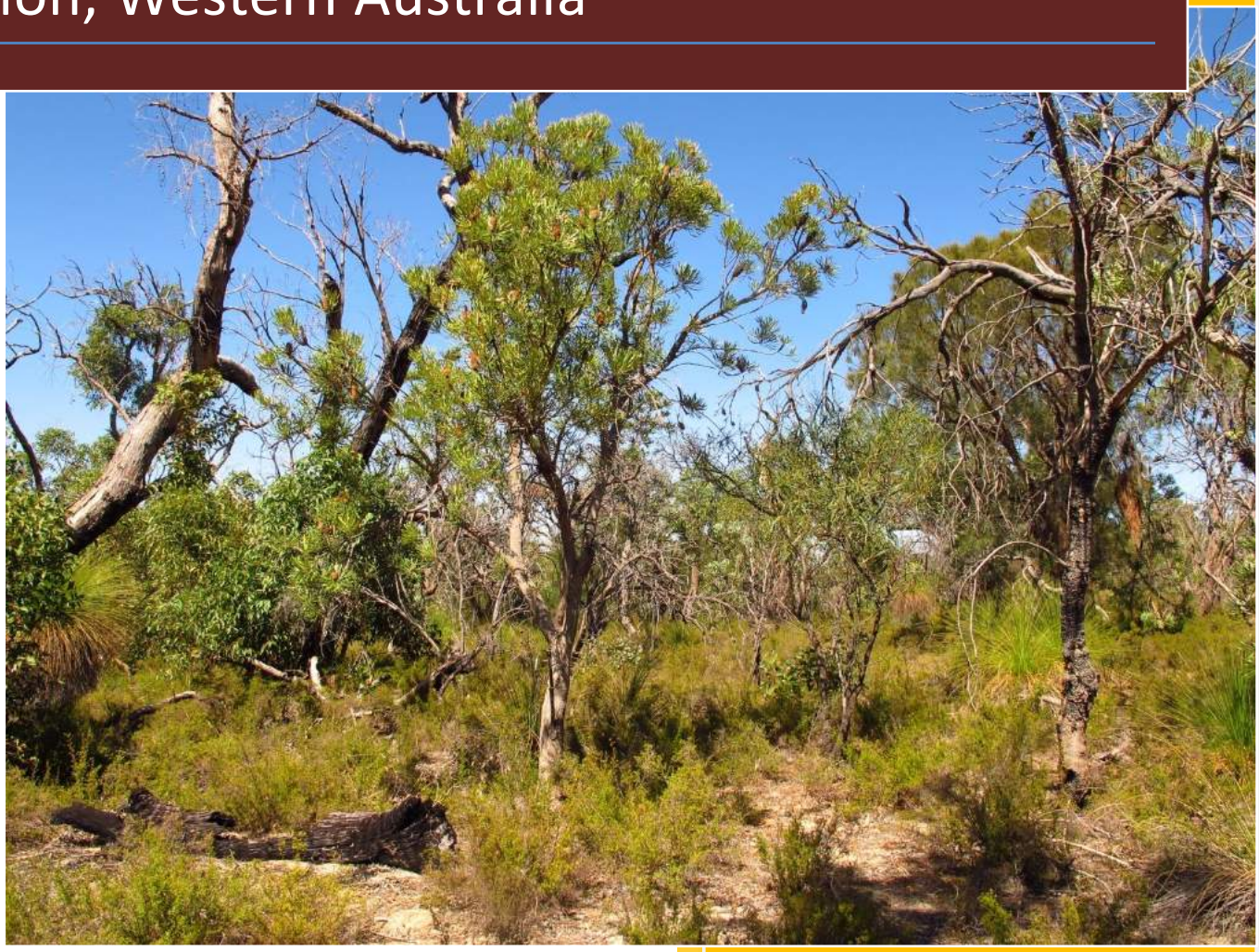
Desktop Review and Risk Assessment of Short Range Endemic Invertebrates for the Yanchep Rail Extension, Western Australia



Report by Invertebrate Solutions for
Public Transport Authority

May 2018

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Frontispiece: *Banksia* woodland near Yanchep

