
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513447
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513445
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366626 6513444
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366624 6513446
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366622 6513446
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366620 6513447
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366619 6513444
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366615 6513442
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366617 6513441
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513440
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366623 6513442
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513441
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513442
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366624 6513443
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366616 6513453
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366611 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513444
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366615 6513439
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366616 6513436
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366614 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366616 6513432
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366617 6513430

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366617 6513426
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366618 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366615 6513421
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366614 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366609 6513423
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366608 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366619 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366620 6513412
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513410
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513410
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513407
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513406
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513405
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513403
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366639 6513403
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366640 6513402
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366641 6513404
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366642 6513405
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366644 6513400
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366652 6513407
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366652 6513408
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366654 6513409
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366651 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366652 6513415
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366653 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366655 6513415
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366654 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366659 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366657 6513431
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366654 6513430
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366647 6513429
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366646 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366644 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366643 6513435
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366639 6513439
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366638 6513440
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513437
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513435
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366632 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366629 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366629 6513435
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513437
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366627 6513438
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513436
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366622 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366622 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366620 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513428
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366627 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366629 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513427

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513429
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366636 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513423
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513420
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513418
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513417
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513421
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366626 6513421
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513415
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513413
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366645 6513415
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366646 6513417
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366647 6513419
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366647 6513423
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366644 6513426
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366781 6513325
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366789 6513339
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366785 6513341
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366782 6513339
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366778 6513332
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366777 6513336
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366772 6513344
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366779 6513351
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366772 6513340
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366751 6513368
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366762 6513366
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366764 6513364
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366764 6513364
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366764 6513371
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366756 6513368
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366757 6513367
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366758 6513366
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366757 6513365
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366473 6513456
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366473 6513454
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366473 6513453
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366473 6513452
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366475 6513452
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366476 6513452
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366478 6513446
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366477 6513444
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366476 6513438
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366482 6513435
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366485 6513437
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366487 6513439
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366489 6513438
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366483 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366483 6513432
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366482 6513430
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366480 6513429
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366482 6513428

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366502 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366515 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366474 6513473
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366472 6513471
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366532 6513419
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366534 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366561 6513409
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366562 6513407
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366574 6513404
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366575 6513403
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366578 6513403
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366582 6513400
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366582 6513398
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366582 6513398
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366582 6513412
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366581 6513416
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366567 6513421
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366556 6513424
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366581 6513442
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366580 6513439
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366589 6513437
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366589 6513440
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366606 6513475
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366605 6513475
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366610 6513479
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366610 6513480
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366618 6513485
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513454
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513451
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366636 6513451
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366639 6513452
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366640 6513451
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366641 6513450
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366642 6513450
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366642 6513450
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366644 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366667 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366665 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366663 6513432
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366664 6513430
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366664 6513428
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366668 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366672 6513424
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366678 6513424
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366691 6513431
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366688 6513426
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366686 6513426
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366682 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366682 6513419
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366683 6513418
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366685 6513417
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366686 6513416
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366686 6513415
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366685 6513414

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366684 6513413
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366684 6513412
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366681 6513413
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366680 6513410
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366696 6513368
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366646 6513386
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513392
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513392
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513394
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513395
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513394
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513394
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513394
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513395
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513396
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366623 6513398
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513400
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513401
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513401
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366617 6513401
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366616 6513399
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366614 6513397
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366611 6513402
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366611 6513409
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513409
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366610 6513410
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366609 6513411
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366610 6513412
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366604 6513411
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366602 6513411
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366600 6513413
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366600 6513416
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366601 6513418
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366598 6513424
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366596 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366594 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366592 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366597 6513430
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366607 6513431
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366608 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366609 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366608 6513453
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366607 6513455
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366606 6513457
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366609 6513464
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366608 6513464
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366607 6513468
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366605 6513469
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366605 6513469
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366607 6513461
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366613 6513450
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366613 6513453
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513456
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366611 6513460

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513464
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513467
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366627 6513454
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513451
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366629 6513451
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513447
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513445
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366626 6513444
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366624 6513446
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366622 6513446
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366620 6513447
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366619 6513444
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366615 6513442
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366617 6513441
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513440
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366623 6513442
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513441
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513442
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366624 6513443
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366616 6513453
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366611 6513449
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366612 6513444
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366615 6513439
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366616 6513436
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366614 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366616 6513432
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366617 6513430
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366617 6513426
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366618 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366615 6513421
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366614 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366609 6513423
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366608 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366619 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366620 6513412
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366621 6513410
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513410
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513407
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513406
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513405
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513403
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366639 6513403
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366640 6513402
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366641 6513404
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366642 6513405
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366644 6513400
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366652 6513407
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366652 6513408
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366654 6513409
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366651 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366652 6513415

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366653 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366655 6513415
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366654 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366659 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366657 6513431
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366654 6513430
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366647 6513429
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366646 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366644 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366643 6513435
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366639 6513439
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366638 6513440
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513437
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513435
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366632 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366629 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366629 6513435
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513437
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366627 6513438
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513436
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366622 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366622 6513434
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366620 6513433
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366625 6513428
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366627 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366629 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513429
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513427
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366636 6513425
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366634 6513423
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513422
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513420
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513418
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366635 6513417
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366628 6513421
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366626 6513421
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366630 6513415
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366631 6513414
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366633 6513413
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366645 6513415
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366646 6513417
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366647 6513419
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366647 6513423
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366644 6513426
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366781 6513325
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366789 6513339
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366785 6513341
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366782 6513339
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366778 6513332
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366777 6513336
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366772 6513344

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366779 6513351
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366772 6513340
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366751 6513368
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366762 6513366
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366764 6513364
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366764 6513364
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366764 6513371
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366756 6513368
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366757 6513367
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366758 6513366
Priority Flora	Beyeria cinerea subsp. cinerea (P3)	50 J 366757 6513365
Priority Flora	Leucopogon maritimus (P1)	50 J 366621 6513445
Priority Flora	Leucopogon maritimus (P1)	50 J 366603 6513478
Priority Flora	Leucopogon maritimus (P1)	50 J 366631 6513443
Priority Flora	Leucopogon maritimus (P1)	50 J 366605 6513475
Priority Flora	Leucopogon maritimus (P1)	50 J 366667 6513433
Priority Flora	Leucopogon maritimus (P1)	50 J 366665 6513433
Priority Flora	Leucopogon maritimus (P1)	50 J 366668 6513425
Priority Flora	Leucopogon maritimus (P1)	50 J 366607 6513468
Priority Flora	Leucopogon maritimus (P1)	50 J 366623 6513442
Priority Flora	Leucopogon maritimus (P1)	50 J 366616 6513453
Priority Flora	Leucopogon maritimus (P1)	50 J 366775 6513344
Priority Flora	Leucopogon maritimus (P1)	50 J 366777 6513344
Priority Flora	Leucopogon maritimus (P1)	50 J 366775 6513344
Priority Flora	Stylidium maritimum (P3)	50 J 366629 6513437
Priority Flora	Stylidium maritimum (P3)	50 J 366631 6513438
Priority Flora	Stylidium maritimum (P3)	50 J 366626 6513440
Priority Flora	Stylidium maritimum (P3)	50 J 366626 6513438
Priority Flora	Stylidium maritimum (P3)	50 J 366625 6513437
Priority Flora	Stylidium maritimum (P3)	50 J 366615 6513436
Priority Flora	Stylidium maritimum (P3)	50 J 366617 6513427
Priority Flora	Stylidium maritimum (P3)	50 J 366625 6513442
Priority Flora	Stylidium maritimum (P3)	50 J 366612 6513452
Priority Flora	Stylidium maritimum (P3)	50 J 366606 6513467
Priority Flora	Stylidium maritimum (P3)	50 J 366781 6513345
Priority Flora	Stylidium maritimum (P3)	50 J 366780 6513346
Priority Flora	Stylidium maritimum (P3)	50 J 366782 6513346
Priority Flora	Stylidium maritimum (P3)	50 J 366782 6513347
Priority Flora	Stylidium maritimum (P3)	50 J 366780 6513350
Priority Flora	Stylidium maritimum (P3)	50 J 366776 6513347
Priority Flora	Stylidium maritimum (P3)	50 J 366604 6513472
Priority Flora	Stylidium maritimum (P3)	50 J 366605 6513475
Priority Flora	Stylidium maritimum (P3)	50 J 366634 6513451
Priority Flora	Stylidium maritimum (P3)	50 J 366644 6513449
Priority Flora	Stylidium maritimum (P3)	50 J 366671 6513424
Priority Flora	Stylidium maritimum (P3)	50 J 366673 6513422
Priority Flora	Stylidium maritimum (P3)	50 J 366674 6513425
Priority Flora	Stylidium maritimum (P3)	50 J 366606 6513457
Priority Flora	Stylidium maritimum (P3)	50 J 366612 6513456
Priority Flora	Stylidium maritimum (P3)	50 J 366611 6513460
Priority Flora	Stylidium maritimum (P3)	50 J 366619 6513444
Priority Flora	Stylidium maritimum (P3)	50 J 366615 6513442
Priority Flora	Stylidium maritimum (P3)	50 J 366617 6513441
Priority Flora	Stylidium maritimum (P3)	50 J 366621 6513440

CATEGORY	FEATURE	COORDINATE (WGS84)
Priority Flora	Stylidium maritimum (P3)	50 J 366627 6513438
Priority Flora	Stylidium maritimum (P3)	50 J 366773 6513321
Priority Flora	Stylidium maritimum (P3)	50 J 366786 6513334
Priority Flora	Stylidium maritimum (P3)	50 J 366777 6513335
Priority Flora	Stylidium maritimum (P3)	50 J 366762 6513369
Sleeper Weeds	*Eragrostis curvula	50 J 366716 6513327
Sleeper Weeds	*Eragrostis curvula	50 J 366697 6513455
Sleeper Weeds	*Hyparrhenia hirta	50 J 366716 6513327
Sleeper Weeds	*Schinus terebinthifolia	50 J 366656 6513491

Appendix E

Vertebrate Fauna Survey (Terrestrial Ecosystems 2020)

Vertebrate Fauna Survey – Two Rocks Beach Access, Two Rocks

Version 3. January 2020

Prepared for:
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By:
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DISCLAIMER

Front Cover: Fauna habitat in the project area

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EXECUTIVE SUMMARY

The City of Wanneroo requested a Level 1 vertebrate fauna survey for a portion of the foreshore reserve in Two Rocks. This area is bound by the Indian Ocean to its west and Two Rocks Road to its east. The area lies within Bush Forever Site 397 and consists of approximately 10.4ha of land owned by the Western Australian Planning Commission (WAPC) and the Crown.

There are three broad fauna habitats in the project area:

- coastal low heath on sand;
- mixed open shrubland and heath on sand; and
- mixed closed shrubland over sand and limestone.

Some of the site is highly disturbed or cleared and provides no habitat value.

The coastal dunes will have a few amphibian species, 8-15 reptile species, few bird species and a couple of mammal species. Conservation significant species potentially utilising the project area are Quenda (Priority 4) and Black-striped Snake (Priority 3). Carnaby's and Forest Red-tail Black-Cockatoos fly over the project area but would only very infrequently utilise the project area as it isn't their preferred foraging habitat, and they would not roost or nest in the area. There is a very low probability that the Peregrine Falcon, Osprey and Fork-tailed Swift would be seen flying over the project area.

1 INTRODUCTION

1.1 Background

The City of Wanneroo requested a Level 1 vertebrate fauna survey for a portion of the foreshore reserve in Two Rocks. This area is bound by the Indian Ocean to its west and Two Rocks Road to its east (Figure 1). The area lies within Bush Forever Site 397 and consists of approximately 10.4ha of land owned by the Western Australian Planning Commission (WAPC) and the Crown.

The specific area (i.e. project area) assessed includes:

- the entire Lot 8613 of Deposited Plan 213232 (94 Two Rocks Road, Two Rocks);
- part Lot 8989 of Deposited Plan 213232 owned by the WAPC, located adjacent to Lot 8613; and
- part Lot 15452 of Deposited Plan 40341 of Foreshore Reserve managed by the City, located adjacent to Lot 8613.

The City is proposing to construct a car park, access road and beach access within the defined area.

1.2 Project objectives and scope of works

Terrestrial Ecosystems was commissioned by the City of Wanneroo to undertake a Level 1 vertebrate fauna survey of the project area to support an environmental impact assessment which has been be written up as a separate report (Terrestrial Ecosystems and One Tree Botanical 2020). The methodology broadly follows that described in the Environmental Protection Authority (EPA) *Technical Guidance Terrestrial Fauna Surveys* (EPA 2016b) and the *Technical Guidance - Sampling methods for terrestrial vertebrate fauna* (EPA 2016a).

A Level 1 fauna survey involves undertaking a desktop review and reconnaissance site visit. The objectives of this fauna survey were to:

- provide an indication of the vertebrate fauna assemblage (reptiles, amphibians, mammals and birds) in and near the project area, so that potential impacts on the fauna and fauna assemblage might be adequately assessed; and
- describe the major vertebrate fauna habitats present.

To achieve these objectives, Terrestrial Ecosystems:

- reviewed Terrestrial Ecosystems' database [includes Atlas of Living Australia and Department of Biodiversity, Conservation and Attractions (DBCA) records in NatureMap] to identify potential vertebrate fauna within the area;
- searched the DBCA's NatureMap for Threatened and Priority Species;
- searched the Commonwealth Governments database of fauna of national environmental significance to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* or international migratory bird agreements (JAMBA/CAMBA);
- undertook a site reconnaissance survey;
- reviewed previous fauna surveys conducted near the project area in similar habitat types; and
- discussed the likelihood of *EPBC Act 1999* and *Biodiversity Conservation* (*BC*) *Act 2016* listed species being present in the project area.

2 EXISTING ENVIRONMENT

2.1 Location of project area

The project area is within the Swan Coastal Plain 2 (SWA2) Interim Biogeographic Regionalisation of Australia (IBRA) subregion. This subregion is a low lying coastal plain, once vegetated by Banksia and Tuart on sandy soils, with *Casuarina obesa* on outwash plains and paperbark in swampy areas (Mitchell *et al*. 2002). The subregion is part of the West Botanical Province which has high species richness and diversity in flora and vegetation. The area was considered in the Bush Forever project that identified regionally significant bushland for protection by reservation or within a statutory planning framework (Department of Planning 2000).

2.2 Landforms and soils

The project area is in the Quindalup Dunes, which includes calcareous sands formed into parabolic dunes and beach ridge plains (Churchward and McArthur 1980, Gozzard 2007). These dunes are Holocene in age (McArthur and Bettenay 1974).

2.3 Land use history

The dominant land uses in the IBRA subregion are urban, rural residential, industrial, cultivation, forestry plantations, grazing and conservation areas. The greater Perth metropolitan area now extends almost from Mandurah to Alkimos, with towns further north at Yanchep and Two Rocks and east over the Darling Scarp. Much of the area is highly fragmented and disturbed as it was the site of early settlement in Western Australia. The subregion includes multiple conservation areas and nature reserves.

2.4 Climate

The project area is characterised as warm Mediterranean (Mitchell *et al*. 2002). Lancelin, which is approximately 70km to the north, and similarly situated on the coast, has an annual rainfall of approximately 853mm, although this varies considerably from year-to-year. The highest mean maximum and minimum temperatures in Lancelin are in January to March (Bureau of Meteorology 2019). The lowest mean daily maximum and minimum temperatures occur in July (Chart 1). Rainfall predominantly occurs between May and August and winter rains result from low pressure cells moving in an easterly direction.

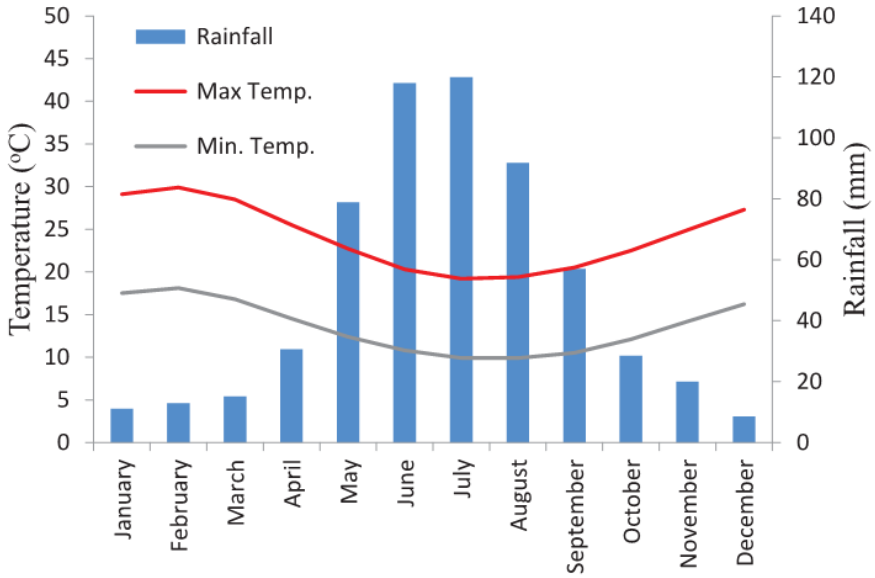

Chart 1. Climatic averages for Lancelin

2.5 Regional biological fauna context of project area

The frogs, reptiles, mammals and birds in the vicinity of the project area have been surveyed for other environmental assessments and research purposes and are therefore known. Fauna surveys and assessments undertaken in the vicinity of the project area that have been reviewed for this assessment include:

- Alan Tingay & Associates (1991) *Response to Draft north-west corridor structure plan, Department of Planning & Urban Development (February 1991), Yanchep Structure Plan, Vertebrate Fauna Survey*. Perth.
- Alan Tingay & Associates (1996) *Alkimos - Eglington Vertebrate Fauna Survey, October 1996*. Perth.
- Alan Tingay & Associates (1998) *Yanchep Sun City, Environmental Assessment for the Rezoning of lots 201 and 202 Breakwater Drive, Two Rocks to Rural Community*. Perth.
- Alan Tingay & Associates (1999a) *Pt Lot 2 Burns Beach, Vertebrate Fauna*. Perth.
- Alan Tingay & Associates (1999b) *Shire of Wanneroo, Town Planning Scheme No. 1, Amendment 787, Yanchep - Two Rocks, Environmental Review*. Perth.
- Alan Tingay & Associates (1999c) *Shire of Wanneroo, Town Planning Scheme No. 1, Amendment 837 - Yanchep / Two Rocks, Environmental Review*. Perth.
- Alan Tingay & Associates (2002) *Review of Two Rocks - Yanchep Foreshore Management Plan. Perth.*
- ATA Environmental (1991) *Yanchep Structure Plan Vertebrate Fauna Survey*, Unpublished report for Tokyu Corporation, Perth.
- ATA Environmental (2005). *Metropolitan Region Scheme Amendment 1029/33. Alkimos-Eglinton Flora, Vegetation and Fauna Baseline Information. Interpretation Report*. Perth.
- ATA Environmental (2007) *Vertebrate Fauna Assessment St Andrews Estate (Southern Precinct), Yanchep*, Unpublished report for Yanchep Sun City Pty Ltd, Perth.
- ATA Environmental (2008) *Vertebrate Fauna Assessment Lot 3 Romeo Road, Alkimos, Unpublished report for Northern Corridor Developments Limited*. Perth.
- ATA Environmental (2008) *Vertebrate Fauna Assessment Lot 3 Romeo Road, Alkimos*. Perth.
- Bamford Consulting Ecologists (1998) *Report on a Vertebrate Survey at Burns Beach*. Perth.
- Bamford Consulting Ecologists (2005) *Alkimos Proposed Wastewater Treatment Plant: Fauna Assessment*, Unpublished report for Water Corporation, Perth.
- Bamford Consulting Ecologists (2005) *Alkimos Proposed Wastewater Treatment Plant: Fauna Assessment*. Perth.
- Biota Environmental Sciences (2000) *Lot 52 Burns Beach Road Fauna Survey*. Perth.
- Department of Conservation and Land Management. (1993) *Fauna studies in water supply Reserve 34537, adjacent to Neerabup National Park*. Perth.
- ENV Australia (2006) *Lots 1005 and 1006 Alkimos Fauna Habitat Assessment.* Perth.
- GHD (2014a) *Mitchell Freeway extension: Burns Beach Rd to Romeo Rd Level 2 Flora & Level 1 Fauna Assessment*. Unpublished report for Main Roads Western Australia, Perth.
- GHD (2014b) *Neerabup Road Extension Level 2 Fauna Survey*, Unpublished report for Main Roads Western Australia. Perth.
- Gole, C.A. (2003) *Bird Survey in selected Perth Metropolitan Reserves. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project*, Unpublished report Birds Australia and Perth Biodiversity Project, Perth.
- Harvey, M. S., Dell, J., How, R. A. and Waldock, J. M. (1997) *Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms, Perth*, Report to the Australian Heritage commission NEP Grant N95/49.
- Kitchener, D.J., Chapman, A. and Barron, G. (1978). Mammals of the Northern Swan Coastal Plain. *Faunal Studies of the Northern Swan Coastal Plain*. Unpublished report for the Western Australian Museum and Department of Conservation and Environment. Perth.
- Ninox Wildlife Consulting (1990) *Eglinton Beach Resort an appraisal of the vertebrate fauna*. Perth.
- Storr, G.M., Harold G. and Barron, G. (1978a) The amphibians and reptiles of the northern Swan Coastal Plain. *Faunal Studies of the Northern Swan Coastal Plain*. Western Australian Museum, unpublished report, Perth.
- Storr, G.M., Johnstone, R.E. and Harold, G. (1978b) Birds of the northern Swan Coastal Plain, Western Australia. *Faunal Studies of the Northern Swan Coastal Plain*. Western Australian Museum, Unpublished report. Perth.
- Terrestrial Ecosystems (2005) *Terrestrial Vertebrate Fauna Species Likely to be found in the Alkimos-Eglinton Area, with a comment on Significant Fauna Species and the Impacts of the Proposed Disturbance*. Unpublished report for ATA Environmental, Dilhorn House, 2 Bulwer St, Perth, WA, 6000. Perth.
- Terrestrial Ecosystems (2018) *City of Wanneroo Black-Cockatoo Habitat Survey*. Perth.

- Terrestrial Ecosystems (2020b) Vertebrate fauna survey – Lot 211 Quinns Rocks. Unpublished report for the City of Wanneroo.
- Terrestrial Ecosystems (2020a) Vertebrate fauna survey – Yanchep Lagoon, Yanchep. Unpublished report for the City of Wanneroo.
- Valentine, I.E., Wilson, B.A., Reaveley, A., Huang, N., Johnson, B. and Brown, P.R. (2009) *Patterns of Ground-dwelling Vertebrate Biodiversity in the Gnangara Sustainability Strategy Study Area*, Unpublished report for the Department of Environment and Conservation. Perth.
- Western Australian Museum (1978). *Faunal Studies of the Northern Swan Coastal Plain*. Western Australian Museum. Perth.

Data in the Atlas of Living Australia and Western Australian Museum has also been added to the information contained in Appendix B, and the compilation of the species lists for the project area.

Few of these reports contain survey data for vertebrate fauna on the dune system close to the coast where there are few trees. Reports providing useful data included ATA Environmental (1991, 2007, 2008), Biota Environmental Sciences (2000), Valentine *et al*. (2009), GHD (2014b), Gole (2003) and Bamford Consulting Ecologists (2005). Data from these reports are provided in Appendix B along with data from the Western Australian Museum, NatureMap and Atlas of Living Australia. Some of the data from consultants' fauna surveys are deposited in government databases, so it is possible there is some duplication of data in Appendix B.

2.5.1 Fauna species at risk

Mitchell *et al.* (2002) reported multiple vertebrate fauna species at risk in the subregion. However, some of these species have not been recorded near the project area for many years (e.g. *Myrmecobius fasciatus, Pseudocheirus occidentalis, Setonix brachyurus*), although, species such as *Calyptorhynchus latirostris, Calyptorhynchus banksii naso, Isoodon fusciventer* and *Neelaps calonotos* are still present, and regularly encountered. There is a very low probability that the Peregrine Falcon would be seen in the project area.

3 METHODOLOGY

3.1 Database searches

A review of the *EPBC* list of protected species was undertaken to identify species of conservation interest to the Commonwealth Government. The search area was a linear shaped polygon along the coastal strip using the following coordinates 31.8775ºS 115.775ºE, 31.8775ºS 115.8ºE, 30.9ºS 115.34ºE, 30.9ºS 115.269ºE (Appendix A). In addition, a desktop search of the Terrestrial Ecosystems' fauna survey database was used to develop an appreciation of the vertebrate fauna assemblages in relevant sections of the bioregion near the project area. The DBCA threatened and priority species database was searched via the records in NatureMap.

Other more general texts were also used to provide supplementary information on vertebrate fauna in the bioregion, including Tyler *et al.* (2000) for frogs; Storr *et al.* (1983, 1990, 1999, 2002) for reptiles; Johnstone and Storr (1998, 2004) for birds; and Van Dyck and Strahan (2008) for mammals.

Collectively these sources of information were used to create lists of species expected to utilise the project area and broader subregion. It should be noted that these lists will include species that have been recorded in the general region but are possibly vagrants and they will not generally be found in the project area due to a lack of suitable habitat (e.g. water and shore birds). Vagrants can be recorded almost anywhere. Many of the records are historical and the species is no longer present in the area (e.g. Malleefowl). Many of the bird, mammal, reptile and amphibian species have specific habitat requirements that may be present in the general area but not in the project area. Also, the ecology of many of these species is often not well understood and it can sometimes be difficult to indicate those species whose specific habitat requirements are not present in the project area. Therefore, many species will be included in the lists produced from database searches but will not be present in the actual project area.

There are errors in most databases, including NatureMap, Atlas of Living Australia and the WAM collection. These errors occur because of a misidentification of individuals, taxonomic name changes and incorrect coordinates being entered into the database. Terrestrial Ecosystems was unable to verify the primary records, so it has used the information provided. Obvious errors have been removed but readers should appreciate that species lists and fauna surveys reported in the appendices may include these errors.

3.2 Site inspection and fauna habitat assessment

A site visit was undertaken on 29 August 2019 to assess fauna habitat types and condition in the project area. This information included a description of the habitat structure, habitat condition, landform, soils and vegetation and time since last fire.

The fauna habitat assessment had two foci:

- assessing fauna habitat types and their condition; and
- assessing the possible presence of and recording evidence of conservation significant fauna.

Dr Scott Thompson, who undertook the site assessment stopped at multiple locations within the project area and recorded a suite of data about the fauna habitat and its condition. This information included a description of the habitat structure, habitat condition, landform, soils and vegetation and time since last fire. Table 1 details the data assessed at each location as part of the habitat assessment.

Table 1. Habitat assessment factors

Observer's name	
Coordinates of the location as UTM (GDA94)	
Fire history – options	
○ > 5 years	
○ 1-5 years	
○ < 1 year	
Landform – options	
○ Beach	○ Lower slope
○ Clay plain	○ Mid slope
○ Cliff	○ Ridge
○ Creek line	○ River

○ Dam	○ Rocky outcrop / breakaway
○ Drainage line	○ Salt lake
○ Dune crest	○ Sand dune
○ Dune slope	○ Sand plain
○ Dune swale	○ Stony plain
○ Escarpment	○ Swamp
○ Flat	○ Undulating
○ Gorge	○ Upper slope
○ Gully	○ Wetland
○ Intertidal / mangrove	○ Water hole
○ Lake / lake edge	
Habitat quality – options	
○ *High quality fauna habitat* – These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.	
○ *Very good fauna habitat* - These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) and generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally effected by disturbance.	
○ *Good fauna habitat* – These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.	
○ *Disturbed fauna habitat*– These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, containing weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.	
○ *Highly degraded fauna habitat* – These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Fauna assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.	
*Habitat structur*e – combined into habitat description	
Upper stratum	
○ Tall open woodland	○ Scattered tall trees
○ Tall woodland	○ Scattered trees
○ Open woodland	○ Scattered low trees
○ Woodland	○ Low closed forest
○ Open forest	○ Low open forest
○ Closed forest	○ Low woodland
○ Tall closed forest	○ Low open woodland
○ Tall open forest	
Middle stratum	
○ Shrubland	○ Open heath
○ Tall shrubland	○ Low closed heath
○ Tall open shrubland	○ Low open heath
○ Low shrubland	○ Tall closed scrub
○ Scattered low shrubs	○ Tall open scrub
○ Low open shrubland	○ Scattered tall shrubs
○ Scattered tall shrubs	○ Open shrubland
○ Closed heath	○ Scattered shrubs
Lower stratum	
○ Closed hummock grassland	○ Closed tussock grassland / sedgeland / herbland
○ Mid-dense hummock grassland	○ Tussock grass land / sedgeland / herbland
○ Hummock grassland	○ Open tussock grassland / sedgeland / herbland
○ Open hummock grassland	○ Scattered tussock / grasses / sedges / herbs
○ Scattered hummock grassland	○ Very open tussock grassland / herbland

Soil Type – options	
○ Sand	○ Silty loam
○ Loamy sand	○ Sand clay loam
○ Clayey sand	○ Clay
○ Clay loam	○ Peat / organic
○ Silty clay loam	○ Stony
○ Sandy loam	
Soil colour - options	
○ Black	○ Red
○ Brown	○ White
○ Grey	○ Yellow
○ Orange	
Surface stones – options	
○ None	○ Boulders (>250mm)
○ Pebbles (0-50mm)	○ Rocks
○ Cobbles (51-250)	

3.3 Survey and reporting staff

Dr Scott Thompson undertook the site investigation and fauna habitat assessment. Drs Graham and Scott Thompson prepared the report and Dr Scott Thompson reviewed the report before it was sent to the client. Both senior scientists have appropriate relevant post-graduate qualifications, extensive experience in conducting fauna assessments on the Swan Coastal Plain, have published research articles on biodiversity, fauna assemblages, conservation significant species, trapping techniques and temporal variations in trapped fauna assemblages and are therefore appropriately trained and experienced for the task of preparing this assessment.

3.4 Taxonomy and nomenclature

Taxonomy and nomenclature for fauna species used in this report are generally based on the WA Museum species list except for bats, which follow Churchill (2008) and birds which follow Christidis and Boles (2008). Terrestrial Ecosystems' has presumed that the identifications referred to in the appendices or in reports used to provide local and regional comparative data are correct and we have only corrected obvious records where the nomenclature was known to be incorrect.

3.5 Limitations

This Level 1 fauna risk assessment is based on information contained in the Commonwealth Government database and other published and unpublished fauna survey data for the bioregion and a site visit. It is acknowledged that multiple surveys conducted in different seasons, repeated over several years are necessary to fully appreciate the fauna assemblage in the project area.

The EPA's (2016a) *Technical Guidance Terrestrial Fauna Surveys* suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 2.

Table 2. Fauna survey limitations and constraints

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultant carrying out this assessment	No	The environmental scientists that undertook the site assessment, drafted and reviewed this report are familiar with the vertebrate fauna of this bioregion.
Scope	No	All aspects of the scope of works have been addressed.
Proportion of fauna identified, recorded and/or collected	No	Not applicable.
Accuracy of previous survey work	Yes, negligible	Terrestrial Ecosystems has reported fauna survey data recorded by various authors but is not able to vouch for the accuracy of much of this information. It is acknowledged that the taxonomy of Western Australian vertebrates is continually being revised and the nomenclature of some of the species listed in the appendices may have changed since publication by the authors.
Sources of information	Yes, negligible	Vertebrate fauna information was available from on-line databases and unpublished and published reports of surveys conducted in the bioregion in a variety of habitat types. Many of these surveys employed a low level of trapping effort which significantly impacts on the capacity of these data to represent the fauna assemblages in the areas surveyed.
Proportion of the task achieved	No	All tasks completed.
Timing/weather/ season/ cycle	N/A	Weather was fine during the site visit.
Disturbances which affected results of the survey	No	Disturbance areas throughout the project area have been factored into this assessment.
Intensity of survey effort	N/A	
Completeness	No	All aspects of this assessment have been completed.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	No	All areas could be accessed.
Availability of contextual information on the region	No	Fauna survey data are scant for the coastal dune habitats, and specifically fauna habitats accessed in the project area.

4 RESULTS

4.1 Fauna habitat

Fifty-five habitat assessments were completed in the project area (Figure 2). There are three broad fauna habitats in the project area (Table 3). Some of the site is highly disturbed or cleared and provides no habitat value.

Table 3. Habitat types

Habitat category	Description	Area (ha)
Coastal low heath on sand	Low coastal heath on unconsolidated sandy low primary dunes. The quality of fauna habitat was variable.	1.915
Mixed open shrubland and heath on sand	Mixed open shrubs on taller unconsolidated sandy dunes. The quality of fauna habitat was variable.	6.22
Mixed closed shrubland over sand and limestone	Mixed closed shrubs on sand with limestone outcropping. The quality of fauna habitat was variable.	1.973
Highly disturbed		0.302

Plates 1-8 provide representative images of the fauna habitat types.

Plate 1. Coastal low heath on sand

Plate 2. Coastal low heath on sand

Plate 3. Mixed open shrubland and heath on sand

Plate 4. Mixed open shrubland and heath on sand

Plate 5. Mixed closed shrubland over sand and limestone

Plate 6. Mixed closed shrubland over sand and limestone

Plate 7. Highly disturbed or cleared

Plate 8. Highly disturbed or cleared

The condition of the fauna habitat varied from high quality, particularly in areas where the dense vegetation inhibits human access, to areas that are highly degraded, mostly by people accessing the beach. Appendix D provides a visual overview to the range of fauna habitats in the project area. The location for each of these photographs is shown in Figure 2.

4.2 Bioregional vertebrate fauna assemblage

Appendix B provides a summary of the fauna survey data that are available near the project area. There are appreciable differences in the recorded fauna assemblages within and among fauna surveys shown in Appendix B. These differences are partially due to the low survey effort deployed by some of the surveys and they also reflect variations in soils and vegetation as well as temporal variations in the fauna assemblages.

Tables 4-7 provide a list of vertebrate species potentially found near the project area that have been compiled based on the fauna survey report results shown in Appendix B.

Table 4. Birds potentially found near the project area

Family	Species	Common Name
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk
	Accipiter fasciatus	Brown Goshawk
	Aquila audax	Wedge-tailed Eagle
	Circus approximans	Swamp Harrier
	Elanus axillaris	Black-shouldered Kite
	Haliastur sphenurus	Whistling Kite
	Hieraaetus morphnoides	Little Eagle
	Lophoictinia isura	Square-tailed Kite
Anatidae	*Tadorna tadornoides*	Australian Shelduck
Podargidae	*Podargus strigoides*	Tawny Frogmouth
Casuariidae	*Dromaius novaehollandiae*	Emu
Laridae	*Chroicocephalus novaehollandiae*	Silver Gull
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis
Columbidae	*Columba livia*	Domestic Pigeon
	Ocyphaps lophotes	Crested Pigeon
	Phaps chalcoptera	Common Bronzewing
	Phaps elegans	Brush Bronzewing
	Spilopelia senegalensis	Laughing Turtle-dove

Family	Species	Common Name
	Spilopelia chinensis	Spotted Turtle-dove
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra
	Todiramphus sanctus	Sacred Kingfisher
Meropidae	*Merops ornatus*	Rainbow Bee-eater
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo
	Chalcites basalis	Horsfield's Bronze-cuckoo
	Chalcites lucidus	Shining Bronze-cuckoo
	Heteroscenes pallidus	Pallid Cuckoo
Falconidae	*Falco berigora*	Brown Falcon
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco longipennis	Australian Hobby
	Falco peregrinus	Peregrine Falcon
Phasianidae	*Coturnix pectoralis*	Stubble Quail
Otididae	*Ardeotis australis*	Australian Bustard
Rallidae	*Porzana tabuensis*	Spotless Crake
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill
	Acanthiza inornata	Western Thornbill
	Gerygone fusca	Western Gerygone
	Sericornis frontalis	White-browed Scrubwren
	Smicrornis brevirostris	Weebill
Acrocephalidae	*Acrocephalus australis*	Australian Reed-warbler
Artamidae	*Artamus cinereus*	Black-faced Woodswallow
	Artamus cyanopterus	Dusky Woodswallow
	Artamus personatus	Masked Woodswallow
	Cracticus nigrogularis	Pied Butcherbird
	Cracticus torquatus	Grey Butcherbird
	Gymnorhina tibicen	Australian Magpie
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike
	Lalage tricolor	White-winged Triller
Corvidae	*Corvus coronoides*	Australian Raven
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow
	Hirundo neoxena	Welcome Swallow
	Petrochelidon nigricans	Tree Martin
Maluridae	*Malurus lamberti*	Variegated Fairy-wren
	Malurus leucopterus	White-winged Fairy-wren
	Malurus splendens	Splendid Fairy-wren
	Stipiturus malachurus	Southern Emu-wren

Family	Species	Common Name
Megaluridae	*Cincloramphus mathewsi*	Rufous Songlark
	Acanthorhynchus superciliosus	Western Spinebill
	Anthochaera carunculata	Red Wattlebird
	Anthochaera chrysoptera	Little Wattlebird
	Anthochaera lunulata	Western Little Wattlebird
	Epthianura albifrons	White-fronted Chat
	Gavicalis virescens	Singing Honeyeater
	Gliciphila melanops	Tawny-crowned Honeyeater
	Lichenostomus ornatus	Yellow-plumed Honeyeater
	Lichmera indistincta	Brown Honeyeater
	Manorina flavigula	Yellow-throated Miner
	Melithreptus lunatus	White-naped Honeyeater
	Sugomel nigrum	Black Honeyeater
	Phylidonyris niger	White-cheeked Honeyeater
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater
Monarchidae	*Grallina cyanoleuca*	Magpie-lark
Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoe Bird
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush
	Pachycephala pectoralis	Golden Whistler
	Pachycephala rufiventris	Rufous Whistler
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote
	Pardalotus striatus	Striated Pardalote
Petroicidae	*Eopsaltria georgiana*	White-breasted Robin
	Petroica boodang	Scarlet Robin
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail
	Rhipidura leucophrys	Willie Wagtail
Timaliidae	*Zosterops lateralis*	Silvereye
Cacatuidae	*Cacatua sanguinea*	Little Corella
	Calyptorhynchus banksii naso	Forest Red-tailed Cockatoo
	Calyptorhynchus latirostris	Carnaby's Cockatoo
	Eolophus roseicapilla	Galah
Psittacidae	*Barnardius zonarius*	Australian Ringneck
	Neophema elegans	Elegant Parrot
	Trichoglossus haematodus	Rainbow Lorikeet
Strigidae	*Ninox boobook*	Southern Boobook

Table 5. Amphibians potentially found near the project area

Family	Species	Common Name
Hylidae	*Litoria moorei*	Motorbike Frog
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog
	Limnodynastes dorsalis	Western Banjo Frog

Family	Species	Common Name
Myobatrachidae	*Crinia insignifera*	Squelching Froglet
	Myobatrachus gouldii	Turtle Frog
	Pseudophryne guentheri	Gunther's Toadlet

Table 6. Mammals potentially found near the project area

Family	Species	Common Name
Canidae	*Vulpes vulpes*	Red Fox
Felidae	*Felis catus*	Cat
Dasyuridae	*Sminthopsis fuliginosus*	Grey-bellied Dunnart
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo
	Notamacropus irma	Western Brush Wallaby
Tarsipedidae	*Tarsipes rostratus*	Honey Possum

Family	Species	Common Name
Leporidae	*Oryctolagus cuniculus*	Rabbit
Peramelidae	*Isoodon fusciventer*	Quenda
Muridae	*Mus musculus*	House Mouse
	Rattus fuscipes	Bush Rat
	Rattus rattus	Black Rat
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat

Table 7. Reptiles potentially found near the project area

Family	Species	Common Name
Agamidae	*Ctenophorus adelaidensis*	Western Heath Dragon
	Pogona minor	Dwarf Bearded Dragon
Diplodactylidae	*Crenadactylus ocellatus*	Clawless Gecko
	Diplodactylus polyophthalmus	Speckled Stone Gecko
	Strophurus elderi	Jewelled Gecko
	Strophurus spinigerus	South-western Spiny-tailed Gecko
Elapidae	*Brachyurophis fasciolata*	Narrow-banded Burrowing Snake
	Brachyurophis semifasciata	Half-girdled Snake
	Demansia psammophis	Yellow-faced Whipsnake
	Echiopsis curta	Bardick
	Neelaps bimaculatus	Black-naped Burrowing Snake
	Neelaps calonotus	Black-striped Burrowing Snake
	Parasuta gouldii	Gould's Snake
	Pseudonaja affinis	Dugite
	Pseudonaja mengdeni	Western Brown Snake
	Simoselaps bertholdi	Jan's Banded Snake
	Simoselaps littoralis	West Coast Banded Snake
Gekkonidae	*Christinus marmoratus*	Marbled Gecko
Pygopodidae	*Aprasia repens*	Southwest Sandplain Worm Lizard
	Delma concinna	Javelin Lizard
	Delma fraseri	Fraser's Delma
	Delma grayii	Side-barred Delma
	Lialis burtonis	Burton's Legless Lizard
	Pletholax gracilis	Keeled Legless Lizard
	Pygopus lepidopodus	Common Scaly-foot
Pythonidae	*Morelia spilota*	Carpet Python
Scincidae	*Acritoscincus trilineatus*	Western Three-lined Skink
	Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink
	Ctenotus australis	Western Limestone Ctenotus
	Ctenotus fallens	West-coast Laterite Ctenotus
	Cyclodomorphus celatus	Western Slender Bluetongue
	Egernia kingii	King's Skink
	Egernia napoleonis	Southwestern Crevice Skink
	Hemiergis quadrilineatum	Two-toed Earless Skink
	Lerista distinguenda	South-western Orange-tailed Slider
	Lerista elegans	West Coast Four-toed Lerista
	Lerista lineopunctulata	Dotted-line Robust Slider
	Lerista praepedita	Blunt-tailed West-coast Slider
	Menetia greyii	Common Dwarf Skink
	Morethia lineoocellata	Pale-flecked Morethia
	Morethia obscura	Shrubland Pale-flecked Morethia
	Tiliqua occipitalis	Western Blue-tongued Lizard
	Tiliqua rugosa	Bobtail
Typhlopidae	*Anilios australis*	Austral Blind Snake
	Anilios pinguis	Rotund Blind Snake
Varanidae	*Varanus gouldii*	Gould's Goanna
	Varanus tristis	Black-headed Monitor

These lists include species commonly found in Banksia and Tuart woodlands on the inland side of the coastal dunes, so there are species shown in these lists that are unlikely to be recorded in the coastal dunes, although they may infrequently be recorded as vagrants, particularly for the avian species.

4.3 Conservation significant fauna

Conservation significant fauna are protected by the Commonwealth *EPBC Act 1999*, and this list includes species covered by international treaties such as the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) and the Western Australia (WA) *BC Act 2016*. The *BC Act 2016* provides for the publishing of the *Wildlife Conservation (Specially Protected Fauna) Notice* that lists species under multiple categories. In addition, DBCA maintains a list of fauna that require monitoring under four priorities based on the current knowledge of their distribution, abundance and threatening processes. The *EPBC Act 1999* and *BC Act 2016* imply legislative requirements for the management of anthropogenic impacts to minimise the effects of disturbances on species and their habitats. Priority species have no statutory protection, other than the DBCA wishes to monitor potential impacts on these species. Environmental consultants and proponents of developments are encouraged to avoid and minimise impacts on these species. Definitions of the significant fauna under the *BC Act 2016* are provided in Appendix C.

The fauna species that have special status in either State or Commonwealth government legislation or are on the DBCA Priority species list and are potentially present in the vicinity of the project area are listed in Table 6. Although they were recorded in the search of the MNES online database, migratory species that typically would be found around the edge of salt lakes, clay pans, estuaries and marshes have been excluded from Table 6 as there is no suitable habitat nearby.

Threatened and conservation significant waders and shorebirds that utilise the beaches along the edge of the ocean or are marine migratory species or marine turtles that were identified in the MNES online search have not been included in this assessment as the project area does not include habitat in which they will forage or nest.

Two threatened species of fauna and two migratory species of birds were identified under the *EPBC Act 1999* as potentially occurring in the project area or surrounds. There is one Schedule 7 species as listed under the *BC Act 2016* and two species listed on the DBCA's Threatened and Priority Fauna List that potentially occur in the project area or surrounds. The following is an assessment of the likelihood of each of the species listed in Table 6 being found in the project area.

Table 8. Assessment of the potential presence of a conservation significant fauna species in the project area

Species	DBCA Schedule / Priority	Status under Commonwealth *EPBC Act*	Comment on the potential presence of a species
Woylie *Bettongia penicillata*	Critically Endangered	Endangered	Locally extinct from this area.
Western Ringtail Possum *Pseudocheirus occidentalis*	Critically Endangered	Critically Endangered	Locally extinct from this area.
Australasian Bittern *Botaurus poiciloptilus*	Endangered	Endangered	Not present in the project area due to a lack of suitable habitat.
Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*	Endangered	Endangered	Flies over the project area, but a lack of suitable feeding, roosting and nesting resources means any visits will be infrequent.
Forest Red-tailed Black-Cockatoo *Calyptorhynchus banksii naso*	Vulnerable	Vulnerable	Flies over the project area, but a lack of suitable feeding, roosting and nesting resources means any visits will be infrequent.
Malleefowl *Leipoa ocellata*	Vulnerable	Vulnerable	Locally extinct from this area.
Chuditch *Dasyurus geoffroii*	Vulnerable	Vulnerable	Locally extinct from this area.
Balston's Pygmy Perch *Nannatherina balstoni*		Vulnerable	Not present in the project area due to a lack of suitable habitat.
Lancelin Island Skink *Ctenotus lancelini*	Vulnerable	Vulnerable	Highly unlikely to be in the project area.
Fork-tailed Swift *Apus pacificus*	Migratory	Migratory	May infrequently be seen flying in the region.
Grey Wagtail *Motacilla cinerea*	Migratory	Migratory	Highly unlikely to be seen in the project area.
Osprey *Pandion haliaetus*	Migratory	Migratory	Regularly seen flying over the project area but there are no roosting trees, so it is unlikely to roost in the project area.
Quenda *Isoodon fusciventer*	P4		Potentially in the project area.
Black-striped Snake *Neelaps calonotos*	P4		Potentially in the project area.
Peregrine Falcon *Falco peregrinus*	OS		May very infrequently be seen in the project area.

P3 and P4 = Priority 3 and 4 species, OS – Other specially protected fauna
Results of the Commonwealth *EPBC Act 1999* protected matters database search are provided in Appendix A.

Woylie (*Bettongia penicillata*) – Critically endangered under the *BC Act* 2016 and endangered under the *EPBC Act 1999*

The Brush-tailed Bettong or Woylie is a small (1-1.6kg) mammal that has a preference for open forests and woodlands, with clumped low understorey of tussock grasses or clumped low woody scrub (Christensen 2000). Woinarski *et al*. (2014) reported a population reduction of greater than 90% in the last 10 years.

It has not been recorded near the project area for many years, so it is Terrestrial Ecosystems' view that it is not present in the project area.

Western Ringtail Possum (*Pseudocheirus occidentalis*) – Critically endangered under the *BC Act* 2016 and *EPBC Act 1999*

The Western Ringtail Possum is an arboreal mammal with a body weight between 820–1020g. This species is regularly encountered in urban development and disturbed areas throughout its distribution which has contracted from what appears to have been a patchy distribution covering the south west of Western Australia from south-east of Geraldton to the Nullarbor with the most inland recordings coming from the Tuatanning Nature Reserve (de Tores *et al*. 1995). Its distribution encompassed a variety of vegetation types including coastal Peppermint (*Agonis flexuosa*), and Peppermint/Tuart (*Eucalyptus gomphocephala*) associations, Eucalypt and Casuarina (*Allocasuarina huegeliana*) woodlands, and mallee heath from the Hampton Tableland (Baynes 1987). It is now almost exclusively restricted to the coastal Peppermint woodland and coastal Peppermint/Tuart associations from the Australind-Eaton area to Two Peoples Bay. The only known natural extant inland populations are in the lower Collie River Valley, Perup Nature Reserve, around Albany and surrounding forest block near Manjimup. DBCA has translocated individuals to Yalgorup National Park and there are isolated populations south of Mandurah.

Factors thought to have contributed to this species decline include habitat loss, modification or fragmentation, changing fire regimes, disease, competition and predation by introduced predators (Clarke *et al*. 2008, Department of Environment Water Heritage and the Arts 2008).

It has not been recorded near the project area for many years, so it is Terrestrial Ecosystems' view that it is not present in the project area.

Australasian Bittern (*Botaurus poiciloptilus*) Endangered under the *BC Act* 2016 and *EPBC Act 1999*

The Australasian Bittern has a distribution from Moora through much of the south-west and east to Mt Arid; however, it is rarely recorded. It is almost always found in dense *Typha*, *Baumea* and sedges in freshwater or brackish swamps (Johnstone and Storr 1998). Garnett *et al*. (2011) reported its population across Australia as less than 2,000 and in decline. Most of the Western Australian records come from Lake Muir.

It has not been recorded in the vicinity of the project area in other fauna surveys. It is highly unlikely to be present in or near the project are due to a lack of semi-permanent water on the very sandy soils.

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) - Vulnerable under the *BC Act* 2016 and *EPBC Act 1999*

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) is a large, pied, cockatoo. Garnett *et al*. (2011) and the DSEWPaC (2011) reported that Carnaby's Black-Cockatoo inhabits the south-west of Western Australia, from Kalbarri to as east on the south coast as Esperance. It breeds inland and moves to the coastal areas when chicks have fledged (Saunders *et al*. 1985). Carnaby's Black-Cockatoos are highly gregarious, usually seen in trios, small parties or large flocks (up to 5000 birds)(Perry 1948). These flocks usually contain males, females and immature birds.

In some locations, breeding populations have decreased or become locally extinct (Saunders 1986, Saunders and Ingram 1987). For example, in the Coomallo Creek area north of Perth, Black-Cockatoos laid 74 clutches in 1973,

75 in 1974, 82 in 1975 but only 20 in 1994 and 19 in 1996 (Saunders and Ingram 1987). Saunders (1986) reported finding 13 nests at Manmanning in 1969 but by 1977, the species had stopped breeding in the area. Saunders (1990) reported failed nestings due to predation by a cat, galahs broke Carnaby's Black-Cockatoo eggs and took over nests, while other adult birds were killed by vehicles and Wedge-tailed Eagles (*Aquilla audax*).

Carnaby's Black-Cockatoos are partly migratory and partly sedentary (Higgins 1999). In the drier regions of their geographic range where most of the native vegetation has been cleared (e.g. wheatbelt), Carnaby's Black-Cockatoos are postnuptial migrants (Saunders 1980, Saunders and Ingram 1995). After breeding, individuals in these areas migrate to feed in higher rainfall areas including the Swan Coastal Plain, and to a lesser extent, forests dominated by *E. marginata* (Jarrah), *C. calophylla* (Marri) and *E. diversicolor* (Karri; Saunders 1980). On the Swan Coastal Plain, Carnaby's Black-Cockatoos have been recorded foraging in most suburbs and in pine plantations within the greater Perth metropolitan area (Perry 1948). Vagrants have been recorded on Rottnest Island (Winnett 1989) and Garden Island (Wykes *et al*. 1999). These later two sightings clearly indicate that Carnaby's Black-Cockatoo will fly considerable distances over non-vegetated areas to forage.

Garnett *et al*. (2011) estimated there were between 10,000 and 60,000 birds in the population.

Saunders (1980) recorded non-breeding cockatoos at Coomallo Creek foraging within a 50km radius of their breeding area, whereas, cockatoos at Manmanning moved a much greater distance to the coastal plain during their non-breeding season. These data suggest that Carnaby's Black-Cockatoo move from areas where there is little food to southern and western coastal areas where food is presumably more plentiful during summer and autumn (Davies 1966, Saunders 1980).

Carnaby's Black-Cockatoo breed between July and November mostly in eucalypt woodland (Saunders 1980, 1986). Carnaby's Black-Cockatoo nest in tree hollows that are created by fire, fungi, termites or old age, with hollows between 2.5 and 12m above the ground (Saunders 1979, Higgins 1999). Hollows are large, ranging from 10 to over 250cm in depth (Higgins 1999). These hollows are usually in live or dead smooth-barked *Eucalyptus salmonophloia* (Salmon Gum) or *Eucalyptus wandoo* (Wandoo). However, Carnaby's Black-Cockatoo will also nest in *E. longicornis* (Red Morrell), *E. loxophleba* (York Gum), *E. gomphocephala* (Tuart), *E. rudis* (Flooded Gum), *E. salubris* (Gimlet), *E. occidentalis* (Swamp Yate) and *C. calophylla* (Higgins 1999, Cale 2003). When breeding, they most often forage in the surrounding shrubland and kwongan heath (Higgins 1999). On the Swan Coastal Plain, breeding could occur in *E. gomphocephala*, *E. rudis*, *E. occidentalis* and *C. calophylla*. Adults return to the same breeding area each year (Saunders 1977) and some use the same tree hollow for many years in succession to raise their chicks, others shift their nests among a number of trees in the same area (Saunders and Ingram 1998).

Eggs are laid on a mat of wood chips chewed from the sides of the hollow. Clutches are 1-2, but most often only one chick is raised. Incubation takes 29 days, and only the female incubates and broods (Johnstone et al. 2011). Initially the female will return to the nest mid-morning to feed the chick, but after about 2-3 weeks both parents leave in the early morning and return late evening.

Young remain with their parents until the parents return to the breeding area in the following year (Saunders 1980). Immature birds probably do not move into the breeding areas until they are ready to breed, although little is known of the movements of immature Carnaby's Black-Cockatoo until they are ready to breed (Saunders 1977).

The breeding success of Carnaby's Black-Cockatoo is believed to be strongly influenced by the availability of food at breeding sites (Saunders *et al.* 1985). Saunders (1977) found that birds that foraged within one or two kilometres from nesting sites had greater fledgling success than those from populations that had to travel up to four kilometres to obtain food. In a study that monitored Carnaby's Black-Cockatoo's breeding over 25 years at Coomallo Creek, Saunders and Ingram (1998) showed that the number of breeding attempts halved by the end of the study. During this period, native vegetation cover was reduced from 90% in 1959 to 25% in 1996. Their study revealed that although there was a surplus of trees with hollows of sufficient sizes, clearing of adjacent foraging habitat had adversely impacted on the success of breeding birds. Therefore, breeding sites typically have nearby areas of scrub and heath where birds forage on seeds and flowers of numerous trees and shrubs including *Banksia*, *Hakea*, *Dryandra, Grevillea* and *Callistemon* spp. (Robinson 1965, Saunders 1980, Higgins 1999). Unlike other cockatoo

species, Carnaby's Black-Cockatoo will not utilise cereal crops (Saunders *et al*. 1985), but will feed on *Erodium* seed (Saunders 1980).

At Coomallo Creek, Carnaby's Black-Cockatoo travelled on average 1.4km from their nests to forage, whereas at Manmanning they foraged more widely and travelled an average of 2.5km from their nest to forage (Saunders 1980). At Manmanning, road and railway reserves were extensively used for foraging, presumably as this was the closest food source to their nests. The availability of food near the nest influenced the time spent incubating eggs and fledging body mass (Saunders 1980). At Manmanning, Carnaby's Black-Cockatoo traversed agricultural land to forage in remnant plots of uncleared land.