Contents

Contents iii
Executive Summary vi
1. Introduction 1
1.1. Purpose of this report 2
1.2. Study Area 2
1.3. Introduction to SRE invertebrate fauna 4
1.4. Conservation Legislation and Guidance Statements 5
1.5. Report Limitations and Exclusions 6
1.6. Assumptions 6
2. Desktop Methods 7
2.1 Likelihood of SRE invertebrate occurrence 7
2.2 Potential Impacts to SRE invertebrates 8
3. Desktop SRE invertebrate Review 9
3.1 SRE invertebrates of Swan Coastal Plain 9
3.2 Conservation Significant Fauna in the Study Area 10
3.3 SRE Habitat in the Study Area 10
3.4 Potential occurrence of SRE Invertebrates within the Study Area 16
3.5 Distribution of Confirmed SRE species within the YRE Development Envelope 19
3.6 Distribution of Likely SRE species within the YRE Development Envelope 22
4. SRE preliminary impact assessment 33
4.1 Local impacts during construction and operation 33
4.2 Regional significance and cumulative impacts 35
5. Conclusions and Recommendations 37
5.1 Recommendations 38
6. References 39
Appendix 1
Department of Parks and Wildlife Conservation Codes (November 2015)
Appendix 2
Protected Matters Search Tool results
Appendix 3
Components of the Yanchep Rail Extension Project Part 1 and 2

List of Figures

Figure 1 Yanchep Rail Extension Project SRE fauna Study Area. 3

Figure 2 SRE Habitat suitability in the YRE Development Envelope and local area based on GHD 2018 vegetation mapping and aerial images 13

Figure 3 SRE Habitat suitability in the Desktop Study Area based on aerial images only 15

Figure 4 Distribution of the Confirmed SRE mollusc species. 25

Figure 5 Distribution of the Confirmed SRE mollusc species in relation to the YRE Development Envelope 26

Figure 6 Distribution of the Confirmed SRE mygalomorph spider, millipede and tree cricket species. 27

Figure 7 Distribution of the Confirmed SRE mygalomorph spider, millipede and tree cricket species in relation to the YRE Development Envelope 28

Figure 8 Distribution of the Likely SRE isopod, millipede and tree cricket species. 29

Figure 9 Distribution of the Likely SRE isopod, millipede and tree cricket species in relation to the YRE Development Envelope 30

Figure 10 Distribution of the Likely SRE mygalomorph species 31

Figure 11 Distribution of the Likely SRE mygalomorph species in relation to the YRE Development Envelope 32

List of Tables

Table 1 Short Range Endemic Status of Species 5

Table 2 SRE species likelihood of occurrence definitions 7

Table 3 Conservation significant SRE Invertebrates potentially within the Study Area. 10

Table 4 Vegetation units in the YRE Development Envelope and SRE invertebrate habitat potential (after GHD 2018). 11

Table 5 SRE habitat availability in hectares at the local and regional scale 12

Table 6 SRE habitat availability in percent of area at the local and regional scale 12

Table 7 Potential SRE Invertebrates in WAM databases recorded from within the Study Area... 16

Table 8 SRE and conservation significant taxa within the YRE Development Envelope 18

Table 9 Risk of direct impact to SRE invertebrates from the YRE Project 34

Table 10 Risk of indirect impact to SRE invertebrates from the YRE Project 34

List of Plates

Plate 1 The P4 listed Graceful Sun-moth from within the YRE Project Envelope (After GHD 2011.). 9

Plate 2 Pachysaga munggai/strobila from the YRE Development Envelope (Image after GHD 2012) 24

Executive Summary

The Yanchep Rail Extension (YRE) project is a 14.5 kilometre (km) extension of the Joondalup railway line, which includes new stations at 3 locations; Alkimos, Eglinton and Yanchep. The YRE project's 143.11 hectare (ha) Development Envelope, which encompasses Part 1 and 2 development footprints (including railway extension and stations) and construction and access areas, generally lies between the suburbs of Butler and Yanchep and includes the suburbs of Alkimos and Eglinton. Part 1 of the project proposes to extend the existing Joondalup railway line by 7.3 kilometres from Butler Station to the suburb of Eglinton in the City of Wanneroo. Part 2 of the project proposes to extend the Joondalup railway line from Eglinton Station to Yanchep Station and includes a turnback facility to the north of the Yanchep Station to allow for the turning and stowage of trains.

Following referral of Part 1 of the YRE project to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act), the EPA decided on 13 March 2018 that the proposal would be assessed on referral and additional information. The EPA issued a Notice Requiring Information for Assessment under section 40(2)(a) of the EP Act, which included the requirement for a desktop short range endemic (SRE) fauna investigation.