The social organisation of breeding Carnaby's Black-Cockatoo is known (Saunders 1974, 1977, 1979, 1980, Saunders *et a*l. 1985, Saunders 1986, Higgins 1999). Carnaby's Black-Cockatoo start reproducing at about four years of age and continue for at least 15 years (Cale 2003). Strong pair bonds are then formed, often for life. Females lay one or two eggs asynchronously with an average of 8 days (range 1-12) between the laying of the first and second egg. Egg laying usually occurs in early July to mid-October, with inland birds laying approximately three weeks later than those closer to the coast. Females incubate their 1-2 eggs for 29 days (Saunders 1982). When two eggs are laid, it is rare for both nestlings to successfully fledge. The female alone broods and feeds the young birds. Initially, the female, and later the chick, rely on the male for food during the brooding and hatching of the eggs (Saunders 1977, 1982). After two to three weeks, both parents forage and return at mid-morning and dusk to feed the young (Saunders 1977, 1982). The young are dependent on parents for several months after fledgling. Fledglings are independent after about 10-11 weeks (Saunders 1977).

Saunders (1980) reported Carnaby's Black-Cockatoo at Coomallo Creek (breeding area) foraged mostly on native plants, with the only exception being *Erodium* sp.. Higgins (1999) reported the habitat of Carnaby's Black-Cockatoo was uncleared or remnant woodlands dominated by *Eucalyptus*, particularly *E. wandoo* and *E. salmonophloia* and often in shrubland or kwongan heathland dominated by *Hakea*, *Dryandra*, *Banksia* and *Grevillea* and seasonally in *Pinus* plantations and less often in *C. calophylla*, *E. diversicolor* or *E. marginata*.

The belief that Carnaby's Black-Cockatoo numbers are in serious decline has led to a recovery plan being released in 2012 (Department of Parks and Wildlife 2012, 2013). This plan details the current status of the cockatoo and provides conservation measures to increase the population. The five broad recovery actions in this plan are:

- Protect and manage important habitat – identify, protect and manage habitat critical for survival (nesting, foraging and roosting) for Carnaby's Black-Cockatoos across their breeding and non-breeding range;
- Conduct research to inform management – undertake research into the biology, ecology, and conservation management of Carnaby's Black-Cockatoo;
- Undertake regular monitoring – monitor population parameters, habitat, threats and status of the Carnaby's Black-Cockatoo;
- Manage other impacts – monitor the impacts and implement strategies to reduce other factors detrimentally affecting Carnaby's Black-Cockatoo, and support rehabilitation programs;
- Undertake information and communication activities – develop and distribute awareness raising and guidance materials for decision makers, establish joint management agreements and provide for improved sharing of information between agencies; and
- Engage with the broader community – engage with and involve people across the community in the conservation of Carnaby's Black-Cockatoo.

Carnaby's Black-Cockatoo has been recorded in other fauna surveys in the vicinity of the project area and they were observed nearby during the site investigations, however, due to a lack of suitable foraging, nesting and roosting habitat they are unlikely to utilise the project area.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) - Vulnerable under the *BC Act* 2016 and *EPBC Act 1999*

The Forest Red-tailed Black-Cockatoo is one of three large black-cockatoos found in Western Australia. *Calyptorhynchus banksii naso* frequents the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (Department of Sustainability Environment Water Population and Communities 2011). It was mostly seen in the hills, but small numbers of birds were seen at Mundijong, Baldivis, Karnup, Stakehill, Pinjarra, Coolup and in the Lake Clifton area (Johnstone *et al*. 2011). In 2011, there was an increase in the number of Forest Red-tailed Black-Cockatoo on the coastal strip north from Rockingham to the northern metropolitan suburbs. The reason for the recent increase in abundance is unknown.

Forest Red-tailed Black-Cockatoo nest hollows have been recorded between 6.5 and 33m above the ground, with entrance sizes ranging from 10 x 12cm to 44 x 150cm and a depth of 0.3-8.2m (Johnstone *et al*. 2013a, b). Breeding occurs in all months, but peaks in April-June and August-October with an incubation period of 29-31 days. A female broods her hatchling for the first 3-10 days after hatching and then leaves the nest each day at dawn and returns to feed the chick at dusk. Hatchlings are fully feathered at about 48 days. The majority of nests are in Marri, but they have also been recorded in Jarrah, Blackbutt, Bullich and Wandoo. Nest sites are often clustered in an area.

Johnstone and Kirkby (2011) reported the Forest Red-tailed Black-Cockatoo to feed mostly on seeds from *C. calophylla*, *E. marginata*, but also on *Allocasuarina fraseriana* (Sheoak), *Persoonia longifolia* (Snottygobble), *Eucalyptus patens* (Blackbutt) and introduced species such as *M. azedarach* (Cape Lilac) and *Corymbia citriodora* (Lemon-scented Gum).

Loss of breeding habitat in the form of suitable hollows and adequate feeding resources in the vicinity of nesting hollows to enable adults to feed chicks is a primary threat. Abbott (1998) reported that trees within its known breeding distribution was not a factor in limiting breeding. He estimated there were about 15,000 birds and Garnett *et al*. (2011) thought about 10% of these birds bred each year. Competition for nesting hollows by other cockatoos, Wood Ducks, Galahs and feral Honey Bees appears to also be a significant threat (Garnett *et al*. 2011).

The Forest Red-tailed Black-Cockatoo is unlikely to frequent the project area as there are very few plants that offer a food resource. There are no Forest Red-tailed Black-Cockatoo nesting or roosting sites in the project area due to a lack of suitable trees.

Malleefowl (*Leipoa ocellata*) – Vulnerable under the *BC Act* 2016 and *EPBC Act 1999*

Malleefowl are large, ground-dwelling birds that rarely fly unless alarmed or are perching for the night. Historically, Malleefowl have been found in mallee regions of southern Australia from approximately the 26th parallel of latitude southwards. Prior to vegetation clearing for agriculture, Malleefowl were abundant in the WA Wheatbelt. Vegetation clearing for agriculture also opened adjacent bushland to predators, and in the south-west of WA, Malleefowl often only persist in isolated remnant patches of native vegetation. Sheep and other herbivores (e.g. goats, kangaroos) grazing in remnant vegetation removes or thins the undergrowth, and they also compete with Malleefowl for herbaceous foods and can cause changes to the structure and floristic diversity of foraging habitats (Benshemesh 2007).

Malleefowl and their eggs are vulnerable to predation by foxes, and newly hatched chicks are vulnerable to foxes, cats and raptors (Priddel and Wheeler 1990, 1997, Benshemesh and Burton 1999, Benshemesh 2007, Lewis and Hines 2014). Their abundance in the Goldfields is low and they are sparsely distributed, favouring those areas that are more densely vegetated. Malleefowl build distinctive nests that comprise a large mound of soil/rock covering a central core of leaf litter. These nest mounds range in diameter but can span more than five metres and may be up to one metre high. Malleefowl are generally monogamous and once breeding commences they pair for life. The presence of nest mounds provides an indication of the presence of Malleefowl in the area.

Malleefowl has not been observed in the bioregion for many decades and it is not present in or near the project area.

Chuditch (*Dasyurus geoffroii*) – Vulnerable under the *BC Act 2016* and *EPBC Act 1999*.

The Chuditch is the largest extant carnivorous marsupial in WA. It is usually active from dusk to dawn. Formally known from over 70% of Australia, the Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of south-west WA and other isolated areas. Chuditch are solitary animals for most of their life and den in hollow logs, burrows, culverts, etc. and have also been recorded in tree hollows and rock cavities. Chuditch are opportunistic feeders, and forage primarily on the ground at night. Their diet can include other mammals, birds, lizards, bird and reptile eggs but the majority is a mixture of large invertebrates (e.g. spiders, scorpions and crickets).

Chuditch have not been recorded in or near the project area for many years, so it is highly unlikely to be present.

Balston's Pygmy Perch (*Nannatherina balstoni*) - Vulnerable under the *BC Act 2016* and *EPBC Act 1999*.

Balston's Pygmy Perch is the rarest of all the endemic freshwater fishes of south-western Australia. It inhabits coastal streams, lakes, ponds and swamps, where the water is dark and acidic (pH as low as 3.0) and has a large seasonal fluctuation in temperature (11-30°C). It is often found in association with tall sedge thickets.

Balston's Pygmy Perch is not present in the project area due to a lack of permanent freshwater.

Lancelin Island Skink (*Ctenotus lancelini*) - Vulnerable under the *BC Act 2016* and *EPBC Act 1999*.

The approved conservation advice (2008) for the Lancelin Island Skink indicates that this small grey-brown lizards with indistinct streaks running along its back from the neck to the base of the tail is known only from Lancelin Island off the Western Australian coast (Pearson and Jones 2000). It typically uses all vegetation types on the island, but favours slopes facing north to north-east; areas protected from the prevailing south-westerly winds.

Having not been found on the mainland, except for a single individual near Lancelin, it is highly unlikely that the Lancelin Island Skink would be recorded in the project area.

Fork-tailed Swift (*Apus pacificus*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

This species breeds in the northeast and mid-east Asia and winters in Australia and southern New Guinea. It is a visitor to most parts of Western Australia, beginning to arrive in the Kimberley in late September, in the Pilbara in November and in the southwest land division in mid-December, and leaving by late April. The Fork-tailed Swift is an almost exclusively aerial species, foraging and sleeping on the wing. It rarely comes to ground, usually only for breeding. It is common in the Kimberley, uncommon to moderately common near northwest, west and southeast coasts and rare to scarce elsewhere. It is rarely seen in the Goldfields.

Terrestrial Ecosystems' assessment is that the Fork-tailed Swift may very infrequently be seen flying over the project area, however, the Fork-tailed Swift is essentially an aerial species and would be highly unlikely to land in the project area.

Grey Wagtail (*Motacilla cinerea*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

The Grey Wagtail is a small yellow breasted bird with a grey back and head. Johnstone and Storr (2004) reported this migratory species as breeding in Palearctic from western Europe and north-west Africa to eastern Asia and wintering in Africa, south-east Asia, Indonesia, the Philippines, New Guinea and Australia. Its preferred habitat in Australia is banks and rocks in fast-running fresh water including rivers, streams and creeks where it feeds on insects. The Atlas of Living Australia records two sightings on the south-coast of Western Australia and none around the project area.

It is highly unlikely to be seen in the project area due to a lack of records and suitable habitat.

Osprey (*Pandion haliaetus*) – Migratory under the *EPBC Act 1999*

The Osprey is a large raptor that is mostly found in coastal areas, off-shore islands and the lower sections of rivers. It mainly feeds on fish, sea-snakes and large lizards. This species is a regular coastal visitor and likely to be recorded flying over the project area; however, due to a lack of trees is unlikely to roost on site.

The Osprey is seen along the coastal area searching for food in the shallow water. It nests on tall structures, rock outcrops and large trees, none of which are in the project area.

Quenda (*Isoodon fusciventer*) – Priority 4 species with the DBCA

Quenda prefer dense scrub (up to one metre high), with swampy vegetation but are found in a variety of other habitats. They will often feed in adjacent forest and woodland that is open grassland, pasture and crop land lying close to dense cover.

Quenda have been recorded as far north as Two Rocks in the DBCA threatened species database, and Dr Scott Thompson caught them near the old Club Capricorn Resort. It is possible that Quenda are present in very low densities in areas that provide suitable habitat. Given the abundance of foxes and cats along the coastal zone, Quenda are only going to survive in areas of dense undergrowth which provide some protection from these predators.

Black-striped Snake (*Neelaps calonotus*) – Priority 3 with DBCA

This species occurs on dunes and sand-plains vegetated with heaths and eucalypt/banksia woodlands. It feeds largely on skinks and its distribution is restricted and threatened by urban development. In its natural undisturbed state, the project area would provide habitat for the Black-striped Snake. The DBCA threatened species database has records of this snake around Mindarie, and the Atlas of Living Australia records one south of Lancelin, so it is feasible that they are in the project area.

Peregrine Falcon (*Falco peregrinus*) – Other specially protected fauna under the *BC Act 2016*

The Peregrine Falcon is uncommon, although widespread throughout much of Australia excluding the extremely dry areas and has a wide and patchy distribution. It favours hilly or mountainous country and open woodlands and may be an occasional visitor to the project area. Nesting sites include ledges along cliffs, granite outcrops and quarries, hollow trees near wetlands and old nests of other large bird species. There is no evidence to suggest any change in status in the last 50 years.

The Atlas of Living Australia contains records of this species around Joondalup and Lancelin, so it is possible that they are infrequently seen in the project area, however, the habitat in the project area is atypical for this species. The Peregrine Falcon will not rely on this site for continued survival in the region.

5 DISCUSSION

5.1 Adequacy of the fauna survey data for fauna habitats represented in the project area

The EPA's (2016a) *Technical Guidance on Terrestrial Fauna* indicated that a Level 2 fauna assessment is required for a disturbance area of in excess of 10ha in this bioregion. The project area is marginally greater than 10ha, however, the proposed impact area is only about 3ha; the impact area is therefore less than one of the criterion which trigger the requirement for a Level 2 survey in the Swan Coastal Plain 2 subregion.

Level 2 fauna surveys are typically not undertaken now on the Swan Coastal Plain as the EPA considers the vertebrate fauna in this IBRA subregion to be well known. Even if such a survey was undertaken, it is unlikely to provide new species, in particular a conservation significant species that have not previously been identified for this area that would alter the assessment of potential impacts, however, as with all surveys, until it is completed the outcome is unknown.

5.1.1 Amphibians

Amphibians typically found on the Swan Coastal Plain are listed in Table 3. The lack of permanent freshwater means that only those species able to survive away from permanent water on very porous sandy soil (e.g. potentially *Heleioporus eyrei*, *Limnodynastes dorsalis* and *Myobatrachus gouldii*) are likely to be present in the project area. Frogs in this area are normally only detected immediately after rainfall. All three species have a wide-spread distribution and are abundant. There are no conservation significant amphibians in the Swan Coastal IBRA subregion.

5.1.2 Reptiles

Reptile species richness in the project area will be comparable with other sandy dune habitats in the subregion. The list provided in Appendix A represents species likely to be found over a large area of diverse habitat types. Sandy dune habitats are likely to have a restricted reptile fauna assemblage and these areas would typically support 8-15 species of reptiles, but many of these would be in low abundance (see Table 5). The herpetofauna assemblage in the project area are likely to be similar to that in the adjacent areas.

The Black-striped Snake, which is listed as a Priority 4 species, is found in Banksia woodlands and sandy areas in the Perth region. There are records of this snake in the vicinity of the project area, so it is potentially present in the project area.

The Lancelin Island Skink is essentially only known from an off-shore island, and the single record on the mainland probably represents a translocation from the island. It is highly unlikely that this species is present in the project area.

5.1.3 Birds

Avian species richness on the Swan Coastal Plain is influenced by rainfall, urban disturbance and vegetation clearing, and in coastal areas the migratory shore birds and waders that may be seasonally present along the beaches. The list provided in Table 2 represents species likely to be found over a large area of diverse habitat types. Coastal dunes with limited variation in the vegetation structure and diverseness in habitats would typically support between 20-40 species of birds, but many of these would be in very low numbers (see Appendix A).

The Peregrine Falcon, which is a Schedule 7 species under the *BC Act*, will normally have a very large home range and is unlikely to be seen on the relatively flat coastal dunes.

5.1.4 Mammals

The diversity of small terrestrial mammals potentially caught in the project area would be low given the lack of diversity on the sandy coastal dunes. Although, records of Chuditch (*Dasyurus geoffroii*), Woylie (*Bettongia penicillata*) and Western Ringtail Possums (*Pseudocheirus occidentalis*) are present in the MNES database search for the area (Appendix B), they are no longer present in the region, having been predated on by foxes and cats and lost due to vegetation clearing and urban development many years ago.

Quenda are present on the sections of dense vegetation on the sandy dunes in the vicinity of the project area. This species is in low abundance, as it is predated on by foxes and feral cats which are present in the area.

It was noted during the site visit that there was a high abundance of rabbits, and moderate density of cats and foxes utilising the project area.

6 SUMMARY

The City of Wanneroo is proposing to construct a car park, access road and beach access from Two Rocks Road to the beach through an area of natural vegetation on the sand dunes south of Two Rocks.

Terrestrial Ecosystems undertook a Level 1 vertebrate fauna survey of the 10.4ha project area, which included a review of the available literature to determine vertebrate fauna species potentially in the project area and a site visit to determine major fauna habitats and their condition as the basis for an impact assessment which is contained in a separate report (Terrestrial Ecosystems and One Tree Botanical 2020).

The total assessed area is 10.4ha and there are three broad fauna habitats in the project area:

- coastal low heath on sand;
- mixed open shrubland and heath on sand; and
- mixed closed shrubland over sand and limestone.

Some of the site is highly disturbed or cleared and provides no habitat value.

It is probable that Quenda (Priority 4) and Black-striped Snake (Priority 3) are present in the project area. Carnaby's and Forest Red-tailed Black-Cockatoo would very infrequently be seen flying over the site, but the project is not their preferred foraging habitat, and they would not roost or nest in the area. The Osprey will be regularly seen flying over the site but there is a very low probability that the Peregrine Falcon would be seen near project area.

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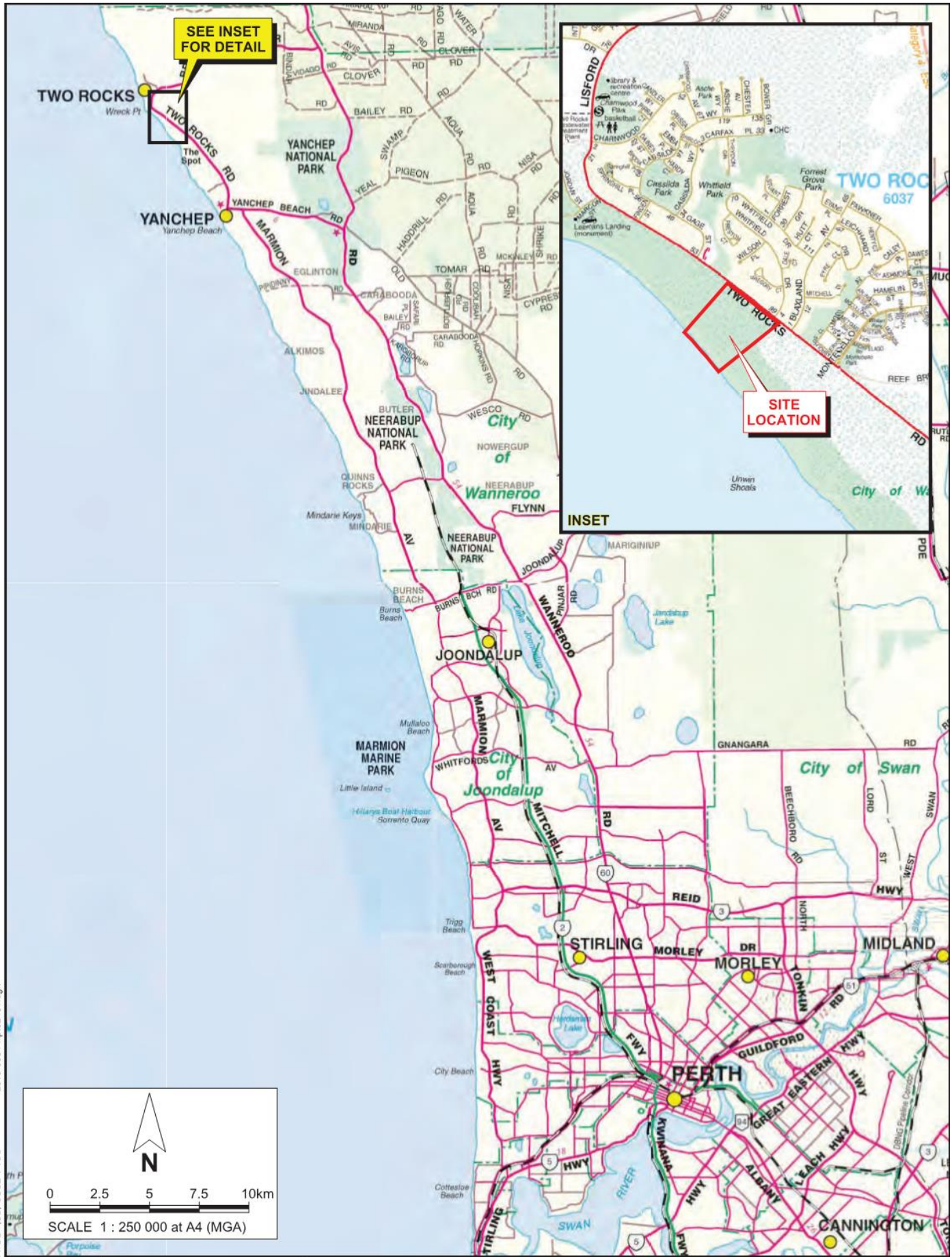
Figures

Vertebrate Fauna Survey - Two Rocks Beach Access, Two Rocks



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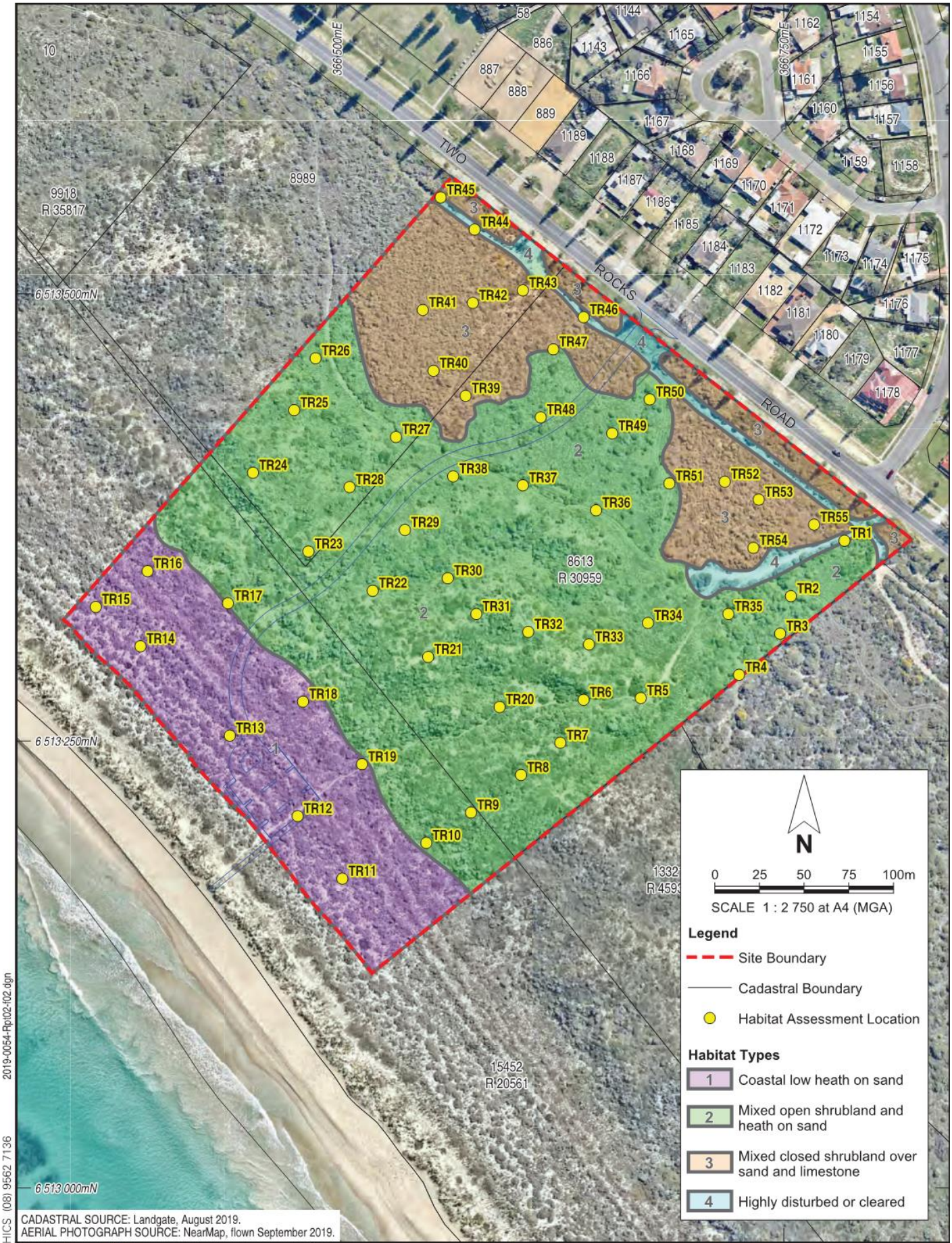
TERRESTRIAL ECOSYSTEMS

City of Wanneroo
VERTEBRATE FAUNA SURVEY
TWO ROCKS BEACH ACCESS WAY, TWO ROCKS

Figure 1

REGIONAL LOCATION

Drawn: S. Thompson | Date: 8 Oct 2019 | Job: 2019-0054



CADASTRAL SOURCE: Landgate, August 2019.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown September 2019.

PINPOINT CARTOGRAPHICS (08) 9562 7136 2019-0054-Rpt02-f02.dgn

TERRESTRIAL ECOSYSTEMS

City of Wanneroo
VERTEBRATE FAUNA SURVEY
TWO ROCKS BEACH ACCESS WAY, TWO ROCKS

Figure 2

FAUNA HABITAT ASSESSMENT

Drawn: S. Thompson | Date: 8 Oct 2019 | Job: 2019-0054

Appendix A
Results of the *EPBC Act* Protected Matters Search

Vertebrate Fauna Survey - Two Rocks Beach Access, Two Rocks

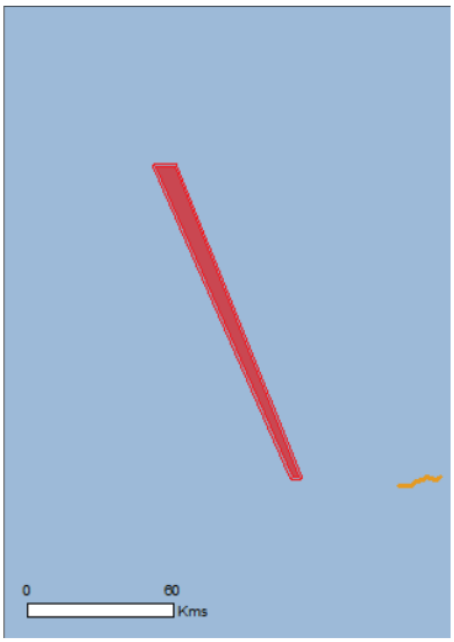
EPBC Act Protected Matters Report

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.

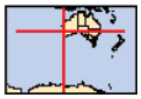
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 29/08/19 16:03:03



Coordinates
Buffer: 1.0Km



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:	3
Listed Threatened Species:	53
Listed Migratory Species:	45

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:	2
Commonwealth Heritage Places:	1
Listed Marine Species:	75
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	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:	3
Regional Forest Agreements:	None
Invasive Species:	39
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 ecological community	Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically 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
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	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
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	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
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
Phoebetria 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, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to 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
Fish		
Nannatherina balstoni Balston's Pygmy Perch [66698]	Vulnerable	Species or species

		habitat likely to occur within area
Insects		
Hesperocolletes douglasi Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat may 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	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Plants		
Chorizema varium Limestone Pea [16981]	Endangered	Species or species habitat known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat may occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat may occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus argutifolia Yanchep Mallee, Wabling 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
Marianthus paralius [83925]	Endangered	Species or species habitat known 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
Ctenotus lancelini Lancelin Island Skink [1482]	Vulnerable	Species or species habitat 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	Foraging, feeding or related behaviour 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 likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	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
Hydroprogne caspia Caspian Tern [808]		Breeding known 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
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	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		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Breeding known to occur within area
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	Foraging, feeding or related behaviour known to 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
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat

		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		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to 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]		Breeding known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land - Defence - LANCELIN TRAINING AREA

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Lancelin Defence Training Area	WA	Listed place

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		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to 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]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to 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 Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Diomedea exulans Wandering Albatross [89223]	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 known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known 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
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]		Breeding known to occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area
Phoebetria 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

Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	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
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat 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		

[66235]		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
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
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	Species or species habitat known 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		[Resource Information]
Name	Status	Type of Presence
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 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 Dophin, 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
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.		

habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Lancelin And Edwards Islands	WA
Nilgen	WA
Unnamed WA49994	WA

Invasive Species	[Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur 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
Sus scrofa Pig [6]	Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]	Species or species habitat likely to occur within area
Plants	
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]	Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]	Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]	Species or species habitat likely to occur within area
Asparagus declinatus Bridal Veil, Bridal Veil Creeper, Pale Berry Asparagus Fern, Asparagus Fern, South African Creeper [66908]	Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]	Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]	Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]	Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]	Species or species habitat may occur within area

Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]	Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]	Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]	Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]	Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]	Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]	Species or species habitat likely to 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

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

-31.8775 115.775,-31.8775 115.8,-30.9 115.34,-30.9 115.269,-31.8775 115.775

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.

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Appendix B
Vertebrate Fauna Recorded in Biological Surveys in the Region

Vertebrate Fauna Survey - Two Rocks Beach Access, Two Rocks

Appendix B(1). Vertebrate fauna assessments

		Surveys	A	B	C		D	E	F	G			H								I	J			K		L			M
Family	Species	Common Name			Brighton	Unknown			Trinity	Acacia	Dryandra	Eucalypt & Banksia	Banksia	Site 01	Site 02	Site 10B	Site 02B	Site 02A	Site 10A	Site 01A	Site 14A	Site 4	Site 4	Site 2	Site 1	Opportunistic	Opportunistic	Site 5	Cassilda Park	Kinsale Park	Brighton	
Birds																															X
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk																								1					
	Accipiter fasciatus	Brown Goshawk								1	1	1														2					
	Aquila audax	Wedge-tailed Eagle																					1								
	Circus approximans	Swamp Harrier																								3					
	Elanus axillaris	Black-shouldered Kite								1													1			4					
	Haliastur sphenurus	Whistling Kite								1																2					
	Hieraaetus morphnoides	Little Eagle																					1	1		3					
	Lophoictinia isura	Square-tailed Kite																					1								
Anatidae	*Tadorna tadornoides*	Australian Shelduck																				5									
Podargidae	*Podargus strigoides*	Tawny Frogmouth																								1					
Casuariidae	*Dromaius novaehollandiae*	Emu																				1	1		1	9					
Laridae	*Chroicocephalus novaehollandiae*	Silver Gull																						1							
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis																								92					
Columbidae	*Columba livia*	Domestic Pigeon																					1	12							
	Ocyphaps lophotes	Crested Pigeon								3	7															15					
	Phaps chalcoptera	Common Bronzewing									2	1										2	1			14					
	Phaps elegans	Brush Bronzewing							75																						
	Spilopelia senegalensis	Laughing Turtle-dove								6	4													6		2		1	1		
	Spilpopelia chinensis	Spotted Turtle-dove																							1						
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra										6											1			9					
	Todiramphus sanctus	Sacred Kingfisher										2	1									1		1		1		1			
Meropidae	*Merops ornatus*	Rainbow Bee-eater																				2				26					
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo																				1	3		1						
	Chalcites basalis	Horsfield's Bronze-cuckoo								1	1												2	1	1	1					
	Chalcites lucidus	Shining Bronze-cuckoo																					2								
	Heteroscenes pallidus	Pallid Cuckoo																					2								
Falconidae	*Falco berigora*	Brown Falcon																								2					
Falconidae	*Falco cenchroides*	Nankeen Kestrel											1											2	1	1			1		
	Falco longipennis	Australian Hobby																					1			1					
	Falco peregrinus	Peregrine Falcon																						1							
Phasianidae	*Coturnix pectoralis*	Stubble Quail																								7					
Otididae	*Ardeotis australis*	Australian Bustard																						1							
Rallidae	*Porzana tabuensis*	Spotless Crake				1																									
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill	X																				1		1	8					
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	X										3									4	5			9					
	Acanthiza inornata	Western Thornbill	X							7													4			28					
	Gerygone fusca	Western Gerygone	X							1		10	6									6	12		2	1	35			1		
	Sericornis frontalis	White-browed Scrubwren	X								3											2			22		13		1	1		
	Smicrornis brevirostris	Weebill	X									11											1			1	11					
Acrocephalidae	*Acrocephalus australis*	Australian Reed-warbler	X																												

		Surveys	A	B	C		D	E	F	G			H								I	J			K		L			M
Family	Species	Common Name			Brighton	Unknown			Trinity	Acacia	Dryandra	Eucalypt & Banksia	Banksia	Site 01	Site 02	Site 10B	Site 02B	Site 02A	Site 10A	Site 01A	Site 14A	Site 4	Site 4	Site 2	Site 1	Opportunistic	Opportunistic	Site 5	Cassilda Park	Kinsale Park	Brighton	
Artamidae	*Artamus cinereus*	Black-faced Woodswallow	X			5					11													7		1	2					
	Artamus cyanopterus	Dusky Woodswallow	X																													
	Artamus personatus	Masked Woodswallow	X																													
	Cracticus nigrogularis	Pied Butcherbird	X																													
	Cracticus torquatus	Grey Butcherbird	X							2	6	3	3										1	3	5		4			1	1	
	Gymnorhina tibicen	Australian Magpie	X							1		7	6									4	7	2	3	1	74		1	1	1	
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	X			5				1	3	1	3										3	2			12		1			
	Lalage tricolor	White-winged Triller	X			15					1																					
Corvidae	*Corvus coronoides*	Australian Raven	X							2			1									4	6	6	6	1	34			1		
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow	X																					1	1		3					
	Hirundo neoxena	Welcome Swallow	X							4														1	4		20		1	1		
	Petrochelidon nigricans	Tree Martin	X																					1	18							
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	X			5																					24		1			
	Malurus leucopterus	White-winged Fairy-wren	X																						4		23					
	Malurus splendens	Splendid Fairy-wren	X							12	30	22	18									4	18	8	1		204					
	Stipiturus malachurus	Southern Emu-wren	X																													
Megaluridae	*Cincloramphus mathewsi*	Rufous Songlark	X																													
	Acanthorhynchus superciliosus	Western Spinebill	X																				4				4					
	Anthochaera carunculata	Red Wattlebird	X			5				1	11	11	15									5	6	4	6	1	36		1	1		
	Anthochaera chrysoptera	Little Wattlebird																					14	1	1		3					
	Anthochaera lunulata	Western Little Wattlebird	X																													
	Epthianura albifrons	White-fronted Chat	X																								15					
	Gavicalis virescens	Singing Honeyeater	X							7	4		10										2	1	12		10		1	1		
	Gliciphila melanops	Tawny-crowned Honeyeater	X																					12			9					
	Lichenostomus ornatus	Yellow-plumed Honeyeater																					1									
	Lichmera indistincta	Brown Honeyeater																									193					
	Lichmera indistincta	Brown Honeyeater	X							3		44	11										21	15	7				1	1		
	Manorina flavigula	Yellow-throated Miner	X																												1	
	Melithreptus lunatus	White-naped Honeyeater																					1									
	Sugomel nigrum	Black Honeyeater																									109					
	Phylidonyris niger	White-cheeked Honeyeater	X			1				30	230	10												5	3				1			
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	X																				3				152		1	1		
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	X																				1				2		1	1	1	
Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit	X			15				2															1	1	31					
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoe Bird				10																										
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	X								5	8										2	5				1					
	Pachycephala pectoralis	Golden Whistler										5	9									1										
	Pachycephala rufiventris	Rufous Whistler	X																			10	3				19					
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	X																				4									
	Pardalotus striatus	Striated Pardalote	X									1										5	8				4			1		
Petroicidae	*Eopsaltria georgiana*	White-breasted Robin	X																													
	Petroica boodang	Scarlet Robin	X																				6									

		Surveys	A	B	C		D	E	F	G			H								I	J			K		L			M
Family	Species	Common Name			Brighton	Unknown			Trinity	Acacia	Dryandra	Eucalypt & Banksia	Banksia	Site 01	Site 02	Site 10B	Site 02B	Site 02A	Site 10A	Site 01A	Site 14A	Site 4	Site 4	Site 2	Site 1	Opportunistic	Opportunistic	Site 5	Cassilda Park	Kinsale Park	Brighton	
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	X								4	1									2	5		3		34		1			
	Rhipidura leucophrys	Willie Wagtail	X			1				1		1											1	1		11		1	1		
Timaliidae	*Zosterops lateralis*	Silvereye	X						62	70	45	11											4	4		321		1	1	1	
Cacatuidae	*Cacatua sanguinea*	Little Corella							2												2				1	14					
	Calyptorhynchus latirostris	Carnaby's Cockatoo								2	1	8									3	4	1			240					
	Eolophus roseicapilla	Galah								2	12	4									8	12		5	1	116		1	1		
Psittacidae	*Barnardius zonarius*	Australian Ringneck								2	14										4	19			1	67			1		
	Neophema elegans	Elegant Parrot																				1									
	Trichoglossus haematodus	Rainbow Lorikeet																			2										
Strigidae	*Ninox boobook*	Southern Boobook																				2					1				
Fish																															
Percichthyidae	*Bostockia porosa*	Nightfish	X																												
Amphibians																															
Hylidae	*Litoria moorei*	Motorbike Frog	X																												
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog	X	8		40			1			1	17			1	6	12		7	13		3				3				
	Limnodynastes dorsalis	Western Banjo Frog	X	15	30	75				4	23	1	2			2	1	5		4	2		1		1		16				
Myobatrachidae	*Crinia insignifera*	Squelching Froglet	X	7		35																									
	Myobatrachus gouldii	Turtle Frog																				2									
	Pseudophryne guentheri	Gunther's Toadlet	X	1		1																									
Mammals																															
Canidae	*Vulpes vulpes*	Red Fox							1				1										1	1	1						
Felidae	*Felis catus*	Cat																						1	1						
Dasyuridae	*Dasyurus geoffroii*	Chuditch	X	1																											
	Sminthopsis fuliginosus	Grey-bellied Dunnart																					1								
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo	X	1						6	1	3										8	11		1						
	Notamacropus irma	Western Brush Wallaby																				1									
Tarsipedidae	*Tarsipes rostratus*	Honey Possum	X	5		5				16													1				3				
Leporidae	*Oryctolagus cuniculus*	Rabbit																				1	1	1	1						
Peramelidae	*Isoodon obesulus*	Quenda	X						1																						
Muridae	*Mus musculus*	House Mouse			10				98	13	17	7	4		1	2		14	5		1	2		6			5				
	Rattus fuscipes	Bush Rat	X	6		1	4	1	6		1								1					3							
	Rattus rattus	Black Rat							2													1		2							
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	X	1			1															1			1						
Reptiles																															
Agamidae	*Ctenophorus adelaidensis*	Western Heath Dragon	X	7		35										5	1														
	Pogona minor	Dwarf Bearded Dragon	X	8		8			35	2		1	3			3	9							1			3				
Diplodactylidae	*Crenadactylus ocellatus*	Clawless Gecko	X	3																		2									
	Diplodactylus polyophthalmus	Speckled Stone Gecko	X	2		10																									
	Strophurus elderi	Jewelled Gecko								1																					
	Strophurus spinigerus	South-western Spiny-tailed Gecko	X	4		4			81	8	4					5	7					2									
Elapidae	*Brachyurophis fasciolata*	Narrow-banded Burrowing Snake	X																												
	Brachyurophis semifasciata	Half-girdled Snake	X	4		20			12				2														1				

		Surveys	A	B	C		D	E	F	G			H								I	J			K		L			M
Family	Species	Common Name			Brighton	Unknown			Trinity	Acacia	Dryandra	Eucalypt & Banksia	Banksia	Site 01	Site 02	Site 10B	Site 02B	Site 02A	Site 10A	Site 01A	Site 14A	Site 4	Site 4	Site 2	Site 1	Opportunistic	Opportunistic	Site 5	Cassilda Park	Kinsale Park	Brighton	
	Demansia psammophis	Yellow-faced Whipsnake							15	7	2	1	2				2											1				
	Echiopsis curta	Bardick	X	3		15			8	1																		2				
	Neelaps bimaculatus	Black-naped Burrowing Snake	X	2		10			3																			1				
	Neelaps calonotus	Black-striped Burrowing Snake	X	1																												
	Parasuta gouldii	Gould's Snake	X	8		8			12	1																						
	Pseudonaja affinis	Dugite	X	1	2	1			9		1	2												1	1							
	Pseudonaja mengdeni	Western Brown Snake							1																							
	Simoselaps bertholdi	Jan's Banded Snake	X	9		9			38	2	2		6				2	1										1				
	Simoselaps littoralis	West Coast Banded Snake	X																													
Gekkonidae	*Christinus marmoratus*	Marbled Gecko	X	4		20			10											4	2											
Pygopodidae	*Aprasia repens*	Southwest Sandplain Worm Lizard	X	4		25																2			1			1				
	Delma concinna	Javelin Lizard	X		5				6																							
	Delma fraseri	Fraser's Delma	X	1		5			7				1											1				1				
	Delma grayii	Side-barred Delma	X	3		15			22								1															
	Lialis burtonis	Burton's Legless Lizard	X	4		20			57			1	1			1		2				6	1									
	Pletholax gracilis	Keeled Legless Lizard							6																1							
	Pygopus lepidopodus	Common Scaly-foot	X	2	1	2			22		1																					
Pythonidae	*Morelia spilota*	Carpet Python	X	1																												
Scincidae	*Acritoscincus trilineatus*	Western Three-lined Skink	X	2		10															2											
	Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink	X	3		15			19		2	2	5					1	1	8	8	5	2			1						
	Ctenotus australis	Western Limestone Ctenotus	X	5	10	25			73	3	11	1	5				5	3										12				
	Ctenotus fallens	West-coast Laterite Ctenotus	X	5	20	25			57	6	20	22	16				2	5		3	2	2			1			22				
	Cyclodomorphus celatus	Western Slender Bluetongue	X	6		30					2	1																2				
	Egernia kingii	King's Skink																							1							
	Egernia napoleonis	Southwestern Crevice Skink	X	2	5	10			20			3																				
	Hemiergis quadrilineatum	Two-toed Earless Skink	X	8	45	40			123	18	9	32	43			7	3	11	5	20	3	63	3	1	1			2				
	Lerista distinguenda	South-western Orange-tailed Slider							1													4										
	Lerista elegans	West Coast Four-toed Lerista	X	11	20	55											9	18		4	48	2	2	2	2			1				
	Lerista lineopunctulata	Dotted-line Robust Slider	X	4		20			2									1														
	Lerista praepedita	Blunt-tailed West-coast Slider	X	13		65			11								1					2	1									
	Menetia greyii	Common Dwarf Skink	X	5	5	25			17	2	2	4	3			2	1	3	2	24	57	5	1	6				2				
	Morethia lineoocellata	Pale-flecked Morethia							8													1	1	1								
	Morethia obscura	Shrubland Pale-flecked Morethia	X	2	20	10			40		3	3	4				2	4	2	6	21	8	1									
	Tiliqua occipitalis	Western Blue-tongued Lizard							7				2		2			1					2	4	2	1		9				
	Tiliqua rugosa	Bobtail	X	1	2				46	2	3	3	10	9	16	1	1	4				1						4				
Typhlopidae	*Anilios australis*	Austral Blind Snake	X	1		2			4				1																			
	Anilios pinguis	Rotund Blind Snake							2																							
Varanidae	*Varanus gouldii*	Gould's Goanna							1																							
	Varanus tristis	Black-headed Monitor	X	1		1																										
Chelidae	*Chelodina colliei*	Collie's Snake-necked Turtle		1		5																										

A Atlas of Living Australia

B Western Australian Museum

C NatureMap - Brighton
D NatureMap - Gnangara
E NatureMap – Mitchell Freeway
F Terrestrial Ecosystems (2012) Trinity
G ATA Environmental (ATA Environmental 2008) Vertebrate Fauna Assessment Lot 3 Romeo Road, Alkimos, Unpublished report for Northern Corridor Developments Limited.
H Valentine, I.E., Wilson, B.A., Reaveley, A., Huang, N., Johnson, B. and Brown, P.R. (2009) *Patterns of Ground-dwelling Vertebrate Biodiversity in the Gnangara Sustainability Strategy Study Area*, Unpublished report for the Department of Environment and Conservation, Perth.
I GHD (2014b) *Neerabup Road Extension Level 2 Fauna Survey*, Unpublished report for Main Roads Western Australia, Perth
J ATA Environmental (1991) *Yanchep Structure Plan Vertebrate Fauna Survey*, Unpublished report for Tokyu Corporation, Perth.
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L Gole, C.A. (2003) *Bird Survey in selected Perth Metropolitan Reserves. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project*, Unpublished report Birds Australia and Perth Biodiversity Project, Perth.
M Bamford Consulting Ecologists (2005) *Alkimos Proposed Wastewater Treatment Plant: Fauna Assessment*, Unpublished report for Water Corporation, Perth.

Appendix B(2). Vertebrate fauna assessments

		Survey	A						
Family	**Species**	**Common Name**	**Site 3**	**Site 6**	**Site 5**	**Site 4**	**Site 2**	**Site 1**	**Opportunist**
Amphibians									
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog	24	12	13	27	9	5	
	Limnodynastes dorsalis	Western Banjo Frog				4			
Myobatrachidae	*Crinia georgiana*	Quacking Frog				4			
	Crinia insignifera	Squelching Froglet				1			
	Pseudophryne guentheri	Gunther's Toadlet				1			
Birds									
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	1						
	Elanus axillaris	Black-shouldered Kite	1						
	Hieraaetus morphnoides	Little Eagle					1		
Anatidae	*Anas superciliosa*	Pacific Black Duck				2			
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	1						1
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	6						
Columbidae	*Phaps chalcoptera*	Common Bronzewing	1			1			
	Spilopelia senegalensis	Laughing Turtle-dove				2			
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra		1		7	2		
	Todiramphus sanctus	Sacred Kingfisher		1	1	6	3	1	
Meropidae	*Merops ornatus*	Rainbow Bee-eater				1	8	1	1
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-cuckoo					1		
	Chalcites lucidus	Shining Bronze-cuckoo		3					
	Heteroscenes pallidus	Pallid Cuckoo						1	
Falconidae	*Falco berigora*	Brown Falcon		1					
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill				4			
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill		10		25	4	9	
	Acanthiza inornata	Western Thornbill		9			17		
	Gerygone fusca	Western Gerygone	20	24	10	6	47	25	2
	Smicrornis brevirostris	Weebill	8	14	1		12	3	
Artamidae	*Cracticus torquatus*	Grey Butcherbird	2	8	8	7	4	2	1
	Gymnorhina tibicen	Australian Magpie	9		6	21	6	11	3
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike		7	2	1	5	11	1
Corvidae	*Corvus coronoides*	Australian Raven	3	5	8	6	14	22	1
Maluridae	*Malurus splendens*	Splendid Fairy-wren				5	14		
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	2	4	10	14	13	12	1
	Gavicalis virescens	Singing Honeyeater		6	7	4	7	6	
	Lichmera indistincta	Brown Honeyeater				3	5	9	
	Phylidonyris niger	White-cheeked Honeyeater			6	3	4	1	
Monarchidae	*Grallina cyanoleuca*	Magpie-lark		2	2	3	1	1	
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush					2		
	Pachycephala pectoralis	Golden Whistler	2	1					
	Pachycephala rufiventris	Rufous Whistler	2	6	1	3	5	1	1
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	1		4		3	4	
Petroicidae	*Petroica boodang*	Scarlet Robin					1		
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	2	2	1	50	11	3	1
Timaliidae	*Zosterops lateralis*	Silvereye	4	8	15	34	90	26	

		Survey	A						
Family	**Species**	**Common Name**	**Site 3**	**Site 6**	**Site 5**	**Site 4**	**Site 2**	**Site 1**	**Opportunist**
Cacatuidae	*Cacatua sanguinea*	Little Corella					5		
	Calyptorhynchus latirostris	Carnaby's Cockatoo	3		2		6		
	Eolophus roseicapilla	Galah		5	6	2	13	15	
Psittacidae	*Barnardius zonarius*	Australian Ringneck	3	7	26	33	33	36	1
	Purpureicephalus spurius	Red-capped Parrot		1		1			
	Trichoglossus haematodus	Rainbow Lorikeet					4	10	
Strigidae	*Ninox boobook*	Southern Boobook					1		
Molossidae	*Austronomus australis*	White-striped Freetail Bat			1				
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat		1					
Mammals									
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo	2	1	1	11	5	2	
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	4	1			4		
Leporidae	*Oryctolagus cuniculus*	Rabbit				1	1		
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot			1				
Equidae	*Equus caballus*	Horse						1	
Muridae	*Mus musculus*	House Mouse			3		1	8	
Reptiles									
Agamidae	*Pogona minor*	Western Bearded Dragon		1	2		1	1	
Diplodactylidae	*Oedura marmorata*	Marbled Velvet Gecko					1	1	
Elapidae	*Neelaps bimaculatus*	Black-naped Burrowing Snake	1						
	Pseudonaja affinis	Dugite	1				1		
	Simoselaps bertholdi	Jan's Banded Snake					1		
Pygopodidae	*Aprasia repens*	Southwest Sandplain Worm Lizard	1	4		1		2	
	Lialis burtonis	Burton's Legless Lizard	4	2	9		10	13	
	Pletholax gracilis	Keeled Legless Lizard						1	
Pythonidae	*Morelia spilota*	Carpet Python					2		
Scincidae	*Acritoscincus trilineatus*	Western Three-lined Skink		1		3			
	Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink	4	8	5		7	3	
	Ctenotus australis	Western Limestone Ctenotus			2		1	2	
	Ctenotus fallens	West-coast Laterite Ctenotus			1		7	8	
	Cyclodomorphus celatus	Western Slender Bluetongue					1		
	Hemiergis quadrilineatum	Two-toed Earless Skink	14	15	9	4	37	28	
	Lerista elegans	West Coast Four-toed Lerista	18	7	6		5	1	
	Lerista praepedita	Blunt-tailed West-coast Slider			1			1	
	Menetia greyii	Common Dwarf Skink	18	6	2	20	1	3	
	Morethia lineoocellata	Pale-flecked Morethia		3	1		4	2	
	Morethia obscura	Shrubland Pale-flecked Morethia	5	3	3		2	1	
	Tiliqua rugosa	Bobtail	3	3	3	4	7	7	
Typhlopidae	*Anilios australis*	Austral Blind Snake	1						
Varanidae	*Varanus tristis*	Black-headed Monitor	1						

A Biota Environmental Sciences (2000) *Lot 52 Burns Beach Road Fauna Survey*, Perth.

Appendix C
Definitions of Significant Fauna under the WA *Biodiversity Conservation Act 2016* and Priority Species

Vertebrate Fauna Survey - Two Rocks Beach Access, Two Rocks

ATTACHMENT C
DEFINITIONS OF SIGNIFICANT FAUNA UNDER THE WA *BIODIVERSITY CONSERVATION ACT 2016*

Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*. Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T Threatened Species

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR Critically endangered species

Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN Endangered species

Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.

VU Vulnerable species

Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Extinct Species

[1] The definition of flora includes algae, fungi and lichens

[2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

EX Extinct species

Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW Extinct in the wild species

Species that "*is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).

Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially Protected Species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI Migratory birds protected under an international agreement

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).

Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

CD Species of special conservation interest (conservation dependant fauna)

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS Other specially protected species

Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations

P1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

P2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

P3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

P4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix D
Fauna habitat assessment results
Vertebrate Fauna Survey - Two Rocks Beach Access, Two Rocks

Date: 29-Aug-19	Habitat Assessment #: TR1	Observers: Dr Scott Thompson
Zone: 50	Easting: 366784 mE	Northing: 6513362 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR2	Observers: Dr Scott Thompson
Zone: 50	Easting: 366754 mE	Northing: 6513331 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR3	Observers: Dr Scott Thompson
Zone: 50	Easting: 366748 mE	Northing: 6513310 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR4	Observers: Dr Scott Thompson
Zone: 50	Easting: 366725 mE	Northing: 6513287 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR5	Observers: Dr Scott Thompson
Zone: 50	Easting: 366670 mE	Northing: 6513274 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR6	Observers: Dr Scott Thompson
Zone: 50	Easting: 366638 mE	Northing: 6513273 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR7	Observers: Dr Scott Thompson
Zone: 50	Easting: 366625 mE	Northing: 6513249 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR8	Observers: Dr Scott Thompson
Zone: 50	Easting: 366603 mE	Northing: 6513231 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR9	Observers: Dr Scott Thompson
Zone: 50	Easting: 366575 mE	Northing: 6513210 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR10	Observers: Dr Scott Thompson
Zone: 50	Easting: 366550 mE	Northing: 6513193 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR11	Observers: Dr Scott Thompson
Zone: 50	Easting: 366503 mE	Northing: 6513173 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR12	Observers: Dr Scott Thompson
Zone: 50	Easting: 366478 mE	Northing: 6513208 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR13	Observers: Dr Scott Thompson
Zone: 50	Easting: 366440 mE	Northing: 6513253 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR14	Observers: Dr Scott Thompson
Zone: 50	Easting: 366390 mE	Northing: 6513303 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR15	Observers: Dr Scott Thompson
Zone: 50	Easting: 366365 mE	Northing: 6513325 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR16	Observers: Dr Scott Thompson
Zone: 50	Easting: 366394 mE	Northing: 6513345 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR17	Observers: Dr Scott Thompson
Zone: 50	Easting: 366439 mE	Northing: 6513327 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR18	Observers: Dr Scott Thompson
Zone: 50	Easting: 366481 mE	Northing: 6513272 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR19	Observers: Dr Scott Thompson
Zone: 50	Easting: 366514 mE	Northing: 6513237 mN
Landform: Coastal undulating	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand	

Habitat Structure: Coastal low heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR20	Observers: Dr Scott Thompson
Zone: 50	Easting: 366591 mE	Northing: 6513269 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR21	Observers: Dr Scott Thompson
Zone: 50	Easting: 366551 mE	Northing: 6513297 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR22	Observers: Dr Scott Thompson
Zone: 50	Easting: 366520 mE	Northing: 6513334 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR23	Observers: Dr Scott Thompson
Zone: 50	Easting: 366484 mE	Northing: 6513356 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR24	Observers: Dr Scott Thompson
Zone: 50	Easting: 366453 mE	Northing: 6513400 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR25	Observers: Dr Scott Thompson
Zone: 50	Easting: 366476 mE	Northing: 6513435 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR26	Observers: Dr Scott Thompson
Zone: 50	Easting: 366488 mE	Northing: 6513464 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR27	Observers: Dr Scott Thompson
Zone: 50	Easting: 366533 mE	Northing: 6513420 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR28	Observers: Dr Scott Thompson
Zone: 50	Easting: 366507 mE	Northing: 6513392 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR29	Observers: Dr Scott Thompson
Zone: 50	Easting: 366538 mE	Northing: 6513368 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR30	Observers: Dr Scott Thompson
Zone: 50	Easting: 366562 mE	Northing: 6513341 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR31	Observers: Dr Scott Thompson
Zone: 50	Easting: 366578 mE	Northing: 6513321 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR32	Observers: Dr Scott Thompson
Zone: 50	Easting: 366607 mE	Northing: 6513311 mN
Landform: Undulating	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR33	Observers: Dr Scott Thompson
Zone: 50	Easting: 366641 mE	Northing: 6513304 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR34	Observers: Dr Scott Thompson
Zone: 50	Easting: 366674 mE	Northing: 6513316 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR35	Observers: Dr Scott Thompson
Zone: 50	Easting: 366719 mE	Northing: 6513321 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR36	Observers: Dr Scott Thompson
Zone: 50	Easting: 366645 mE	Northing: 6513379 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR37	Observers: Dr Scott Thompson
Zone: 50	Easting: 366604 mE	Northing: 6513393 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR38	Observers: Dr Scott Thompson
Zone: 50	Easting: 366565 mE	Northing: 6513398 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR39	Observers: Dr Scott Thompson
Zone: 50	Easting: 366572 mE	Northing: 6513443 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR40	Observers: Dr Scott Thompson
Zone: 50	Easting: 366554 mE	Northing: 6513457 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR41	Observers: Dr Scott Thompson
Zone: 50	Easting: 366548 mE	Northing: 6513491 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR42	Observers: Dr Scott Thompson
Zone: 50	Easting: 366576 mE	Northing: 6513495 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Very Good
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR43	Observers: Dr Scott Thompson
Zone: 50	Easting: 366604 mE	Northing: 6513502 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR44	Observers: Dr Scott Thompson
Zone: 50	Easting: 366577 mE	Northing: 6513536 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR45	Observers: Dr Scott Thompson
Zone: 50	Easting: 366558 mE	Northing: 6513554 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR46	Observers: Dr Scott Thompson
Zone: 50	Easting: 366638 mE	Northing: 6513487 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR47	Observers: Dr Scott Thompson
Zone: 50	Easting: 366621 mE	Northing: 6513469 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR48	Observers: Dr Scott Thompson
Zone: 50	Easting: 366614 mE	Northing: 6513431 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR49	Observers: Dr Scott Thompson
Zone: 50	Easting: 366654 mE	Northing: 6513422 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR50	Observers: Dr Scott Thompson
Zone: 50	Easting: 366675 mE	Northing: 6513441 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand	

Habitat Structure: Mixed open shrubland and heath on sand

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR51	Observers: Dr Scott Thompson
Zone: 50	Easting: 366686 mE	Northing: 6513394 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR52	Observers: Dr Scott Thompson
Zone: 50	Easting: 366717 mE	Northing: 6513395 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR53	Observers: Dr Scott Thompson
Zone: 50	Easting: 366736 mE	Northing: 6513385 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR54	Observers: Dr Scott Thompson
Zone: 50	Easting: 366733 mE	Northing: 6513358 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Date: 29-Aug-19	Habitat Assessment #: TR55	Observers: Dr Scott Thompson
Zone: 50	Easting: 366767 mE	Northing: 6513371 mN
Landform: Flat	Fire History: > 5 years	Habitat Quality: Good to Poor
Soil Type: Sand	Surface: Sand and limestone	

Habitat Structure: Mixed closed shrubland over sand and limestone

TERRESTRIAL ECOSYSTEMS

Appendix F

Two Rocks Archaeological Report (Terra Rosa Consulting 2020)

(Note that this report contains sensitive information. A request can be made to the City of Wanneroo to obtain a copy of this document by sending a request to foi@wanneroo.wa.gov.au).