The desktop assessment for SRE invertebrates recorded nine Confirmed SRE species (three land snails, three mygalomorph trapdoor spiders, one bivalve, one millipede and one tree cricket), 10 Likely SRE species (five mygalomorph trapdoor spiders, two terrestrial slaters, two tree crickets and one millipede), and eight Possible SRE species (five pseudoscorpions, one springtail, one midge, and one harvestman). The remainder of the species were found to be widespread.

Within the YRE Development Envelope, there are two Confirmed SRE species that have a High Likelihood of occurrence; the millipede (*Antichiropus whistleri*) and the trapdoor spider (*Idiosoma sigillatum*). There are also seven Likely SRE species (three mygalomorph spiders, two slaters and a tree cricket) that have a Moderate likelihood of occurring within the YRE Development Envelope as well as the widespread but conservation significant bee (*Hylaeus globuliferus)*. There are also two Possible SRE species, a harvestman arachnid and a pseudoscorpion that have a Moderate and High Likelihood respectively of occurring within the YRE Development Envelope

The only direct impact to SRE fauna is from vegetation clearing within the YRE Development Envelope that will directly remove habitat used by SRE species. This direct impact is relevant for the confirmed SRE millipede species (*Antichiropus whistleri*) as it has been recorded within 120 m of the YRE Development Envelope and is therefore highly likely to occur within both the Development Envelope and the surrounding vegetation. Given the narrow linear nature of the project, and given similar habitat values are likely to be present in surrounding vegetation and surrounding conservation estates, it is considered unlikely that the YRE project would result in local extinction.

The indirect impact of the clearing of native vegetation causing fragmentation of the remaining vegetation may lead to the restriction of genetic flow for SRE species that have limited dispersal capabilities. This indirect impact is considered to be the most significant impact from the YRE Project. This impact is largely unavoidable but is mitigated by the the PTA constructing four fauna underpasses through Ningana Bushland (Bush Forever Site 289) and one in the Parks and Recreation area to the north of the proposed Alkimos Station. These fauna underpasses will allow some limited

dispersion of species such as the SRE millipede (*Antichiropus whistleri*) and mygalomorph spider (*Idiosoma sigillatum*) that will assist in maintaining local connectivity between Yanchep National Park and the coastal vegetation and ultimately maintain genetic connectivity.

At a regional scale across the Swan Coastal Plain (SCP), the direct and indirect impacts are generally considered to be low due to the narrow linear nature of the YRE Project. At the regional scale of the Study Area that encompasses much of the northern SCP the YRE Development Envelope represents only 0.08 % of Medium and 0.04% of Low SRE suitable habitat, and no High SRE suitable habitat. The impact of habitat fragmentation is substantially mitigated through the PTA's construction of five fauna underpasses that will allow genetic connectivity of species at the SCP scale.

Other anticipated impacts including altering local hydrology and vibration are considered to be relatively small in the scale of the northern SCP.

The majority of other anticipated impacts are generally Low or able to be managed through standard construction and operational management and mitigation measures.

The following recommendations are made with regard to the construction of the YRE Project:

- Should the PTA be required to confirm the SRE millipede *Antichiropus whistleri* and mygalomorph spider *Idiosoma sigillatum* occurrence in the Development Envelope or locally within nearby conservation estates, a field survey will be required with regard to Technical guidance sampling of SRE invertebrate fauna (EPA 2016).
- Include appropriate management and mitigation measures to reduce and/or manage the risk of impacts to SREs from weed incursion and increased sedimentation during construction and operations.

1. Introduction

The Yanchep Rail Extension (YRE) project is a 14.5 kilometre (km) extension of the Joondalup railway line, which includes new stations at 3 locations; Alkimos, Eglinton and Yanchep. The YRE project's 143.11 hectare (ha) Development Envelope, which encompasses Part 1 and 2 (including railway extension and stations) and construction and access areas, generally lies between the suburbs of Butler and Yanchep and includes the suburbs of Alkimos and Eglinton.

Part 1 of the project proposes to extend the existing Joondalup railway line by 7.3 kilometres from Butler Station to the suburb of Eglinton in the City of Wanneroo. Part 1 of the proposal is to construct and operate the rail extension and includes two new intermodal (rail, bus, 'park and ride', 'kiss and ride', walk and cycle) transit stations at Alkimos and Eglinton. Part 2 of the project is yet to be referred to the EPA and proposes to extend the railway line from Eglinton Station to Yanchep Station and includes a turnback facility to the north of the Yanchep Station to allow for the turning and stowage of trains. The proposal also includes the construction of a new station at Yanchep with intermodal rail, bus, 'park and ride', 'kiss and ride' and active mode (cycling and walking) facilities at the Yanchep Station.