TERRA ROSA
CONSULTING

Archaeological Site Identification survey of the proposed Two Rocks Beach Access, commissioned by Heritage Link and prepared for the City of Wanneroo

REPORT

Brittany Murray

June 2020

Acknowledgement of Country

Terra Rosa acknowledge the Whadjuk Noongar people, who are the Traditional Custodians of the Country described in this document, and who are the Traditional Custodians of the Country in which Terra Rosa's office is situated.

We pay our respects to their Elders past, present, and emerging, and to their continuing cultural and spiritual connections to their lands.

https://www.reconciliation.org.au/

EXECUTIVE SUMMARY

Archaeological site identification

Clearing Area

Floral Survey Area

Survey dates

28 May 2020

Heritage Link commissioned Terra Rosa Consulting (Terra Rosa) on behalf of the City of Wanneroo to undertake a site identification heritage survey over areas planned for development within the Whadjuk native title claim area (WC2011/009). The heritage survey was undertaken with the endorsement of South West Aboriginal Land and Sea Council (SWALSC), who are the representatives for the Whadjuk Traditional Owners.

The survey was undertaken on the 28 May 2020 by one heritage consultant from Terra Rosa. Due to COVID-19 the South West Aboriginal Land and Sea Council (SWALSC) declined the opportunity to attend the heritage survey and recommended that Aboriginal Consultants be involved in monitoring any areas that are considered at risk. As such, the Archaeological Survey was undertaken with no Whadjuk Traditional Owners present.

The disturbance area was subject to intensive pedestrian transects by a Terra Rosa archaeologist and revealed no aboriginal cultural heritage present within the area. The adjacent 'floral survey' area is also considered likely to be clear of aboriginal cultural heritage due to the results of spot inspections and its proximity and consistency in landform and vegetation to the 'Clearing Area'. The entire area is therefore considered clear for works to proceed, provided that Whadjuk monitors are invited to attend.

Based on the results of the survey and consultation with the Traditional Owners, the following recommendations are made:

1. The City of Wanneroo is advised that the archaeological heritage survey of the 'Clearing Area' is complete and the area is clear of archaeological heritage material.

2. The City of Wanneroo is advised that the 'Floral survey area' is considered likely to be clear of archaeological heritage material due to its proximity to 'Clearing Area'.

3 The City of Wanneroo is advised that no ethnographic heritage survey is required by SWALSC.

4 The City of Wanneroo is advised to have Whadjuk Traditional Owners present to monitor all ground disturbing works.

5 All employees and contractors working within the Two Rocks Beach Access area must restrict access and works to areas that have been subject to heritage survey.

6 If the City of Wanneroo proposes to alter the type of works or to expand their program of works, either in size or scale, beyond what was subject to the heritage survey, it is advised that further consultation with the Whadjuk Traditional Owners should be undertaken prior to the commencement of works.

PROJECT INTRODUCTION

The City of Wanneroo intends to use land within the Whadjuk native title claim area (WC2011/009) to construct a beach access to Two Rocks beach.

To minimise the likelihood of breaching the *Aboriginal Heritage Act 1972 (WA)* (the Act), Heritage Link on behalf of City of Wanneroo commissioned a site identification heritage survey over the areas planned for development. These included a Clearing Area where ground disturbing works would take place and a Flora Survey Area which included the surrounding area.

City of Wanneroo's project area is located along Two Rocks Rd between Gage St and Blaxland Ave. The project area extends approximately 400 metres southwest from the road down to the beachfront.

Survey participants

The heritage survey was conducted on the

28 May 2020

by one Terra Rosa consultant.

On behalf of the City of Wanneroo, Heritage Link engaged Terra Rosa Consulting (Terra Rosa) to conduct an archaeological site identification survey of the area requested.

As the representative for the Whadjuk Traditional Owners, South West Aboriginal Land and Sea Council (SWALSC) has recommended that Aboriginal Consultants are not involved with heritage surveys at this stage, providing they be given the opportunity to monitor ground disturbance of any risk areas. As such, Terra Rosa undertook the Archaeological Survey without any Traditional Owners present.

The heritage survey was carried out by Brittany Murray of Terra Rosa on the 28 May 2020:

Contact details for the survey participants are provided in Appendix A of this report.

Map 1: Heritage survey overview map

Whadjuk people

WC2011/009

Major towns

Perth

Fremantle

Guildford

Armadale

Key waterways

Swan River

Canning River

WHADJUK COUNTRY

The Whadjuk People native title application (WC2011/009) is in the Southwest region and includes the Perth metropolitan area and Fremantle. The claim is bordered to the north by the Yued, to the east by the Ballardong People and to the south by the Gnaala Karla Booja. It sits within the Swan Coastal Plain bioregion that runs from the city of Perth to Cape Naturaliste in the south. The primary geographic feature of this bioregion is the Swan River and prior to European settlement, the coastal plain comprised a series of freshwater wetlands.

The Swan and Canning Rivers hold great significance to the Noongar people, as they are believed to have been created by the rainbow serpent or Waugal, a dreamtime being in the form of a giant snake. In the dreamtime story the Waugal created creeks, waterholes, lakes and valleys on its journey to the ocean from Mt Eliza, including the Swan River (Hughes-Hallett 2010: 4, 11). Waugal are inherently linked to the Dreamtime responsible for creating the landscape and water sources (Shaw & Martin 2011: 53). Permanent water sources continue to be of high cultural importance, indicating the health of country, which in turn reflects the health of culture (Barber & Jackson 2011).

The significance of the Swan River is reflected in the ongoing visitation and association with the river system by Noongar people, whose physical and spiritual wellbeing is viewed as being directly linked to such water sources. Hughes-Hallett (2010: 13) notes that, “the condition of the rivers is directly related to the well-being of the Waugal, and both are interconnected with the health and well-being of Noongar cultural identity. It is thought that if the Waugal leaves or is killed, then the rivers and other water features with which it is connected will dry up, subsequently the processes of rejuvenation, with which it is linked, will cease to occur”.

The knowledge and use of various plants and animals by the Noongar people that occupy the region is indicative of the inherent ongoing connection they have to country. Reflecting the importance to the health, safety and survival of the Noongar people and their Whadjuk people WC2011/009 Major towns Perth Key waterways

Swan River Canning River 10 environment, people, water, plants and animals form part of the order of all forms of cultural and spiritual life (Nannup 2011).

There are many important places in Whadjuk country where the Traditional Owners practice their traditional knowledge and ceremonies as well as to identify and navigate boundaries with neighbouring language groups. The term ‘Aboriginal site’ is used to identify places of importance and significance to Aboriginal people. This is based on the tangible and / or intangible cultural and heritage values contained within. Identified sites on country, based on the register of sites held by the DPLH (2019), include:

- Mythological sites associated with stories and songs;
- Ceremonial sites, including Law Grounds;
- Burial and birthing places;
- Domestic camping and hunting sites (characterised by artefact scatters, rockshelters containing cultural materials, grinding patches, modified trees, hunting hides, and storage places / walled niches); and
- Historical sites associated with the post-European Colonisation period.

Whadjuk country has been inhabited for a considerable period of time; the Upper Swan Bridge camping ground has been dated to 38,000 years BP (Pearce & Barbetti 1981). Prior to European settlement, the coastal plain comprised a series of freshwater wetlands the majority of which have been drained, filled or cleared since 1832. Two freshwater wetlands remain: Lake Monger and Herdsman Lake, which are of special significance to the Whadjuk Traditional Owners. Resources were often accessed via known tracks, concentrated on connecting permanent water sources. One such track went from Perth and followed the northern side of the river (through the modern suburb of Peppermint Grove) to North Fremantle, where it crossed the river and continued on to Bibra Lake. These crossings were used primarily in summer when the fish were in abundance and could be easily caught (Hughes-Hallett 2010: 11).

PROJECT METHOD

Site identification surveys aim to record any identified sites to a standard that enables the ACMC to make a fair assessment of them under sections 5 and 39 the Act.

The archaeological heritage survey of Clearing Area and Flora Survey Area was conducted to a site identification standard in accordance with section 18 (s18) requirements, and in line with the recommendations made in the Desktop Assessment previously conducted for the area (Major Oak 2019). The aims of a site identification survey are to:

1. identify Aboriginal sites (as defined under s5 of the Act) within the requested survey area;
2. document the heritage values of the site comprehensively enough to provide the Department of Planning, Lands and Heritage (DPLH) and the Aboriginal Cultural Materials Committee (ACMC) with a fair understanding of the site's importance and significance under s5 and s39 of the Act; and
3. provide City of Wanneroo with relevant and informed heritage management recommendations for heritage values identified within the requested survey area.

Legislation

Aboriginal Heritage Act 1972

Under section 17 (s17) of the Act, it is an offence to disturb an Aboriginal site without prior written Ministerial consent to do so under s16 or s18 of the Act. This applies regardless of whether an Aboriginal site is registered. Heritage assessments of proposed development areas are conducted to identify the location and extent of sites so that they can be appropriately managed in accordance with the legislative requirements of the Act.

A full copy of the Act can be accessed online.

Desktop method

Registered Aboriginal sites are heritage places that have been assessed by the ACMC as constituting **sites** under sections 5 and 39 of the Act.

Other heritage places include places for which data has been **lodged** with the DPLH but are pending assessment by the ACMC, and places that have already been assessed by the ACMC as not constituting an Aboriginal site under the meaning of the Act (listed as **stored data / not a site**).

A desktop assessment was completed before the start of the field survey to understand the extent of heritage research undertaken to date within the survey area. This research relies largely on the Register of Sites maintained by the DPLH, which is a catalogue of heritage places previously recorded within the area and submitted to the DPLH.

Before the start of the field work the scoped survey areas were entered into the DPLH's Aboriginal Heritage Inquiry System (AHIS) to learn whether any heritage surveys have previously been conducted and whether any registered Aboriginal sites or other heritage places (OHPs) exist in the area.

After the AHIS search has been completed, relevant site files and survey reports were requested from the DPLH for review. A detailed desktop assessment had also been completed previously by Major Oak Heritage Services, which was reviewed as part of this desktop assessment.

Any relevant site files were reviewed and summarised to provide the survey team with an understanding of the cultural landscape context of the survey area.

Survey method

Terra Rosa's heritage consultant conducted an intensive pedestrian inspection of the 'Clearing Area', and spot inspections of the 'Flora Survey Area' in order to identify any heritage places within the proposed development area. Any heritage places identified were recorded to site identification standard, as scoped.

View north-east across survey area

Coordinate capture

MGA Zone 50

All coordinates provided in this report and in the spatial data package accompanying it (Attachment 1) were obtained with a Garmin GPS unit connected to an Apple iPad, using the GDA datum. All grid references are projected in MGA Zone 50, unless otherwise stated. Dependent on external conditions, these units afford an optimal spatial accuracy of ± 5 m.

Report review

A draft version of this report was provided to Heritage Link, who then presented the report to SWALSC for comment. This process provides Terra Rosa with feedback which is considered during the final edit of the report.

SURVEY OUTCOMES

Survey area	Survey standard	Survey status	Survey results
Clearing Area	Site Identification	Complete	Clear
Flora Survey Area	Site Identification	Complete	Clear

Survey results

The Clearing Area was subjected to intensive pedestrian transects in order to identify any heritage places present within the development area and was deemed clear of surface heritage material. The survey area covered the dune system lying between the road and the beach and was heavily vegetated, resulting in low ground visibility throughout much of the survey area.

Several pedestrian and vehicle access tracks ran through the dunes, and some disturbance and rubbish left from campers or beachgoers was also evident throughout the area. The lack of surface expressions of archaeological material throughout the area unsurprising as it is a highly changing coastal dune environment. Due to the shifting nature of dune systems, any potential archaeological material within the area is likely to be subsurface.

Below: *View of survey area from highest point.*

Pedestrian access track running through both survey areas.

Due to the lack of any surface archaeological material within the Clearing Area and the continuity of vegetation and landform throughout the adjacent Flora Survey Area, this second area was only subject to spot inspections. It is highly unlikely that the Flora Survey Area has any surface expressions of archaeological material, with a potential for subsurface material being present.

View north from the beach across the survey area.

Both survey areas are deemed clear of surface archaeological material, however due to the potential for subsurface material and the lack of direct engagement with Whadjuk Traditional Owners during the heritage survey process, Terra Rosa recommends that Whadjuk Traditional Owners be present to monitor any ground disturbance activities undertaken in this area.

View from the road looking south west across survey area.

Rubbish present within survey area.

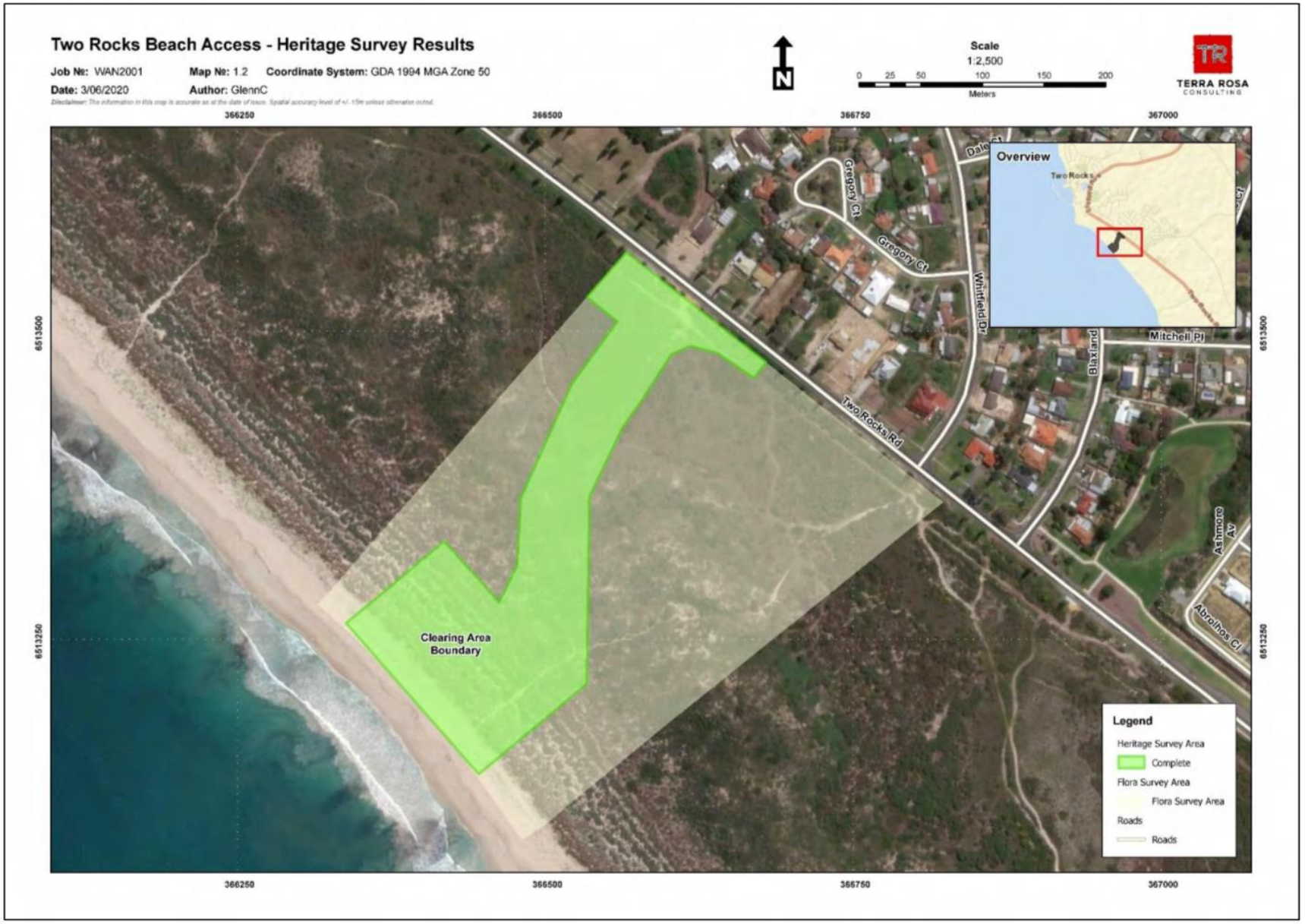
Data

The survey results presented below are also provided in the spatial data pack (Attachment 1) that accompanies this report.

Attachment 1:

TwoRocks Heritage Survey.shp

Map 2: Heritage Survey Results



HERITAGE MANAGEMENT RECOMMENDATIONS

Based on the survey outcomes, Terra Rosa has developed the following recommendations to assist City of Wanneroo with the management of the identified cultural heritage values in the area.

1 **The City of Wanneroo is advised that the archaeological heritage survey of 'Clearing Area' is complete and the area is clear of archaeological heritage material.**

The archaeological heritage survey of the 'Clearing Area' is complete and no Aboriginal cultural heritage was identified within the area. The City of Wanneroo is clear to proceed with the proposed works within the Clearing Area of the Two Rocks Beach Access project area.

2 **The City of Wanneroo is advised that the 'Floral survey area' is considered likely to be clear of archaeological heritage material due to its proximity to 'Clearing Area'.**

The 'Floral survey area' is considered likely to be clear of surface archaeological heritage material due to the results of spot inspections and its proximity and consistency in vegetation and landform to the 'Clearing Area'.

3 **The City of Wanneroo is advised that no ethnographic heritage survey is required by SWALSC.**

SWALSC has advised that the proposed works are not in an area of potential ethnographic significance and as no archaeological heritage material was present within the survey area, no ethnographic survey is required for the proposed development.

4 **The City of Wanneroo is advised to have Whadjuk Traditional Owners present to monitor all ground disturbing works**

As the project area consists of a mobile dune system, any archaeological material present is likely to be subsurface. The City of Wanneroo is advised to have Whadjuk heritage monitors present for all ground disturbance works in order to

restrict the potential impacts to cultural heritage that may be present below ground.

5 **All employees and contractors working within the Two Rocks Beach Access area must restrict access and works to areas that have been subject to heritage survey.**

It is an offence to disturb an Aboriginal heritage place without prior written consent under s16 or s18 of the Act. Financial penalties may be applied against individuals or corporations who disturb a heritage place, regardless of whether that place is catalogued by the DPLH or not.

To avoid a breach of s17 of the Act, the City of Wanneroo must clearly instruct all employees and contractors working within the Two Rocks Beach Access Project Area to restrict access and works to areas that have been subject to heritage survey, and to avoid impact to all heritage places in the area.

6 **If the City of Wanneroo proposes to alter the type of works or to expand their program of works, either in size or scale, beyond what was subject to the heritage survey, it is advised that further consultation with the Whadjuk Traditional Owners should be undertaken prior to the commencement of works.**

City of Wanneroo is advised that only the areas subjected to heritage assessment are clear for the proposed works to proceed. Should the program of works expand in size or scale, or should the City of Wanneroo wish to conduct activities that differ to those discussed during field work, the Whadjuk Traditional Owners will need to be engaged for further heritage assessment.

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APPENDICES

Appendix A – Project contacts

Appendix B - Acronyms and definitions

Appendix A – Project contacts

The contact details of the heritage project stakeholders are provided below. Terra Rosa thanks everyone involved with the heritage survey and its organisation.

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Report authors	Brittany Murray
Editor	Ben Fordyce
Executive sign-off	Scott Chisholm

City of Wanneroo

Contact	Patricia Edwards (Heritage Link)
Address	PO Box 117 North Perth WA 6906

Appendix B - Acronyms and definitions

The following terms and acronyms are used in this report. Definitions are provided below for reference.

Term / abbreviation	Definition
ACMC	Aboriginal Cultural Materials Committee
AHIS	Aboriginal Heritage Inquiry System
DPLH	Department of Planning, Lands and Heritage
GIS	Geographic information system
GPS	Global positioning system
Heritage object	An object to which the Act applies under section 6
Heritage site / Heritage place	Any place which may meet the criteria of an Aboriginal site under s5 of the *Aboriginal Heritage Act 1972 (WA).*
HISF	Heritage Information Submission Form
Isolated artefacts	Cultural material with insufficient density or context to constitute a site.
MGA	Map grid of Australia
NNTT	National Native Title Tribunal
Other Heritage Place	Other heritage places (OHPs) are heritage places classified by the DPLH as either: 1. A heritage place that has been reported to the DPLH but is pending assessment by the ACMC (status L – lodged; also see definition for 'potential site', below); or 2. A heritage place that has been submitted to the DPLH and evaluated by the ACMC to not meet the criteria for inclusion on the Register of Sites (i.e. not a registered Aboriginal site) (status S – stored / not a site).
Registered Aboriginal site	A heritage place which has been determined as meeting criteria under section 5 of the *Aboriginal Heritage Act 1972 (WA),* and has been registered by the Registrar of Aboriginal Sites (DPLH status R - registered).
SWALSC	South West Aboriginal Land and Sea Council
Terra Rosa	Terra Rosa Consulting
Traditional Owners	Whadjuk native title claimants (NNTT no WC2011/009) and invited participants
The Act	*Aboriginal Heritage Act 1972 (WA)*

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0.3	3/06/2020	Draft edited	B. Fordyce
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TERRA ROSA
CONSULTING

Appendix G

Two Rocks Beach Access Way Revegetation and Rehabilitation Plan (CoW 2022c)

CPS 9578/1
Two Rocks Beach Access Way

Revegetation and Rehabilitation Plan

May 2022

City of Wanneroo

Table of Contents

1. Introduction

The City of Wanneroo (CoW) is proposing to construct a beach access, access road and carpark within the boundaries of Lot 8613 on Deposited Plan 213232; Lot 8989 on Deposited Plan 213232; and Lot 15452 on Deposited Plan 40341, in Two Rocks. The project, the Two Rocks Beach Access (hereafter known as the TRBA), will be located in an area of 1.43 hectares of coastal vegetation that is situated in foreshore reserve, south of the Two Rocks Marina and bound by the Indian Ocean to the west and Two Rocks Road to the east (Figure 1 – delineated in red).

The CoW submitted a Native Vegetation Clearing Permit (NVCP) application to clear 1.43 hectares of coastal vegetation to the Department of Water and Environmental Regulation (DWER) for assessment (CPS 9578/1) on 31 January 2022. The NVCP application explicated that the proposed clearing area comprises of priority flora *Leucopogon maritimus* (Priority 1), *Beyeria cinerea subsp. cinerea* (Priority 3) and *Stylidium maritimum* (Priority 3), two priority ecological communities, Bush Forever area 397 and conservation significant fauna Quenda (*Isoodon fusciventer*) (Priority 4) and Black-striped Snake (*Neelaps calonotos*) (Priority 3).

DWER carried out a preliminary assessment of the application and on 28 March 2022 identified that:

- Due to the presence of the above mentioned sensitive receptors, evidence of additional efforts to avoid and/or mitigate the need for clearing are required to be provided; and
- That the area proposed to be cleared is entirely within Bush Forever area (BFA) 397 and that an offset package would need to be provided within Bush Forever 397, in accordance with the WA Environmental Offsets Policy (DWER, 2011) and Appendix 4 of State Planning Policy 2.8 (WAPC, 2010).

This Two Rocks Beach Access Rehabilitation and Revegetation Plan (the “RRP”) has therefore been developed to describe how each of the above will be achieved, as well as the rehabilitation and revegetation of an area of offset, as described below.

Figure 1: Location Plan of proposed works (land parcels outlined in red).

Figure 2: Clearing and Onsite Rehabilitation Plan

As advised by DWER officers on 28 March 2022; and in accordance with State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region (SPP 2.8) (WAPC, 2010); a 2:1 offset ratio is required to counterbalance the permanent removal of 0.65 hectares of native vegetation within Bush Forever site 397. As such, the CoW is proposing the following offsets:

- Revegetation of 0.87 hectares of areas disturbed during construction (0.78 hectares) and previously cleared (0.09 hectares) of the TRBA
- Transferring the vesting of Lots 10 and 8989 Two Rocks Road, Two Rocks, to the Crown under City of Wanneroo management and changing the reserve from Freehold to "Conservation and Passive Recreation" vesting to provide an environmental land offset for the permanently cleared areas.

In addition to the aforementioned, the purpose of the Two Rocks Beach Access Rehabilitation and Revegetation Plan (hereafter known as the RRP) is to guide the on ground works relating to the revegetation of 0.87 ha of areas disturbed during development of the TRBA. This revegetation and rehabilitation plan has been developed in accordance with 'A Guide to Preparing Revegetation Plans for Clearing Permits under Part V of the *Environmental Protection Act 1986*' (DWER, 2018).

This plan has been developed on behalf of the City of Wanneroo by Danielle Garrett, who is employed as the Environmental Asset Planner at the City of Wanneroo. This RRP was based on the Rehabilitation and Revegetation Plan previously submitted by the City as part of CPS 8807/1. Correspondence relating to the RRP should be addressed to:

Danielle Garrett
Locked Bag 1
Wanneroo WA 6946
Tel: 9405 5633
Email: Danielle.Garrett@wanneroo.wa.gov.au

The CoW undertake revegetation projects on an annual basis as part of their Capital Works programs and as a requirement of clearing permit conditions and Federal approvals and have internal resources providing expertise on completion criteria and onsite revegetation techniques. Most recent examples of rehabilitation and revegetation projects undertaken by the CoW include:

- The Mindarie-Burns Beach Dual Use Path – revegetation and rehabilitation activities to meet completion criteria under CPS 8820/3
- Maintenance and revegetation activities at Mather Reserve and Mary Street Reserve to satisfy conditions of EPBC 2007/3479
- Ongoing restoration of coastal and bushland sites under the City's Capital Works program, including weed control, fencing, rehabilitation, erosion control and revegetation.

2. Existing Environment

2.1 Land Tenure and Zoning

The proposed TRBA is located within three separate land parcels, all are zoned for Parks and Recreation under the Metropolitan Region Scheme. A summary of land tenure and zoning is provided in Table 1, below.

Table 1: Land tenure and zoning

Lot Number	Land Owner	MRS Zoning	Reserve Purpose
Lot 8613 on Deposited Plan 213232	Crown Land – COW Managed	Parks and Recreation	Public Recreation
Lot 8989 on Deposited Plan 213232	Western Australian Planning Commission	Parks and Recreation, Urban	N/A - Freehold
Lot 15452 on Deposited Plan 40341	Crown Land – COW Managed	Parks and Recreation, Waterways	Recreation and Purposes Incidental Thereto

The proposed land offset is located within two separate land parcels, which are zoned for Parks and Recreation under the Metropolitan Region Scheme. A summary of land tenure and zoning is provided in Table 2, below.

Table 2: Land tenure and zoning

Lot Number	Land Owner	MRS Zoning	Reserve Purpose
Lot 10 on Deposited Plan 28738	Western Australian Planning Commission	Parks and Recreation	N/A - Freehold
Lot 8989 on Deposited Plan 213232	Western Australian Planning Commission	Parks and Recreation	N/A - Freehold

2.2 Vegetation and Flora

The proposed clearing for the TRBA will initially facilitate the completion of an Unexploded Ordnance (UXO) remediation search; followed by a geotechnical survey to enable final design completion; and finally to facilitate the construction of a beach access and car park. The TRBA construction extent (1.43 hectares) lies within the biological survey area (12.68 hectares) and runs west-east across the Survey Area, as defined in Figure 2.

The City engaged One Tree Botanical to undertake a Level 2 Flora and Vegetation Survey (Appendix A), consistent with the Technical Guide Flora and Vegetation Surveys for Environmental Impact Assessment; Targeted and Detailed Surveys (EPA, 2016). The assessment occurred over two sampling periods, 13-16 September and 19-21 October 2019.

On 29 October 2020, Environmental Officers Danielle Garrett, Tenaha Wilson and Andrew Hawthorne inspected the potential offset site to adequately plan the rehabilitation of the site. During this inspection, it was identified that weed species *Thinopyrum distichium* was the sole species of the frontal dune of this area. Both species at the time were flowering and were distinguishable. This then prompted the City Officers to inspect the frontal dune of the previously surveyed TBRA site. It was then confirmed that the previously identified *Spinifex longifolius* within the frontal dune (Vegetation Type A1) was in fact weed species *Thinopyrum distichium*.

To further verify this, a further site inspection with the TRBA survey botanist (Kelli McCreery) was conducted on the 5th November and it was agreed that the relevant maps and information within the previously provided survey would be updated to reflect the species identification change.

No Threatened Ecological Communities (TECs) listed under the Western Australian *Biodiversity Conservation Act 2016* or the Federal *Environmental Protection Biodiversity Conservation Act 1999* were recorded in the study area.

McCreery (One Tree Botanical, 2020) found that there were challenges to assessing vegetation in this area due to the lack of a proper regional dataset of quadrat data in the Gibson et al. (1994) dataset from near-coastal and Quindalup Dune areas.

Despite this, the assessment was completed against the available information. From the assessment, it was noted that two Priority Ecological Communities (PECs), or variants of, occurred in the study area:

- **PEC SWAN 26**: “Northern Spearwood shrublands and woodlands” (FCT24) (Vegetation Type C) and woodlands
- **PEC SWAN 21**: “Coastal shrublands on shallow sands, southern Swan Coastal Plain” (FCT29a) (Vegetation Types B1 and D1).

“Coastal shrublands on shallow sands, southern Swan Coastal Plain (FCT29a)” is the largest represented PEC, with approximately 0.87 hectares occurring within the TRBA alignment, of which approximately 0.33 hectares occurs within the construction extent. Northern Spearwood shrublands and woodlands (FCT24) also occurs within the TRBA alignment (approximately 0.12 hectares), of which approximately 0.03 hectares occurs within the construction extent.

Six vegetation communities and cleared areas were mapped within the Survey Area (One Tree Botanical, 2020) which forms part of a coastal mosaic, typical of dune systems. The vegetation types included one grassland and five shrublands.

Seven vegetation types were recorded within the study area:

- Low-Lying Primary Dunes on Unconsolidated Sand A1: Incipient Foredune (younger): Uniform regrowth of Grassland **Thinopyrum distichum* (0.137 ha)
- Low-Lying Primary Dunes on Unconsolidated Sand A2: Established Foredune (older): Sparse Shrubland *Olearia axillaris* over Grassland *Spinifex longifolius* and **Thinopyrum distichum* (0.243 ha)
- Low-Lying Primary Dunes on Unconsolidated Sand A3: Beach-ridge Plain: Open Shrubland *Olearia axillaris*, *Rhagodia baccata* subsp. baccata and **Pelargonium capitatum* over Sparse Grassland *Spinifex longifolius* and Sparse Vineland *Cassytha flava var. flava* (0.67 ha)
- Tall Secondary Dunes On Unconsolidated Sand B1: Shrubland dominated by *Acacia cyclops*, *Scaevola crassifolia*, *Spyridium globulosum*, *Santalum acuminatum*, *Myoporum insulare*, *Olearia axillaris*, *Rhagodia baccata subsp. baccata* and *Acanthocarpus preissii*, Sparse Vineland *Hardenbergia comptoniana* and *Cassytha flava var. flava*. Over Forbland dominated by *Senecio pinnatifolius var. latilobus* (1.18 ha)
- Low Dunes On Semi-Consolidated Sand C1: Species rich low Shrubland dominated by *Melaleuca systena* and species rich Forbland dominated by *Lomandra maritima* and Sparse Sedgeland *Lepidosperma calcicola* and Sparse Rushland *Desmocladus asper* (0.291 ha)
- Low Rises With Limestone Outcropping D1: Closed Shrubland *Melaleuca cardiophylla* with other typical shrubs *Melaleuca huegelii*, *Acacia xanthina* and *Dodonaea aptera* with Sparse Vineland *Cassytha aurea var. aurea* over Forbland of native and introduced herbs (0.97 ha)
- Cleared Areas E1: Historically cleared areas; informal walking paths, informal vehicular sand tracks (unused and partially overgrown) (0.182 ha).

Of these, B1 is the most commonly represented vegetation community within the TRBA alignment.

Vegetation type A1 consists entirely of weed species, dominated by **Thinopyrum distichum* (Sea Wheatgrass) on the primary fore dune. From aerial imagery, it appears the species may have either emerged or been planted in the 1990s (Landgate, 2022), when it was commonly used as a rehabilitation species to stabilise dunes (Dixon, 2011). This species will be retained in the TRBA within vegetation type A1 (and where it has proceeded into the A2 vegetation community) to ensure ongoing dune stabilisation, however it will not be replanted as a revegetation species. Infill planting and weed management will occur in a gradual ongoing basis to ensure that the dune stabilisation continues with an eventual overall improved outcome of the diversity in the A2 vegetation area.

Photos and further information for each of the vegetation types in the area proposed to be cleared are provided in Section 5.2.2 of the Flora and Vegetation Survey (Appendix A). Figures 3 and 4 illustrate the vegetation type and vegetation condition of significant flora within the survey area, respectively.

The condition of vegetation mapped within the TRBA alignment ranged from Degraded to Very Good - Excellent, with the majority mapped as Very Good based on the South West Botanical Province (EPA, 2016) and Bush Forever (Keighery, 1994 from Govt. of WA, 2000) vegetation condition scale (Figure 4).

A total of 160 flora species were recorded were recorded from the study area, of which 100 or 63% were natives.

Three Priority Flora species were recorded within the study area:

- *Leucopogon maritimus* (Priority 1);
- *Beyeria cinerea subsp. cinerea* (Priority 3); and
- *Stylidium maritimum* (Priority 3).

Figure 5 illustrates the location of significant flora species within the survey area.

Priority Flora is not common in near coastal areas and three in a single near-coastal vegetation type is unusual. This is an unusually high number for a very small 12.68 hectare near-coastal area. All three species were dominant species within a small area of a single vegetation type (Vegetation Type C - Figure 3) (One Tree Botanical, 2020).

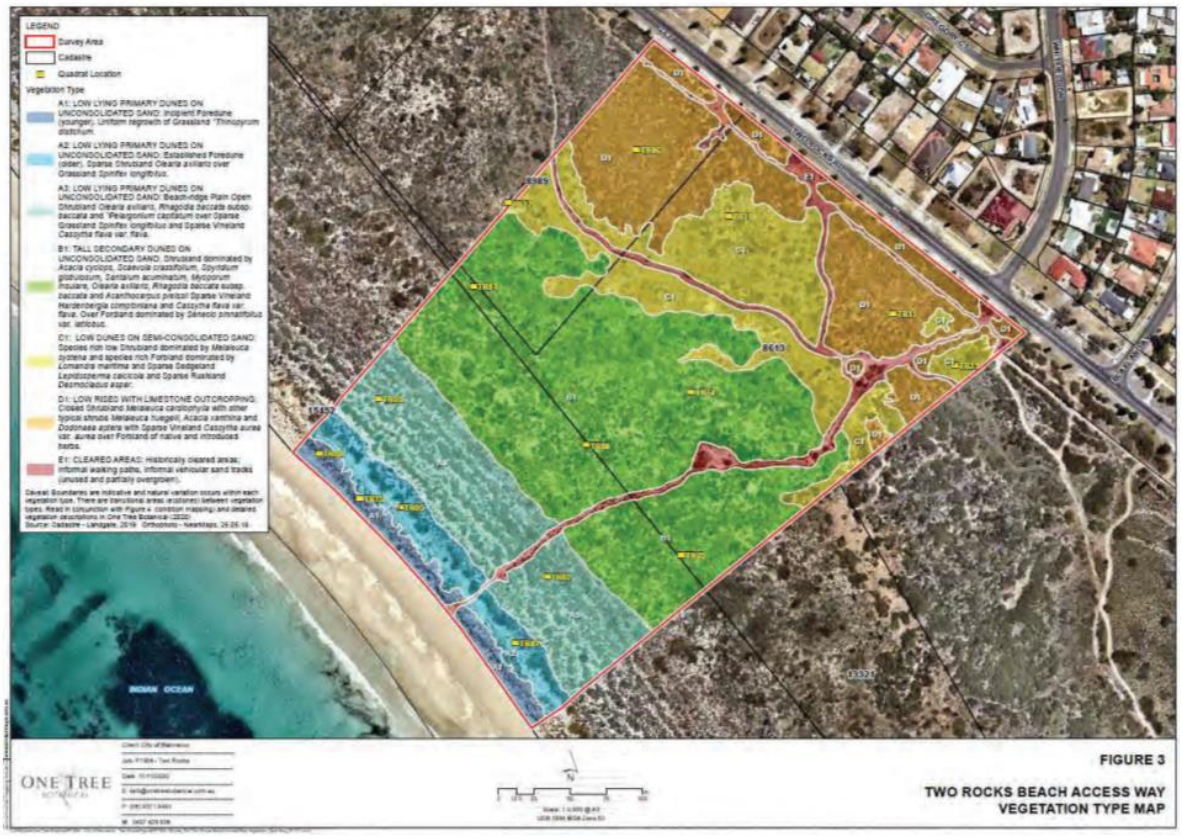


Figure 3: Two Rocks Beach Access Way – Vegetation Type Map (Source: One Tree Botanical (2020))

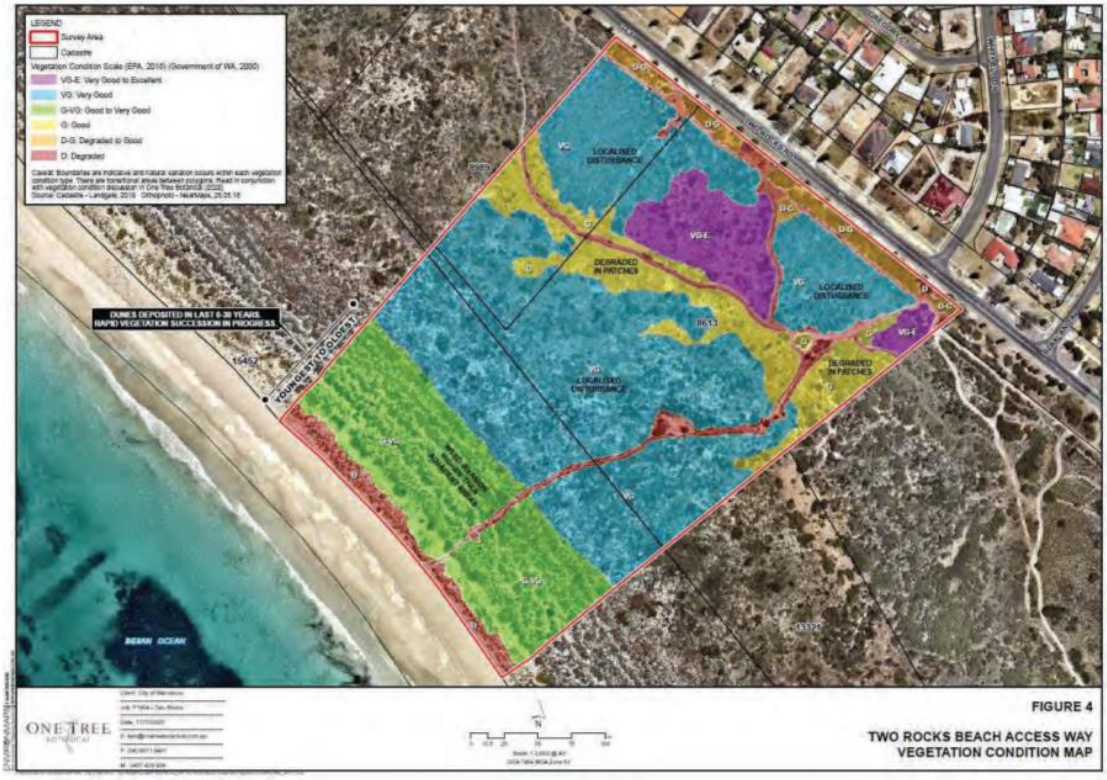


Figure 4: Two Rocks Beach Access Way – Vegetation Condition Map (Source: One Tree Botanical (2020))

Figure 5: Two Rocks Beach Access Way – Priority Flora Locations (Source: One Tree Botanical (2020))

2.3 Hydrology

A review of the Wetlands of the Swan Coastal Plain feature maps (in the WALGA EPT (2020)) identified that there are no surface water expressions within the immediate area of the TRBA. The closest wetland is Loch McNess, a Conservation Category Wetland located approximately 6 km south east of the sites (WALGA, 2020).

Depth of the ground water ranges from between 19 m below ground level in the east to 3 m in the west (DWER, 2022). The groundwater salinity levels are considered 'marginal' with TDS levels 500 - 1000mg/L (DWER, 2022).

2.4 Fauna

A Basic Fauna Survey of the TRBA (Appendix B) was undertaken by Terrestrial Ecosystems (2020a) on 29 August 2019. Results of the survey found that the survey area comprises of three main habitat types (Terrestrial Ecosystems, 2020a), including:

- Coastal low heath on sand;
- Mixed open shrubland and heath on sand; and
- Mixed closed shrubland over sand and limestone.

Some of the site was described as highly disturbed or cleared, providing no habitat value.

The three main habitat types that occur within the survey area also occur within the TRBA alignment and construction extent. Mixed open shrubland and heath on sand is the most common fauna habitat, with 6.22 ha occurring within the TRBA survey area. The remaining TRBA survey area extent comprises of Mixed closed shrubland over sand and limestone; Coastal low heath on sand and highly disturbed areas with 1.973 ha, 1.915 ha and 0.302 ha, respectively.

A desktop study against the DBCA Schedule/Priority species found that 15 conservation significant fauna species may occur within the area, however Terrestrial Ecosystems (2020) commented that only seven of these may occur within the Study Area, including;

- Quenda (*Isoodon fusciventer*);
- Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*);
- Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*);
- Fork-tailed Swift (*Apus pacificus*);
- Osprey (*Pandion haliaetus);*
- Peregrine Falcon (*Falco peregrinus); and*
- Black-striped Snake (*Neelaps calonotos)* (Terrestrial Ecosystems, 2020a).

Only the Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) was recorded by Thompson during field observations during the TRBA survey (Terrestrial Ecosystems, 2020a).

During the site inspections conducted by the CoW Officers on 29 October 2020, two species were observed -

- Red-capped Plover (*Charadrius ruficapillus*) – adjacent to the TRBA alignment on the beach; and
- A White-bellied Sea-Eagle (*Haliaeetus leucogaster*), hunting and soaring south of the TRBA alignment.

3. Site History

3.1 Indigenous and European Heritage

A desktop study of the immediate areas of the TRBA alignment indicated no sites of Cultural or Indigenous heritage value.

3.2 Land Use

The suburb of Two Rocks is named after two prominent rocks located offshore from Wreck Point. With the adoption of the State Government's Corridor Plan in 1970, extensive plans were made for the residential development of the Yanchep and Two Rocks area. In 1969, the Bond Corporation Pty Ltd purchased 19,600 acres of pastoral property, previously owned by the Wydgee Pastoral Company, and proceeded to develop Yanchep Sun City as a satellite city and premier tourist resort in Western Australia (State Heritage Office, 2020).

Residential development was well underway in 1972, followed by a marina in 1973/74 and a shopping and recreation centre at Two Rocks. The Two Rocks Marina was developed by Alan Bond as a training base for Australia's challenge of the America's Cup and to provide facilities for recreational boating and for the local fishing industry. Many of the streets in Two Rocks are named after yachts from America's Cup challengers (State Heritage Office, 2020).

In 1981, following an announcement by the WA Government, work began on the construction of Atlantis Marine Park with a $20 million budget over five years. As well as a tourist destination the park was to be used to research marine life. Sun City Pty Ltd was granted a licence by the Department of Fisheries and Wildlife to catch and keep local dolphins. A feature of the park was the 10 metre sculpture of King Neptune designed by local artist Mark Le Buse. The opening of the park was held on 26 December 1981 and by 1982 over one million visitors went through the gates. The park closed in 1990. The King Neptune statue still remains in the locality of Two Rocks near the Two Rocks Shopping Centre (State Heritage Office, 2020).

Prior to the residential development of Two Rocks in 1972, aerial imagery identifies the land in the immediate vicinity of the TRBA alignment to be in a more degraded condition than today (Landgate, 2022). Over the years, the disturbance in this local area has actually decreased (Figure 6). This may be due to previous land uses such as pastoral activities and vehicle access being more intense in this area during the 1970s and 1980s. Recent years have meant that access is now more restricted and access to the general public is now not only unauthorised but also more difficult with deterrents such as fencing and large boulders to discourage unauthorised vehicles.

The survey area of the TRBA was noted to be a relatively intact area of natural vegetation with the following observations (One Tree Botanical, 2020):

- An old vehicle track was present and surrounded by comparatively disturbed vegetation;
- A corridor had been historically cleared for a powerline;
- An informal pedestrian track is present from Two Rocks Road to the beachfront; and
- The beachfront is currently utilised for recreational purposes.

The Survey Area is a part of a much larger Unexploded Ordinance (UXO) Area: Yanchep Two Rocks Artillery Range (ID: 1035) (Department of Defence, 2020). After WWII the broader area

was used by Armed Forces for target practice. As the area is known for its military history, the CoW has committed to conducting UXO searches as part of the TRBA to ensure that the potential risk of UXO is eliminated. A UXO search will be conducted in all areas of the potential construction site for the TRBA.

Figure 6: Historical aerial imagery of the TRBA on 7 June 1977 and 22 February 2022 (Landgate 2022).

4. Potential Impacts

Threats that have the potential to impact on the TRBA project include:

- Loss of priority flora species
- Death or injury of fauna
- Feral animals
- Weeds
- Rubbish
- Unauthorised access
- Fire
- Pathogens and disease.

Details of these threats are discussed below, with suggested mitigation actions, responsibilities and compliance criteria provided with the schedule, in Table 7.

4.1 Loss of Priority Flora Species

As mentioned in Section 2.2.1 and illustrated in Figure 5, three Priority Flora species were recorded within the study area:

- *Leucopogon maritimus* (Priority 1)
- *Beyeria cinerea subsp. cinerea* (Priority 3)

- *Stylidium maritimum* (Priority 3).

This number of priority species in one vegetation type (Vegetation Type C1) and within a small near-coastal area is uncommon and therefore significant (One Tree Botanical, 2020). It is imperative that any impacts to these species are minimised.

To ensure that the impact to these species was minimised, the original alignment of the path was moved to ensure that the minimum number of species would be impacted. This has now been reduced to four individual plants of *Beyeria cinerea* subsp. *cinerea* (Priority 3). The City has had previous success in the salvage of various species at Hardcastle Park, Landsdasle, and Mather Reserve, Neerabup and we anticipate partial success for the salvage of these four individual plants. The City will endeavour to salvage these four individual plants using a professional revegetation nursery and install them into the revegetation area, however, the success of this cannot be guaranteed. .

In addition to this, the remaining Priority species will be identified and clearly demarcated, prior to any work commencing in the area, i.e. UXO search and construction. The preservation and importance of these species will be communicated in awareness sessions to all key personnel involved in the project. The individual species will be checked for intact demarcation and photographed to ensure they are not impacted. This will occur at the following stages of the project:

- Prior to the UXO search
- Prior to construction
- After construction and revegetation of the battered surfaces.

All records of these checks will be maintained and is scheduled into the Project Schedule, as per Table 7.

4.2 Fauna Management

As mentioned in Section 2.4, several conservation species occur within the TRBA survey area (Appendix B) (Terrestrial Ecosystems 2020a), including;

- Quenda (*Isoodon fusciventer*)
- Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*)
- Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)
- Fork-tailed Swift (*Apus pacificus*)
- Osprey (*Pandion haliaetus*)
- Peregrine Falcon (*Falco peregrinus*)
- Black-striped Snake (*Neelaps calonotos*).

The City will ensure the potential impacts of fauna are managed through the following measures:

- Awareness sessions - The conservation and importance of fauna species will be communicated to all key personnel involved in the project and as part of the induction process, including speed limits to reduce the risk of fauna fatality;

- The importance of the allowing fauna to safely move on during construction and clearing will be communicated. Where species are unable to safely move on, a qualified wildlife handler will be called to relocate the species; and
- A wildlife carer will be immediately called to remove and rehabilitate any injured fauna and reported to the Project Manager within 24 hours of the event occurring.

4.3 Feral Animals

Although the Matters of National Environmental Significance (MNES) database search identifies previous records of the Chuditch (*Dasyurus geoffroii*), Woylie (*Bettongi penicillata*) and Western Ringtail Possums (*Pseudocheirus occidentalis*) in the study area, these species are no longer present due to destruction of habitat and predation by feral animals, such as foxes and cats (Terrestrial Ecosystems, 2020). Feral animals compete with native animals for food and habitat, and have a dramatic effect on fragile ecosystems (Jones & Parish, 2008).

A high abundance of rabbits and medium abundance of foxes and cats were noted in the fauna survey (Terrestrial Ecosystems, 2020a). Whilst foxes and cats predate small mammals, the rabbit competes with native fauna for food and destroys natural habitat. This can be particularly devastating when trying to establish new vegetation. To mitigate the potential impacts of feral animals, the TRBA project will be included in the City's feral animal control program.

4.4 Weeds

Weed species were identified as part of the TRBA Flora survey (One Tree Botanical, 2020). One Tree Botanical (2020) observed 60 weed species, which mainly occurred adjacent to the existing tracks and disturbed area (Vegetation Type E1). Table 3 summarises these species and their priority for management according to the level of invasiveness and spread as environmental weeds under the Western Australian Environmental Weed Strategy (WAEWS) (Department of Conservation and Land Management, 1999).

Nine weed species were rated high, with 30 species recorded as a Moderate rating.

Table 3: Introduced species and priority for management recorded within the TRBA Study Area (One Tree Botanical, 2020).

Species	Common name	Priority for Management
**Brassica tournefortii*	Mediterranean Turnip	High
**Bromus diandrus*	*Great Brome*	*High*
**Eragrostis curvula*	*African Love Grass*	*High*
**Euphorbia terracina*	*Geraldton Carnation Weed*	*High*
**Hyparrhenia hirta*	*Tambookie Grass*	*High*
**Lagurus ovatus*	*Hare's Tail Grass*	*High*
**Lupinus cosentinii*	*Blue Lupin*	*High*
**Pelargonium capitatum*	*Rose Pelargonium*	*High*
**Romulea rosea*	*Guildford Grass*	*High*
**Aira cupaniana*	*Silvery Hair Grass*	*Moderate*
**Arctotheca calendula*	*Cape Weed*	*Moderate*
**Arctotheca populifolia*	*Dune Arctotheca*	*Moderate*
**Avena barbata*	*Wild Oats*	*Moderate*
**Bellardia trixago*	*Bellardia*	*Moderate*
**Briza maxima*	*Blowfly Grass*	*Moderate*
**Briza minor*	*Shivery Grass*	*Moderate*
**Cakile maritima*	*Sea Rocket*	*Moderate*
**Crassula glomerata*	*stonecrops*	*Moderate*

**Cuscuta planiflora*	*Dodder*	*Moderate*
**Cynodon dactylon*	*Couch Grass*	*Moderate*
**Dischisma arenarium*	-	*Moderate*
**Ehrharta brevifolia var. cuspidata*		*Moderate*
**Ehrharta longiflora*	*Annual Veldt Grass*	*Moderate*
**Euphorbia paralias*	*Sea Spurge*	*Moderate*
**Euphorbia peplus*	*Petty Spurge*	*Moderate*
**Galium murale*	*Small Goosegrass*	*Moderate*
**Gladiolus caryophyllaceus*	*Pink Gladiolus*	*Moderate*
**Heliophila pusilla*	-	*Moderate*
**Hypochaeris glabra*	*Flatweed*	*Moderate*
**Lysimachia arvensis*	*Pimpernel*	*Moderate*
**Melilotus indicus*	*Indian Sweet-clover*	*Moderate*
**Parentucellia latifolia*	*Common Bartsia*	*Moderate*
**Rostraria cristata*	*Mediterranean Hairgrass*	*Moderate*
**Schinus terebinthifolia*	*Japanese Pepper Tree*	*Moderate*
**Sonchus oleraceus*	*Common Sowthistle*	*Moderate*
**Tetragonia decumbens*	*Sea Spinach*	*Moderate*
**Thinopyrum distichium*	*Sea Wheatgrass*	*Moderate*
**Trifolium campestre var. campestre*	*Hop Clover*	*Moderate*
**Vulpia myuros forma megaleura*	*Rat's Tail Fescue*	*Moderate*

There are no Declared Pest species recorded from the WA Organism List (WAOL) under the *Biosecurity and Agriculture Management Act 2007* or Weeds of National Significance (WONS) in the TRBA study area.

4.5 Rubbish

Dumping of waste is a common occurrence throughout bushland reserves and parks in residential areas in the CoW. The dumping of lawn clippings and garden waste can lead to weed infestation and plant disease. There was no record of rubbish dumping during either the flora or fauna surveys (One Tree Botanical, 2020; Terrestrial Ecosystems, 2020a).

4.6 Unauthorised Access

Aerial imagery indicates that there has been an ongoing issue with 4WD tracks from as early as 1970 (Landgate, 2022). This may have also resulted from the pastoral land use activity that occurred in these areas in the 1970-80s. This would have exacerbated the erosion to the pre-existing blowouts and damage to the vegetation around these tracks, which is evident in historical aerial imagery and appeared to be an increasing footprint in vehicle tracks and degraded areas until approximately 1990. The overall condition of the TRBA appears to have actually improved since this time, evident by aerial imagery (Landgate, 2022) (see Figure 6), where the vehicle tracks and large degraded areas in the area appear to have commenced restoration, either naturally or through rehabilitation efforts.

Development of surrounding areas in recent years has meant that access is now more restricted. Access to the general public is not only unauthorised but also harder to access, with deterrents such as fencing and large boulders to discourage unauthorised vehicles.