The main components of the overall project consist of the following:

- Underground and overhead utility service identification, relocations and protection.
- Construction of two new narrow gauge tracks (including associated infrastructure such as overhead line equipment, signalling and telecommunications), as part of extending the Butler line to Yanchep.
- Construction of nine road bridge crossings.
- Construction of three new stations; Alkimos Station, Eglinton Station and Yanchep Station.
- Connection of existing narrow gauge tracks to Butler at Butler Station, with infrastructure modifications (such as turnouts, overhead line equipment, signalling and telecommunications) to the station to accommodate for the newly imposed train operation.
- Upgrading existing traction sub-station from 15MVA to 25MVA either at Nowergup or Edgewater.

Following referral of Part 1 of the YRE project to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act), the EPA decided on 13 March 2018 that the proposal would be assessed on referral and additional information. The EPA issued a Notice Requiring Information for Assessment under section 40(2)(a) of the EP Act, which included the requirement for a desktop short range endemic (SRE) fauna investigation.

Due to the potential for impacts to the surface environment, including vegetation clearing and changes to surface hydrology and the potential for subsequent impacts to SRE invertebrates in the Project area, the PTA has requested Invertebrate Solutions undertake a desktop review of SRE invertebrates and preliminary impact risk assessment for the proposed development.

1.1. Purpose of this report

Invertebrate Solutions has been requested by PTA to undertake a desktop assessment for SRE invertebrates in the proposed YRE Development Envelope (Part 1 and 2) and specifically address the following:

- Review of the previous SRE invertebrate fauna assessments in the EIA document (RPS 2018).
- Provide further information about the about the suitable habitats for SRE invertebrates within the YRE Development Envelope and in the local area.
- Provide a summary of the potential direct and indirect impacts to SRE invertebrate fauna as a result of the project.
- Provide an assessment of the significance of these impacts at a local (Yanchep National Park, Bush Forever Site 289 [Ningana bushland], and Neerabup National Park) and regional (Swan Coastal Plain) scale.
- Provide advice on management and/or mitigation measures that could be implemented to minimise impacts.
- Identify other gaps in the information.
- Provide recommendations and suggested requirements for further work to comply with relevant legislation.
- Provide a written report containing the above items.