The City of Wanneroo and the adjacent developers have historically mitigated unauthorised vehicles in the foreshore areas through various mechanisms such as fencing, CCTV surveillance, blocking of paths with large boulders, signage and public communications relating to the potential impacts and fines that may be imposed for offenders.

4.7 Fire

Fire has the potential to alter the structure, density and composition of natural areas (WALGA, 2004). Fire rarely occurs in the primary coastal dunes due to the higher water content, salt coated debris and bare sanded areas that lack sufficient combustible dry matter and surface litter to act as an ignition source (Dixon, 2011). Fire is therefore not likely to occur in most of the A1 - A3 vegetation types of the TRBA.

Fire history was assessed as part of the flora survey and was observed in each of the quadrats, with the vegetation displaying signs of fire occurring in excess of ten years (One Tree Botanical, 2020). Fire in the adjacent area of the TRBA had occurred approximately five years ago (Figure 7), according to the DFES historical data accessed from the CoW's Intramaps, (CoW Intramaps, 2022).

Figure 7: Historical fire (within the land parcel hatched orange) adjacent to the Two Rocks Beach Access (TRBA).

4.8 Phytophthora

Phytophthora is a plant pathogen that presents a significant threat to the health of ecosystems on the Swan Coastal Plain, affecting more than 40% of the native plant species and half of the endangered species in the south-west of Western Australia. There are several species of *Phytophthora*, but *Phytophthora cinnamomi* is the most widespread and destructive (DBCA, 2020). Dieback is a symptom of a *Phytophthora* sp. infection, killing vegetation because it prohibits the plants' ability to take up the water and nutrients. Dieback can be spread through

various vectors, including; soil, footwear, vehicles, machinery and equipment. It can devastate bushland by removing particular plants and changing the nature of the landscape, possibly driving rare species toward extinction (DBCA, 2020).

A common myth is that *Phytophthora* does not occur in coastal areas due to suppression by calcareous materials, such as limestone, due to its high pH. Whist this is true for *Phytophthora cinnamomi*, it is not the case for other species of *Phytophthora*, such as *Phytophthora multivora* and one or more of the currently undescribed *Phytophthora* species (Scott *et al*., 2009). *Phytophthora multivora* is widely distributed, has a wide host range and is associated with deaths of tuart and other species on calcareous soils (Conservation Commission of WA, 2010). A lot more research is needed for this and other species of *Phytophthora* however it is no longer accepted that the use of limestone, or the presence of limestone in a natural landscape, prohibits the pathogen and thus normal dieback processes should be applied including checking limestone bases for the pathogen and ensuring that all standard dieback management practices are adhered to.

Potential dieback was not indicated in the 2019 biological surveys for the TRBA (One Tree Botanical, 2020, Terrestrial Ecosystems, 2020a) however, a formal dieback assessment has not been undertaken as the risk of *Phytophthora* sp. to be present within this area is low. Potential exists for *Phytophthora* sp. and other potential pathogens (such as *Armillaria luteobubalina*) to be introduced as part of the construction process, but standard dieback and vehicle hygiene measures are considered appropriate to mitigate this risk. No significant impact is anticipated related to dieback from the TRBA project, either directly or indirectly.

5. Revegetation Commitments

Vision: The revegetation and rehabilitation will ensure that disturbed areas cleared during development of the TRBA are revegetated and rehabilitated to ensure the conservation values of the Two Rocks foreshore are protected and managed.

Objectives: The main goals of the revegetation plan include:

- Revegetate disturbed areas with local provenance species
- Protect the environmental values surrounding the alignment of the Two Rocks foreshore area
- Manage high priority weed infestations within the revegetation area.

6. Reference Site Floristic Data

Reference site floristic data from quadrats sampled within the TRBA alignment (One Tree Botanical, 2020), the Offset site vegetation assessment (Appendix C) and opportunistic observations have been used to establish the appropriate targets and completion criteria for each vegetation community type for both sites.

The northern and southern batters on either side of the TRBA construction extent will be revegetated with six different types of vegetation units, as represented in Table 4, identified in the Biological Report (One Tree Botanical, 2020) and shown in Figures 3 and 13. Quadrats were selected as reference sites within each vegetation community, to represent the floristic composition within these different vegetation types. These reference sites will be used as a

baseline to assess the future success of the revegetation. The relevant reference sites for each vegetation site and areas of both the northern and southern batters are identified in Table 4 and illustrated in Figure 8.

Table 4: Vegetation Type Reference Sites

Vegetation Type	Relevant Reference Sites within TRBA	Revegetation Area North Batter in TRBA (ha)	Revegetation Area South Batter in TRBA (ha)
A2	TR01, TR05	0.000	0.0119
A3	TR02, TR03	0.0486	0.0747
B1	TR07, TR08, TR09, TR14	0.1261	0.1773
C1	TR12, TR10, TR13	0.0480	0.0574
D1	TR06, TR11	0.2596	0.0732

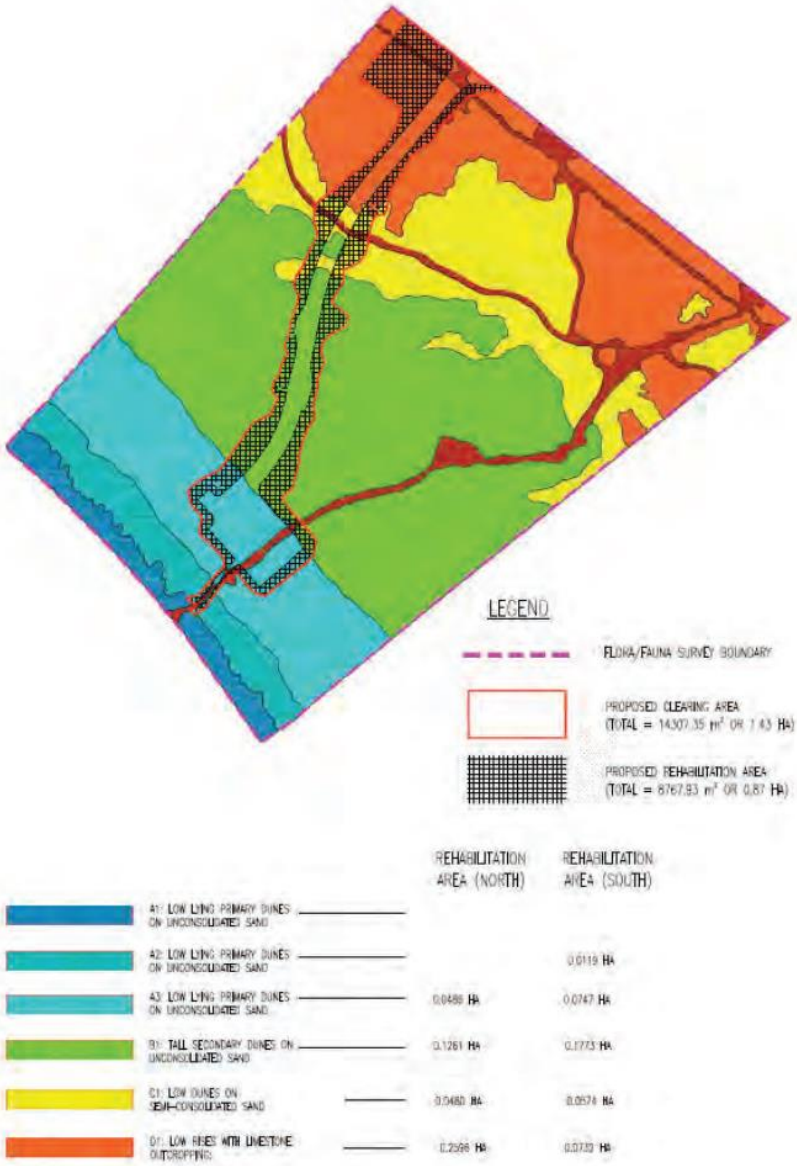


Figure 8: Rehabilitation area categorised by Vegetation types for the Northern and Southern batters, the Two Rocks Beach Access

Individual species lists have been developed for each of the rehabilitation areas in the TRBA in order to align with each of the different vegetation types. Whilst every effort has been made to replicate the species composition, the ratios vary slightly due to the practical challenges involved in recreating these vegetation types (i.e. ability to collect and/or propagate a species). The resulting revegetation species lists have therefore been slightly modified to ensure improved on-ground outcomes. These modifications are summarised for both sites in Table 5.

Table 5: Explanation of modifications to species lists to ensure improved rehabilitation outcomes

Reason for modification	Effected Vegetation Type TRBA
A dominant species in this vegetation type is a weed (*Thinopyrum distichium*). Replicating this species in the rehabilitation would not be a good ecological outcome, so the species has been omitted from the rehabilitation list. Removal of the species may result in erosion to the front dune and therefore will be left in place and other *Spinifex* sp. planted in bare areas adjacent. All other weed species (60 in total) will be managed rather than removed from both sites as the removal of these species may exacerbate erosion of the dunes.	A2
Orchid species (five in total) have been removed as they are too difficult to collect and propagate: *Caladenia latifolia* *Cyrtostylis huegelii* *Eriochilus d. subsp. dilatatus* *Leptoceras menziesii* *Microtis m. subsp. media*	A3 B1 C1 D1
Annual species are difficult to collect and propagate, however, the City will undertake an opportunistic collection of the below species and direct seed where possible: *Daucus glochidiatus* *Hydrocotyle hispidula* *Hydrocotyle pilifera var. glabrata* *Trachymene pilosa* *Hyalosperma cotula* *Leptorhynchos scaber* *Rhodanthe citrina* *Senecio vulgaris* *Isotoma hypocrateriformis* *Silene gallica var. gallica* *Crassula c. var. colorata* *Schoenus clandestinus* *Schenkia australis* *Triglochin isingiana* *Triglochin nana* *Poranthera microphylla* *Parietaria debilis* Moss	A3 B1 C1 D1
Opportunistic species have not been included as they are only minor species and not representative of the existing baseline data (i.e. quadrats): *Millotia myosotidifolia* *Podotheca gnaphalioides* *Allocasuarina l. subsp. lehmanniana* *Salsola australis* *Acrotriche cordata* *Tricoryne elatior*	ALL
The following species have not been included as it is too invasive and may outcompete other important establishing species: *Cassytha aurea var. aurea* *Cassytha flava* *Cassytha glabella forma. casuarinae* *Cassytha r. forma. racemosa*	C1
The following species have been included in the species list however it is not guaranteed that they will be able to be planted due to either their known difficulty in propagation and/or seed collection: *Beyeria c. subsp. cinerea* (P3) *Cryptandra mutila* *Drosera macrantha*	A2 A3 B1 C1 D1

Leptomeria preissiana *Leucopogon insularis* *Leucopogon maritimus* (P1) *Leucopogon parviflorus* *Lysinema pentapetalum* *Pelargonium littorale*	
Other minor species have not been included in the species list as it is more important to focus propagation on the more common species. These minor species are likely to regenerate however from the seed bank in the reserved topsoil: *Wurmbea monantha* *Rytidosperma occidentale* *Austrostipa flavescens* *Poa porphyroclados*	B1 C1 D1

7. Targets and Completion Criteria

This revegetation plan will be implemented over a three year period. The targets and completion criteria for the rehabilitation of the TRBA northern and southern batters are outlined in Table 6 and have been developed to meet the objectives of the RRP. Further detail and the timing of these actions are included in the schedule (Table 7).

Table 6: Completion criteria, targets and monitoring for areas of revegetation

Criterion	Baseline floristic data	Completion targets	Completion criteria	Monitoring
1	Species richness is the average number of species between the reference sites of each vegetation community.	Minimum of 50% of native vegetation species returned based on propagation capacity of species. Therefore revegetation areas shall have a minimum of 50% native species per quadrat, as obtained by the average recorded at the reference sites.	Species richness and number of plants / m^2 in revegetation areas shall have a minimum of 50% native species per quadrat, as obtained by the average recorded at the reference sites.	The species and number of plants / m^2 in the revegetation areas will be counted in years 2, 3 and 5.
2	% cover of weeds in quadrats of each vegetation community is 2% - 30%	Weeds are mostly absent from the quadrats. Considering external pressures (adjacent areas used for public recreation) a target of ≤10% has been established for the revegetation areas.	The revegetation areas must have % cover of ≤10% weeds.	Monitor revegetation areas in years 2, 3 and 5.
3	Survival rate of species to be achieved	If after year 2 and year 3 of planting, a survival rate of 2 plants/m^2 is not achieved, all planted tube stock that have not survived must be replanted within 12 months and monitored for a further 1 year.	The revegetation areas need to ensure a survival rate of no less than 2 plants/m^2 is achieved after three years, and replant any plants within 12 months of dying.	The number of surviving plants in revegetation areas will be counted in years 2, 3 and 5.
4	Rubbish is not present in dune environments.	Rubbish is absent from the revegetation areas.	The revegetation areas contain minimal rubbish.	Monthly asset inspections
5	Unauthorised access is minimised	Fencing is installed and maintained to prevent unauthorised access to the revegetation areas.	Fencing is maintained and there are no visible signs of vandalism and/or unauthorised access to revegetation areas.	Monthly asset inspections
6	Feral animals are mitigated	Potential impacts from introduced animals are	Mitigation measures are implemented if there	Monitor revegetation areas

		monitored and mitigated, where required.	are visible signs of introduced animals species e.g. rabbits, foxes etc.	-as part of annual reports and as part of monthly asset inspections
7	Priority species are retained	All priority species located immediately outside the construction area are to be retained.	No priority species located immediately outside the construction area are impacted.	The priority species are demarcated before, during and after the UXO search and construction works

7.1 Vegetation Establishment

Vegetation establishment in the revegetation areas will occur by spreading topsoil, mulch and the planting of tube stock. Technical specifications detailing vegetation establishment techniques are included within Appendix C - Section 3.

7.2 Seed Collection, Plant Salvage and Propagation

Local provenance species will be sourced from the project site and other reserves suitable for supplying the seed quantities required to meet completion criteria. To ensure sustainable collection practices, seed will be sourced from the following reserves:

- Tamala Park, Mindarie & Burns Beach, CoW and City of Joondalup (CoJ);
- Longbeach Reserve, Quinns Rocks, CoW;
- Claytons Beach reserve, Mindarie, CoW;
- Burns Beach Reserve, Burns Beach, CoJ;
- Mindarie Foreshore, Mindarie, CoW;
- Quinns Rocks Foreshore, Quinns Rocks, CoW; and
- Yanchep Foreshore, Yanchep, CoW.

The timing of seed collection is detailed in the rehabilitation schedule for each site (Table 7 – TRBA site). The City of Wanneroo will engage a contractor (certified by the Revegetation Industry Association of Western Australia (RIAWA)) to undertake seed collection, plant salvage and propagation works. Seed collection and plant propagation will be carried out in accordance with the specifications outlined in Sections 1 and 2 of Appendix C.

Species' lists for seed collection and propagation, in the first four years during and after construction, are provided in Table 8. The species lists have been developed using data collected from the biological survey and prior experience in developing and implementing revegetation projects.

A contractor (certified by the Revegetation Industry Association of Western Australia (RIAWA)) will be engaged to salvage plants that are not able to be propagated commercially and would be cleared as part of the project. The salvage of plants will occur once the UXO search has been undertaken. The plants that can be salvaged include *Beyeria c. subsp. cinerea (P3)* and orchid species. As orchid species are not emergent species, salvage of these plants may not be successful. The City will endeavour to salvage and plant these species, however, there is no guarantee of success.

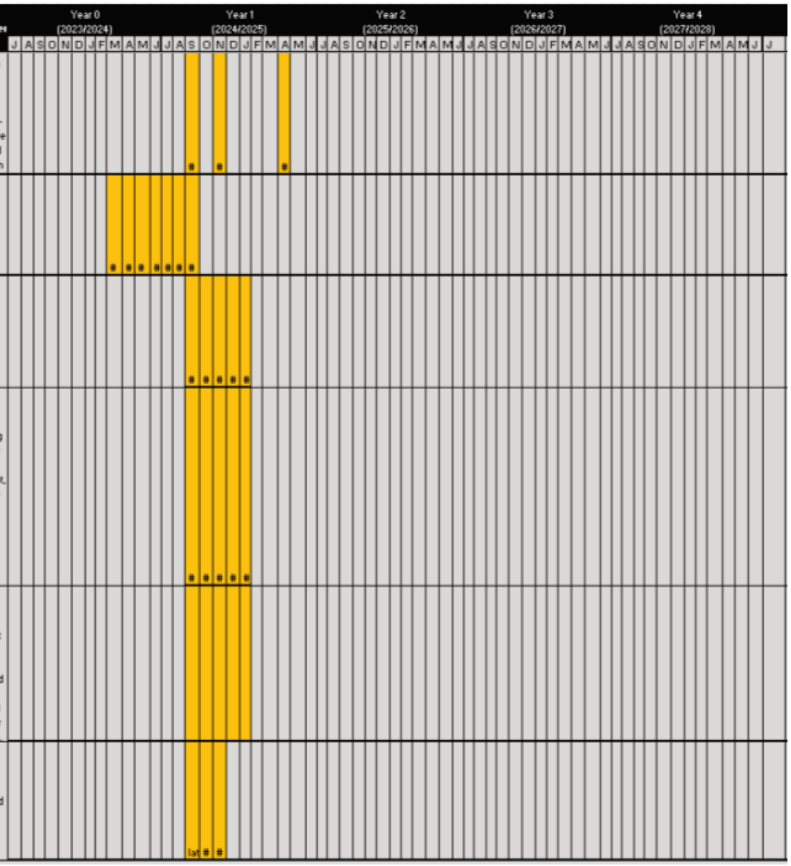
It is intended that the four individual species of Priority 3 *Beyeria cinerea* subsp. *cinerea* will be salvaged from the approved clearing areas prior to clearing vegetation and taken to the

nursery for storage and replanting. The salvaged plants will be planted in the revegetation areas in Year 2 & 3.

Direct seeding will occur in the first year of revegetation and will include grass species listed in Table 9. Opportunistic seed collection for direct seeding of other annual species will occur in Year 0 to be spread within revegetation areas prior to planting in Year 1. The City will endeavour to collect annual species seeds where possible, however, success is not guaranteed. Direct seeding will occur at the optimal time of the year (April-May).

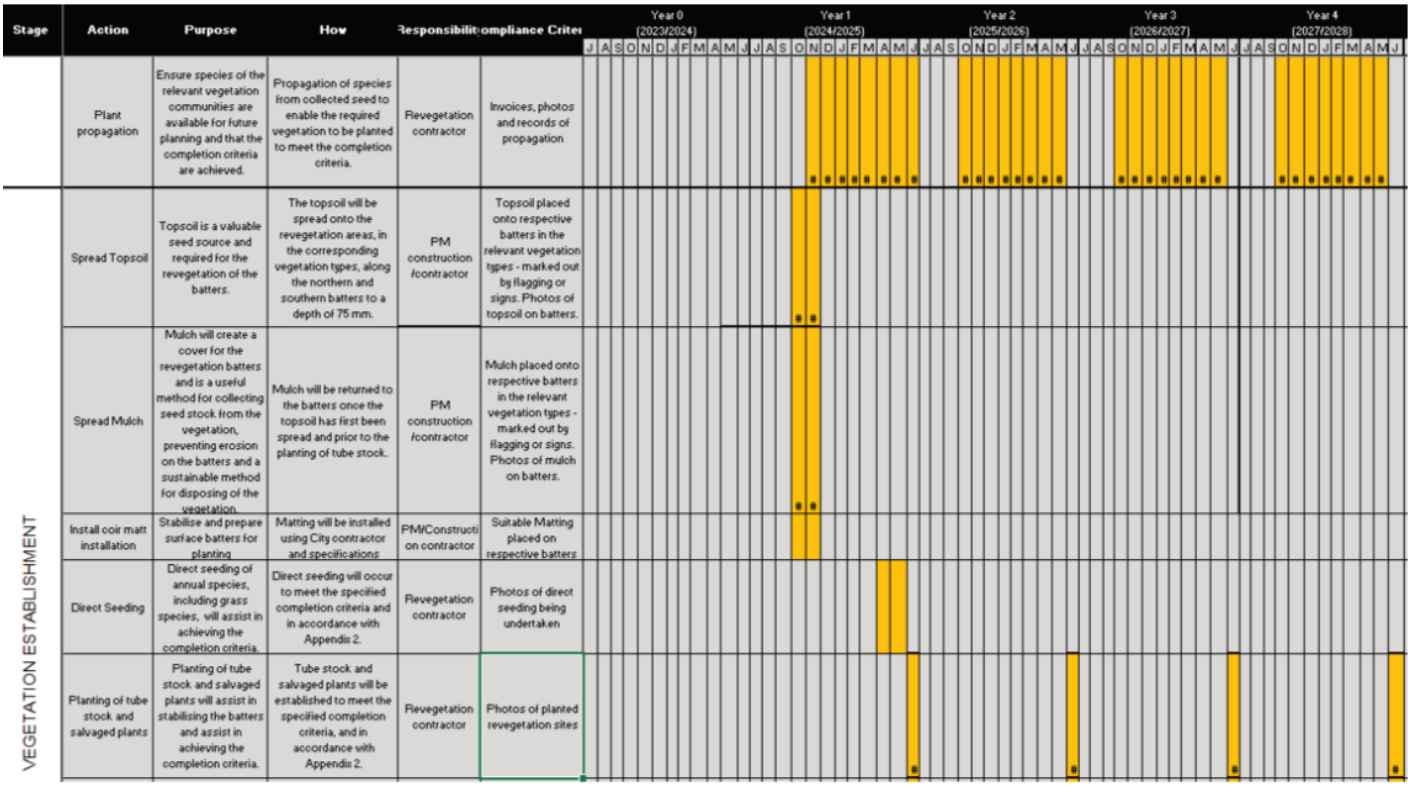
Table 7: Rehabilitation Schedule – TRBA Site

Stage	Action	Purpose	How	Responsibility	Compliance Criteria
SITE PREPERATION	Demarcation of priority species before UXO	Conserve priority species	Competent personnel identify and demarcate Priority species, using botanical report and GPS reference as a guide.	Asset Planning Environmental Asset Planner/Officer or Consultant	Records of each species demarcated against GPS reference points - before UXO, before construction and after construction
	Environmental conditions included in contracts	Ensure environmental conditions of licence are understood and complied with - including the GPS locations of the	Include conditions of CPS in contracts	PM, UXO and construction /contractor	CPS licence Shapefiles
	On site inductions for contactors and key stakeholders	Ensure potential impacts to flora and fauna are mitigated and that CPS conditions are complied with	As a condition of site entry, TRBA contractors and key stakeholders must complete environmental awareness for the clearing permit conditions that interact	Environmental Asset Planner/Officer PM, UXO and construction /contractor	CPS licence Training records Contracts
	Dieback & Pathogen Mitigation	Dieback could be introduced or spread from the construction extent, which could result in a significant threat to the vegetation.	The scope of works and associated technical specification includes the requirement to not introduce or spread any declared pests, weeds or diseases into, or from, the project area, as a result of the work performed by the contractor. This includes the cleaning of machinery prior to entering and leaving site.	UXO, Construction, seed and weed management contractors	Records verifying the requirements of pathogen and weed management, as required in the scope of works and technical specifications.
	Demarcate vegetation areas	To ensure noone breaches the approved clearing area and the mulch/vegetation is stockpiled in corresponding vegetation areas	Survey to demarcate the clearing and vegetation areas prior to UXO and construction with appropriate flagging and survey posts	PM, Contractors and Survey	Photographic evidence of demarcation of clearing footprint and mulch stockpiles. Surveyed area and shapefiles provided of total cleared area after completed works.
	UXO search - TRBA and offset site	Te eliminate UXO risk	Mulch from UXO - remains in construction area for amalgamating into topsoil layer.	PM and UXO contractor	Shapefiles photos before and after UXO

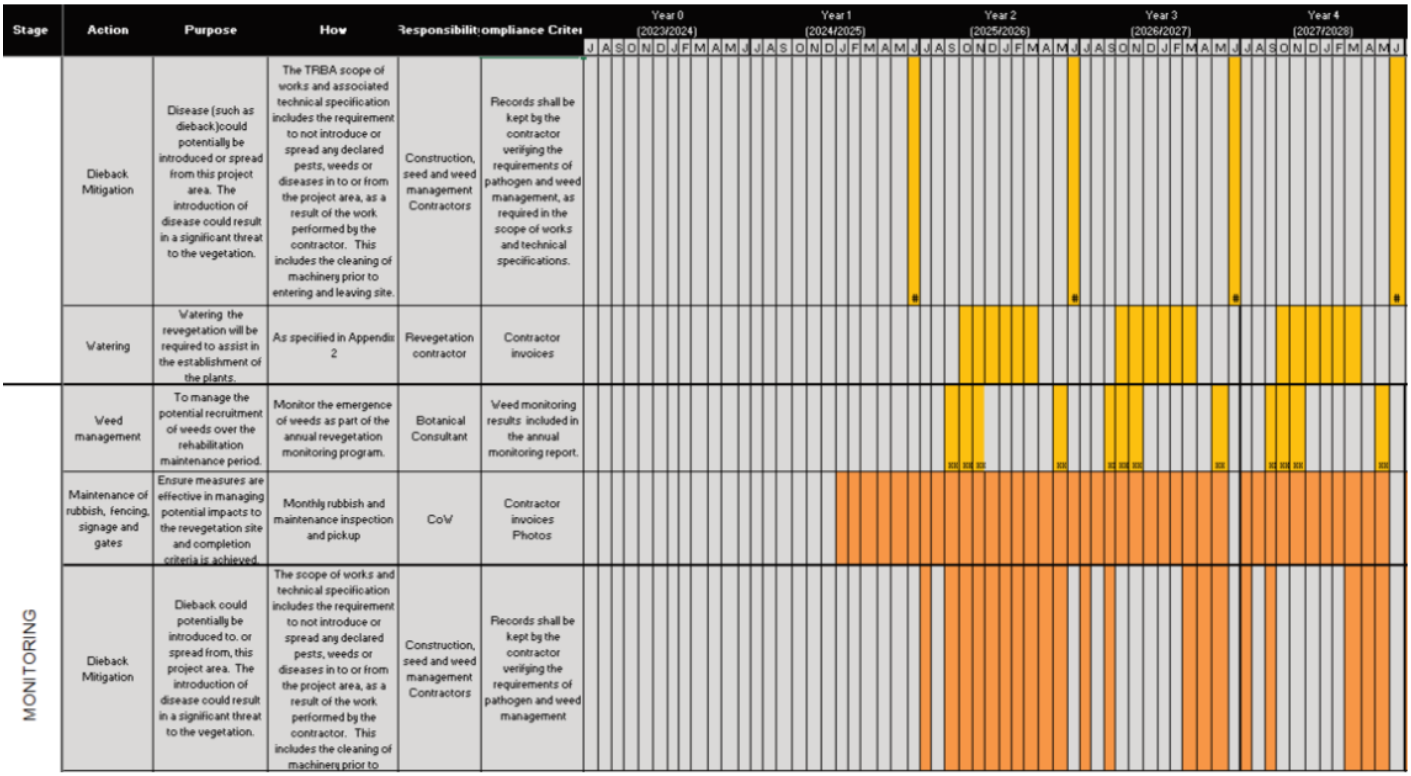


Stage	Action	Purpose	How	Responsibilit	ompliance Crite	Year 0 (2023/2024)	Year 1 (2024/2025)	Year 2 (2025/2026)	Year 3 (2026/2027)	Year 4 (2027/2028)
						J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J
	Salvaging of priority species	Some species are not able to propagated commercially and are priority species which can be salvaged.	UXO to liaise with the Environmental Asset Planner/Officer before they approach Priority species area so that the four indivisuals can be salvaged and used in rehabilitation.	PM Revegetation/ contractor	Receipts from contractor, photos of salvaged plants		Ist # #			
	Weed management	Carry out weed management to target prominent weeds before construction commences.	Targeted weed spraying	PM Revegetation/ contractor	Weed contractor invoices					
	Initial Rubbish Removal	Waste should be lawfully removed and disturbance and handling of topsoil minimised during the construction and rehabilitation processes. Increased handling of topsoil could lead to an incremental loss of topsoil and reduced potential seed source for rehabilitation	An inspection of the construction estent will be completed prior to the commencement of construction to ensure that all waste is identified, hand-picked and removed.	PM Construction contractor	Waste removal receipts and applicable controlled waste documentation		#			
	Seed Collection	Seed will be collected from the relevant vegetation communities to ensure completion criteria is achieved (species richness)	Local provenance species will be sourced from Two Rocks and other reserves suitable for supplying the seed quantities required to meet completion criteria	CoV PM and seed contractor	Seed collection and storage receipts					
	Demarcation of clearing area and vegetation types	Ensure compliance with the permitted clearing area and ensure the relevant materials are placed back onto the batters in the areas, and vegetation types, from which they were sourced.	The construction estent and each of the vegetation types that transect within the construction estent will be demarcated before clearing commences, as outlined in the tender document. E.g. TRIBA colour coding, after UXO search	PM construction /contractor	Photographic evidence of demarcation of clearing footprint and topsoil stockpiles. Surveyed area and shapefiles provided of total cleared area after completed works.		# # # #			

Stage	Action	Purpose	How	Responsibility	Compliance Criteria	Year 0 (2023/2024)	Year 1 (2024/2025)	Year 2 (2025/2026)	Year 3 (2026/2027)	Year 4 (2027/2028)
						J A S O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S	O N D J F M A M J J A S
CONSTRUCTION	Installation of fencing, including feral proof fencing behind the revegetation areas, and gates	Stop unauthorised access and ensure that clearing area is not exceeded. Fencing will protect the revegetation areas and adjacent bushland	Installation of deterrent (e.g.large boulders after UXO search and fencing) and before construction)along construction extent, in accordance with Appendix 2, Section 3.	PM construction /contractor	Photos of deterrents and fencing.		* * * * * * *			
	Collect Mulch	Mulch will create a cover for the revegetation batters, is a useful method for collecting seed stock from the vegetation, and a sustainable method for disposing of the vegetation.	Vegetation will be trimmed and grubbed from each of the corresponding vegetation types and chipped into mulch, through the use of a vegetation chipping device. The mulch will be stockpiled for use in the revegetation of the batters.	PM construction /contractor	Mulch placed into respective vegetation types - marked out by flagging or signs. Photos of vegetation, chipper being used and mulch stockpiles.		* * * *			
	Collect Topsoil	Topsoil is a valuable seed source and required for the revegetation of the batters.	After vegetation removal, the top 75 mm of the topsoil will be removed and stockpiled for later use in the revegetation of the batters. The relvant mulch will be placed on top of the respective top soil stockpiles.	PM construction /contractor	Topsoil placed into respective vegetation types - marked out by flagging or signs. Photos of topsoil stockpiles.		* * * *			
	Construction	To ensure that the construction of the TRBA is built in compliance with the clearing permit.	Prior to vegetation establishment, site preparation and protection activities will be undertaken in accordance with specifications outlined in Appendix C, Section 3. Specifications of the revegetation plan are built into the scope of work for the construction contractor.	PM construction /contractor	TRBA Construction Scope of works		* * * *			
			Ensure compliance with the conditions of the clearing permit and scope of work.	PM construction /contractor	On site inspections and evidence required as part of construction tender and scope of works.		* * * *			



Stage	Action	Purpose	How	Responsibility	Compliance Criteria
VEGETATION ESTABLISHMENT	Plant propagation	Ensure species of the relevant vegetation communities are available for future planning and that the completion criteria are achieved.	Propagation of species from collected seed to enable the required vegetation to be planted to meet the completion criteria.	Revegetation contractor	Invoices, photos and records of propagation
	Spread Topsoil	Topsoil is a valuable seed source and required for the revegetation of the batters.	The topsoil will be spread onto the revegetation areas, in the corresponding vegetation types, along the northern and southern batters to a depth of 75 mm.	PM construction /contractor	Topsoil placed onto respective batters in the relevant vegetation types - marked out by flagging or signs. Photos of topsoil on batters.
	Spread Mulch	Mulch will create a cover for the revegetation batters and is a useful method for collecting seed stock from the vegetation, preventing erosion on the batters and a sustainable method for disposing of the vegetation.	Mulch will be returned to the batters once the topsoil has first been spread and prior to the planting of tube stock.	PM construction /contractor	Mulch placed onto respective batters in the relevant vegetation types - marked out by flagging or signs. Photos of mulch on batters.
	Install coir matt installation	Stabilise and prepare surface batters for planting	Matting will be installed using City contractor and specifications	PM/Construction contractor	Suitable Matting placed on respective batters
	Direct Seeding	Direct seeding of annual species, including grass species, will assist in achieving the completion criteria.	Direct seeding will occur to meet the specified completion criteria and in accordance with Appendix 2.	Revegetation contractor	Photos of direct seeding being undertaken
	Planting of tube stock and salvaged plants	Planting of tube stock and salvaged plants will assist in stabilising the batters and assist in achieving the completion criteria.	Tube stock and salvaged plants will be established to meet the specified completion criteria, and in accordance with Appendix 2.	Revegetation contractor	Photos of planted revegetation sites



Stage	Action	Purpose	How	Responsibilit	ompliance Crite	Year 0 (2023/2024)	Year 1 (2024/2025)	Year 2 (2025/2026)	Year 3 (2026/2027)	Year 4 (2027/2028)
						J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J
	Dieback Mitigation	Disease (such as dieback)could potentially be introduced or spread from this project area. The introduction of disease could result in a significant threat to the vegetation.	The TRBA scope of works and associated technical specification includes the requirement to not introduce or spread any declared pests, weeds or diseases in to or from the project area, as a result of the work performed by the contractor. This includes the cleaning of machinery prior to entering and leaving site.	Construction, seed and weed management Contractors	Records shall be kept by the contractor verifying the requirements of pathogen and weed management, as required in the scope of works and technical specifications.					
	Watering	Watering the revegetation will be required to assist in the establishment of the plants.	As specified in Appendix 2	Revegetation contractor	Contractor invoices					
MONITORING	Weed management	To manage the potential recruitment of weeds over the rehabilitation maintenance period.	Monitor the emergence of weeds as part of the annual revegetation monitoring program.	Botanical Consultant	Weed monitoring results included in the annual monitoring report.					
	Maintenance of rubbish, fencing, signage and gates	Ensure measures are effective in managing potential impacts to the revegetation site and completion criteria is achieved.	Monthly rubbish and maintenance inspection and pickup	CoV	Contractor invoices Photos					
	Dieback Mitigation	Dieback could potentially be introduced to, or spread from, this project area. The introduction of disease could result in a significant threat to the vegetation.	The scope of works and technical specification includes the requirement to not introduce or spread any declared pests, weeds or diseases in to or from the project area, as a result of the work performed by the contractor. This includes the cleaning of machinery prior to	Construction, seed and weed management Contractors	Records shall be kept by the contractor verifying the requirements of pathogen and weed management					

Stage	Action	Purpose	How	Responsibilit	ompliance Criter	Year 0 (2023/2024)	Year 1 (2024/2025)	Year 2 (2025/2026)	Year 3 (2026/2027)	Year 4 (2027/2028)
						J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J
	Monitoring of unauthorised vehicles	Unauthorised vehicles cause damage and destruction of vegetation and exacerbates erosion of landscapes.	The activity of unauthorised vehicles will continue to be monitored throughout this project, with relevant actions implemented, as required.	Monitor project area - Construction Contractor and CoJ. Peet and Satterly manage unauthorised access from their respective developments	Evidence of implemented actions by relevant party e.g.. Photos	As required				
	Monitoring of revegetation site	To ensure that the revegetation site is complying with the completion criteria	Monitoring of the vegetation site each September to monitor compliance with the completion criteria and develop contingency for criteria not being achieved - needs to be done before replanting but also as per EPA guidelines	Botanical Consultant	Revegetation monitoring results included in the annual monitoring report.					
MAINTENANCE	Weed management	To manage the potential recruitment of weeds over the rehabilitation maintenance period.	Implement a weed management program (in accordance with specifications outlined in Appendix C, Section 3) throughout the year to effectively mange the emergence and spread of weeds.	Weed Management contractor	Weed contractor invoices					
	Watering	Where criteria listed in Table 7 are identified as 'at risk' of meeting targets, contingency measures such as remedial planting and watering will be implemented.	Maintenance activities will be undertaken where required over the three year period as outlined in Appendix C, Section 3.	CoV and revegetation contractor	Contractor invoices					
	Plant infill and propagation	Assesment against the rehabilitation success monitoring reports and the Planting of tube stock and salvaged plants will assist in stabilising the batters and assist in achieving the completion criteria.	Tube stock and salvaged plants will be established to meet the specified completion criteria, and in accordance with Appendix 2 and assessment against the monitoring reports.	PM/Revegetation contractor	Photos of planted revegetation sites					

Stage	Action	Purpose	How	Responsibility	Compliance Criteria	Year 0 (2023/2024)	Year 1 (2024/2025)	Year 2 (2025/2026)	Year 3 (2026/2027)	Year 4 (2027/2028)
						J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J	J A S O N D J F M A M J
	Remedial planting	Where criteria listed in Table 7 are identified as 'at risk' of meeting targets, contingency measures such as remedial planting and watering will be	Maintenance activities will be undertaken where required over the three year period as outlined in Appendix C, Section 3.	CoV and revegetation contractor	Contractor invoices Photos					
	Inspection of fencing and revegetation areas	Ensure measures are effective in managing potential impacts to the revegetation site and completion criteria is achieved.	Where criteria listed in Table 7 are identified as 'at risk' of meeting targets, contingency measures such as remedial planting and watering will be implemented. Maintenance activities will be undertaken where required over the three year period as outlined in Appendix C, Section 3.	CoV	Contractor invoices Photos					
REPORTING	Compliance report to DVER	Ensure the clearing permit conditions are complied with and that the revegetation is achieving the completion criteria.	Requirements of clearing permit are monitored and reported in an approved DoVER format	CoV	DoVER receive reports as required under Clearing Permit					

Legend

*	Contingency - dependant on results of monitoring
**	Dependant on rainfall
#	Dependant on approvals

Asset Planning Environmental Asset Planner/Officer - City of Wanneroo
PM = Project Manager (City of Wanneroo)

Table 8: Species Propagation and Planting List

SPECIES	PLANTS REQUIRING PROPAGATION					
	Two Rocks Beach Access Site					
	A2	A3	B1	C1	D1	Total
Acacia cyclops		225 90 90 45	700 280 280 140	40 40 40 40		965 410 410 225
Acacia l. var. lasiocarpa				200 200 200 120		200 200 200 120
Acacia rostellifera				20 20 20 20		20 20 20 20
Acacia xanthina				40 100 50 50	800 500 400 200	840 600 450 250
Acanthocarpus preissii			525 525 600 200	300 300 300 150	945 800 600 500	1770 1625 1500 850
Allocasuarina l. subsp. lehmanniana					135 150 115 50	135 150 115 50
Carex thecata					45 45 45 45	45 45 45 45
Carpobrotus virescens		540 225 225 90	245 105 105 35			785 330 330 125
Clematis linearifolia				50 20 20 20		50 20 20 20
Conostylis candicans subsp. calcicola			175 175 175 70	50 20 20 20		225 195 195 90
Conostylis c. subsp. candicans				50 20 20 20		50 20 20 20
Cryptandra mutila				20 20 20 20		20 20 20 20
Dianella revoluta var. divaricata				50 20 20 20	45 135 135 45	95 155 155 65
Dodonaea aptera				60 80 80 40	135 135 135 135	195 215 215
Eremophila glabra subsp. albicans				20 20 20 20		20 20 20 20

SPECIES	PLANTS REQUIRING PROPAGATION					
	Two Rocks Beach Access Site					
	A2	A3	B1	C1	D1	Total
Exocarpos sparteus			35 70 70 35			35 70 70 35
Ficinia nodosa			175 280 280 140			175 280 280 140
Gastrolobium nervosum				100 80 80 80		100 80 80 80
Gompholobium tomentosum				25 20 20 20		25 20 20 20
Guichenotia ledifolia					90 80 90 90	90 80 90 90
Hardenbergia comptoniana			70 105 105 35	20 20 20 20		90 125 155 55
Hemiandra glabra			105 105 105 105	20 20 20 20		125 125 125 125
Kennedia prostrata				20 20 20 20	225 115 115 150	245 135 135 170
Lepidosperma gladiatum					600 500 500 360	600 500 500 360
Leptomeria preissiana		45 45 45 25	35 35 35 20	40 40 40 20	25 25 25 25	145 145 145 90
Leucopogon insularis				20 20 20 20	225 90 90 90	245 110 110 110
Leucopogon parviflorus				20 20 20 20	245 90 90 90	245 110 110 110
Lomandra maritima				600 500 500 200	1000 1200 1200 500	1600 1700 1700 700
Melaleuca cardiophylla					990 500 500 360	990 500 500 360
Melaleuca h. subsp. huegelii					450 45 45 45	450 45 45 45
Melaleuca systena				120 240 240	315 540 540	435 780 780

SPECIES	PLANTS REQUIRING PROPAGATION					
	Two Rocks Beach Access Site					
	A2	A3	B1	C1	D1	Total
				160	360	
Myoporum insulare		135 450 450 225	265 525 525 265		225 115 115 115	625 1090 1090 605
Olax benthamiana				40 40 40 40		40 40 40 40
Olearia axillaris	300 30 30 20	2200 225 225 135	525 265 265 140	40 20 20 20	90 45 45 25	3155 585 585 340
Opercularia vaginata				80 40 40 80		80 40 40 80
Phyllanthus calycinus				40 40 40 40		40 40 40 40
Pimelea ferruginea				40 40 40 40		40 40 40 40
Pithocarpa cordata		270 45 45 25	105 70 70 35		25 25 25 25	400 140 140 85
Rhagodia b. subsp. baccata	80 10 10 10	900 45 45 45	350 175 175 90		135 90 90 45	1465 320 320 190
Santalum acuminatum			35 35 35 20		45 45 45 25	80 80 80 45
Scaevola crassifolia	100 20 20 20		980 1560 560 350			1080 580 580 370
Scaevola t. subsp. Thesioides				80 40 50 80		80 40 50 80
Senecio pinnatifolius var. latilobus		45 45 45 25	140 70 70 35	40 20 20 20		225 135 135 80
Spinifex longifolius	50 50 75	2160 2160 300	350 350 70			2560 2560 990
Spyridium globulosum			700 525 600 300	120 60 100 50	450 340 400 200	1270 925 1100 550
Templetonia retusa				40 40 40 80	135 135 135 135	175 175 175 215
Thomasia triphylla					25 45 45	25 45 45

SPECIES	PLANTS REQUIRING PROPAGATION					
	Two Rocks Beach Access Site					
	A2	A3	B1	C1	D1	Total
					45	45
Threlkeldia diffusa			175 70 70 70			175 70 70 70
Tricoryne elatior					25 45 45 45	25 45 45 45
Trymalium l. var. ledifolium					90 90 90 90	90 90 90 90
Westringia dampieri				20 20 20 20	25 90 90 90	45 110 110 110

Note – Plant propagation and installation in 2024/2025, seed collection in 2023/2024
Plant propagation and installation in 2025/2026, seed collection in 2024/2025
Plant propagation and installation in 2028/2027, seed collection in 2025/2026
Plant propagation and installation in 2027/2028, seed collection in 2026/2027

Table 9: Species Direct Seeding List Collected from Opportunistic Seed Collection

SPECIES	Direct Seeding				
	Two Rocks Beach Access Site				
	A2	A3	B1	C1	D1
Austrostipa flavescens	✓	✓	✓	✓	✓
Poa porphyroclados					
Rytidosperma occidentale					

7.3 Topsoil and Mulch

The construction extent of the TRBA, fencing alignment for the offset site and each of the vegetation types that transect within these (in accordance with Figure 3) will be demarcated before the UXO search and clearing commences. This will enable the contractor to stockpile any mulch and topsoil material from each vegetation types in the marked corresponding area.

This process assists with the relevant materials being placed back onto the batters in the areas, and vegetation types, from which they were sourced. Due to the lack of tall canopy and the overall height of the vegetation types within both sites, it is not anticipated that considerable mulch will be recovered.

Vegetation will be trimmed and grubbed from each of the corresponding vegetation types and chipped into mulch, through the use of a vegetation chipping device. As described above, the mulch will be stockpiled and returned to the batters once the topsoil has first been spread (see Schedule – Table 7). The mulch will be spread over the revegetation area prior to planting.

The timing of topsoil and mulch spreading is provided in the schedule (Table 7). After vegetation removal has occurred within the TRBA construction area, the top 75 mm of the topsoil will then be removed and stockpiled in accordance with the above described practices. The topsoil will be spread onto the revegetation areas, in the corresponding vegetation types, along the southern and northern batters to a depth of 75 mm.

Whilst it is acknowledged that the topsoil may retain a source of weeds, it is not practical to remove the weed infested topsoil as the loss of native seed resource will be a far greater loss. It is more practical to establish a weed management program to target the prominent weed species and reduce the amount of weed seed source that may be stored in the topsoil. After the establishment of plants, a targeted weed program will take place to manage the potential recruitment of weeds over the rehabilitation maintenance period.

7.4 Site Preparation and Protection

Prior to vegetation establishment, site preparation and protection activities will be undertaken in accordance with specifications outlined in Appendix C. Weed treatment for the species listed in Table 3 will be undertaken in the revegetation area. A single rail conservation fence (Appendix C) will be installed along the TRBA to protect the revegetation areas and adjacent bushland and a feral proof fence will be installed along the outer extents of the revegetation areas to prevent grazing of plantings. The timing of site preparation activities are provided in the schedule (Table 7).

7.5 Maintenance

Maintenance activities will be undertaken following vegetation establishment and site protection activities to ensure measures are effective in managing the disturbances and threats to revegetation areas (Table 7) and conditions are on target for meeting completion criteria (Table 6). Post planting weed control will be undertaken in accordance with specifications outlined in Appendix C. Where criteria listed in Table 6 are identified as ‘at risk’ of meeting targets, contingency measures such as remedial planting and watering will be implemented. Maintenance activities will be undertaken where required over the three year period as outlined in Appendix C.

8. Schedule and Budget

A preliminary schedule (Table 7) has been developed for site preparation, vegetation establishment, monitoring, maintenance and reporting for the revegetation areas. The City of Wanneroo is responsible for implementing the construction and site preparation actions and will resource the revegetation and maintenance of the TRBA, utilising technical expertise from existing personnel and contractors. Timing of some actions may be dependent on project

approval and schedules (i.e. spreading of topsoil). The schedule will be revised in accordance with project approvals and construction schedules.

A cost estimate for the revegetation and maintenance of the construction extent is provided in Table 8. When preparing the cost estimate, some assumptions have been made which include;

- Increase of CPI of 5% pa (compounding each year);
- Topsoil and mulch to be supplied free of charge, costs to spread only; and
- That funding will be available to commence seed collection in FY 2023 with revegetation activities following in subsequent financial years.

Table 8: Budget and Costings – TRBA

Actions	Year 0 (23/24)	Year 1 (24/25)	Year 2 (25/26)	Year 3 (26/27)	Year 4 (27/28)	Year 5 (28/29)	Total
Weed management	$ -	$ 14,560.00	$ 22,920.00	$ 24,070.00	$ 19,800.00	$ 19,800.00	**$ 101,150.00**
Seed collection	$ 8,050.00	$ 27,470.00	$ 12,430.00	$ 6,940.00	$ -	$ -	**$ 54,890.00**
Salvage of plants	$ -	$ 3,000.00	$ -	$ -	$ -	$ -	**$ 3,000.00**
Plant supply	$ -	$ 29,320.00	$ 38,860.00	$ 28,440.00	$ 13,650.00	$ -	**$ 110,270.00**
Collection and propagation of difficult species	$ -	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 10,000.00	**$ 40,000.00**
Planting of tube stock and salvaged plants	$ -	$ 33,820.00	$ 36,820.00	$ 31,420.00	$ 33,730.00	$ -	**$ 135,790.00**
Watering tubestock (6 applications)	$ -	$ -	$ 39,170.00	$ 44,670.00	$ 30,950.00	$ 18,480.00	**$ 133,270.00**
Monitoring of revegetation site	$ -	$ -	$ 20,000.00		$ 20,000.00	$ 20,000.00	**$ 60,000.00**
Maintenance of rubbish	$ -	$ 1,650.00	$ 3,710.00	$ 3,890.00	$ 3,200.00	$ 3,200.00	**$ 15,650.00**
Maintenance of fencing, signage and gates	$ -	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	$ 1,500.00	**$ 7,500.00**
Feral Animal Control	$ -	$ 8,000.00	$ 8,000.00	$ 8,000.00	$ 8,000.00	$ 8,000.00	**$ 40,000.00**
Traffic control - all activities	$ -	$ 7,420.00	$ 16,270.00	$ 16,760.00	$ 13,500.00	$ 12,750.00	**$ 66,700.00**
Total	**$ 8,050.00**	**$ 136,740.00**	**$ 209,680.00**	**$ 175,690.00**	**$ 154,330.00**	**$ 92,230.00**	**$ 776,720.00**

9. Monitoring and Analysis

Monitoring will be undertaken as outlined in Table 6 and 7 to ensure the criteria are on target and will inform contingency measures where required. An environmental specialist experienced in surveying and analysing flora and vegetation on the Swan Coastal Plain will be engaged to undertake monitoring. The specialist will be required to collect flora and vegetation data for analysis of species richness, number of surviving plants, weed coverage, presence of declared weeds and other potential impacts, as described in Section 4. A report shall be prepared in accordance with Appendix C of 'A Guide to Preparing Revegetation Plans for Clearing Permits' and provided to DWER as required by the clearing permit conditions (DWER, 2018).

Personnel will undertake an inspection of the revegetation site (asset inspection) every month to ensure site protection measures (i.e. fencing) are providing the relevant protection functions for the revegetation areas and identify any issues that require maintenance. Actions to rectify issues within revegetation areas will be implemented in a timely manner by raising work orders and/or engaging a contractor.

Monitoring and reporting timeframes are outlined in the Table 7 schedule.

10. References

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11. Appendices

Appendix A: Two Rocks Beach Access Flora and Vegetation Survey (One Tree Botanical, 2020).

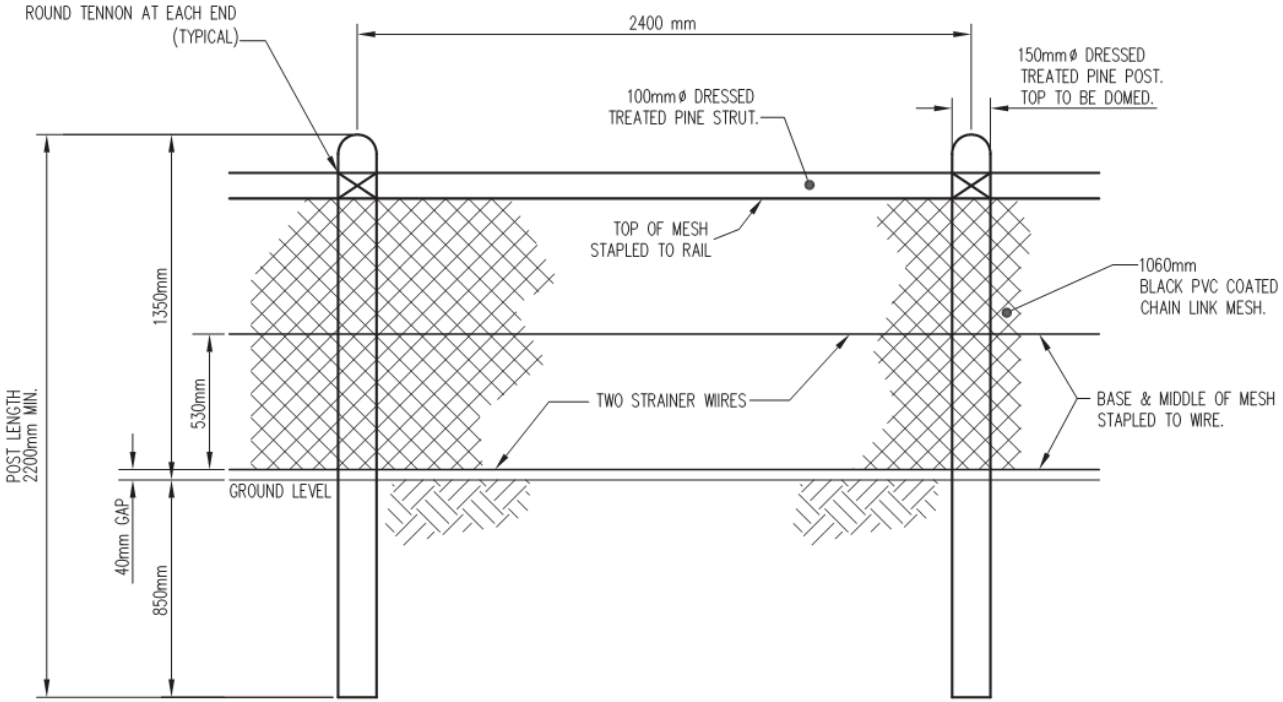
Appendix B: Vertebrate Fauna Survey – Two Rocks Beach Access, Two Rocks (Terrestrial Ecosystems, 2020).

Appendix C: Technical Specifications (City of Wanneroo, 2022).

Appendix H

Fencing Specification (City of Wanneroo 2001)

No	REVISION	BY	DATE	AUTH
0.	ISSUED	J.W.T.	10/2002	
1.	NOTES AND DIMENSIONS AMENDED	T.T.	2/2006	B.C.



MATERIAL SPECIFICATIONS

150–175mm x 2.2m CCA TREATED PINE LOG (FOR PINE UPRIGHTS).
1.57mm GALVANISED TIE WIRE.

NOTES

1. ALL ENDS, JOINS AND TIES TO BE FINISHED NEATLY WITH NO WIRE PROTRUSIONS.
2. WIRE TO BE WRAPPED AROUND PINE POSTS TWICE, THEN WOUND BACK AROUND WIRE THREE TIMES AND CUT OFF FLUSH.
3. FENCING WIRE TO BE FIXED TO OUTSIDE OF FENCE, EXCEPT WHERE PARK ADJOINS PRIVATE PROPERTY, WHERE IT SHOULD BE FIXED TO INSIDE OF FENCE
4. FENCE TO SMOOTHLY FOLLOW THE OVERALL CONTOURS OF THE LAND AS FOR BOLLARDS (NOT TO HAVE SUDDEN DIPS AND RISES).
5. REFER TO STANDARD DRAWING TS 01–09 FOR BOX STRAINER DETAIL.

* INDICATES SIGNATURES ON ORIGINAL ISSUE OF DRAWING.

DATUM: N/A	GRID: N/A	SURVEYOR: N/A
SCALE: 1:20 — 0.2 0 0.2 0.4 0.6 0.8 SCALE IN METRES		
DESIGN ARCHIVE: I:\\TECHNICAL SERVICES DESIGN ARCHIVE		
DRAWING ARCHIVE: I:\\TECHNICAL SERVICES DRAWING ARCHIVE		

DESIGNED: C.O.W.	APPROVED: * B. CARTER 31/10/2002 COORDINATOR PARKS
DRAWN: C.O.W.	APPROVED: * R. KORENHOF 31/10/2002 MANAGER INFRASTRUCTURE
DESIGN CHECKED: * B. CARTER 31/10/2002 COORDINATOR PARKS	
STANDARDS/DOCUMENT CONTROL: * J. TRIMMER 31/10/2002 PROJECTS TECHNICAL SUPPORT OFFICER	APPROVED: * D. BLAIR 31/10/2002 DIRECTOR TECHNICAL SERVICES

FENCING

CONSERVATION PINE RAIL FENCING

LOCALITY

STANDARD

CITY OF WANNEROO
TECHNICAL SERVICES
INFRASTRUCTURE SERVICES

FILE No.	DRAWING No	SHEET	REVISION	ORIGINAL DRG.SIZE
	TS 01 - 7 - 1			A3