1.2. Study Area

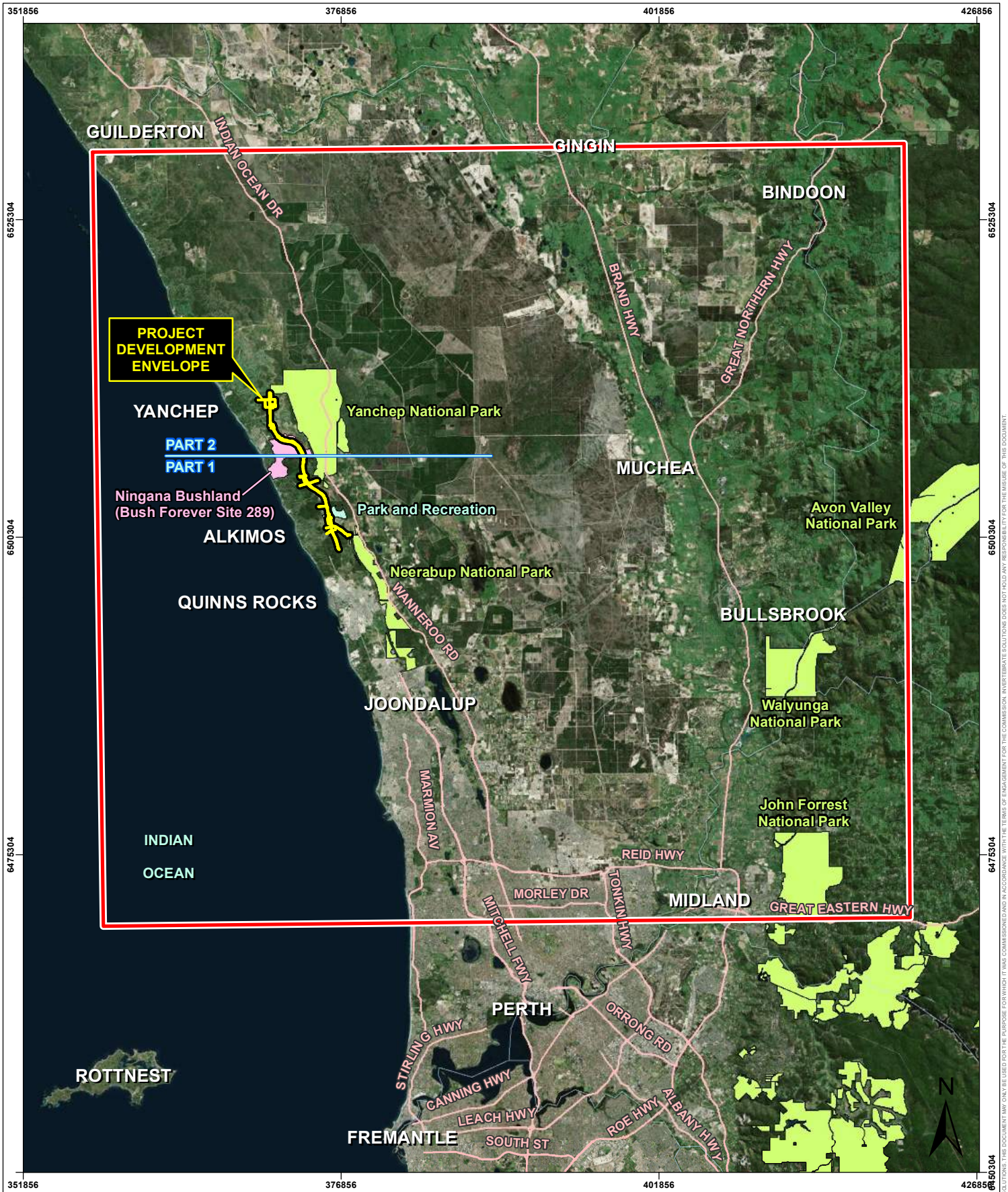
The Study Area for the desktop report is defined by a rectangle bounded by the northwest corner (31°21'00"S 115°30'00"E) and the southeast corner (31°54'00"S 116°10'15"E). The Study Area boundary and the YRE Project Development Envelope are shown in Figure 1

1.3. Documents examined

The following documents have been examined in the compilation of this report, along with other referenced scientific papers used to provide general background:

- GHD (2011). Report for Northern Suburbs Railway Alignment from Romeo Road (Alkimos) to Yanchep Graceful Sun-moth Survey. Unpublished report to the Public Transport Authority, 37p.
- GHD (2012). Northern Suburbs Railway Alignment Butler to Yanchep Environmental Investigation. Unpublished report to the Public Transport Authority, 147p.
- RPS (2017). Environmental Impact Assessment Yanchep Rail Extension: Part 1 – Butler Station to Eglinton Station. Unpublished report to the Public Transport Authority, 794p.
- GHD (2018). Yanchep Rail Extension Biological Assessment, Unpublished report to the Public Transport Authority, 219p.

This report has been prepared with regard to the Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA2016).



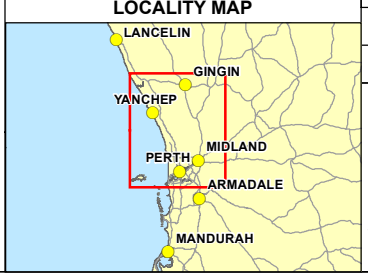
Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope
- National Park
- Ningana Bushland (Bush Forever Site 289)
- Parks and Recreation Area

0 3.75 7.5 15
km
Scale: 1:400,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP



- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- AERIAL PHOTOGRAPHY SOURCED ESRI WORLD IMAGERY

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PROJECT ID	DATE
Yanchep Rail Extension Project	24/05/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 1
Yanchep Rail Extension Project SRE Fauna Study Area

ENVIRONMAPS t: 0406 590 006 Environmental Mapping Solutions www.environmaps.com.au
C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F01 Yanchep Rail Extension Project SRE Fauna Study Area_180524.mxd

1.4. Introduction to SRE invertebrate fauna

Short range endemic (SRE) invertebrates are species with restricted distributions. The isolation of invertebrates in specific habitats or bioregions leads to endemism at various spatial scales. The vast majority of invertebrates are capable of dispersing substantial distances at some phase of their life cycle. Some groups, however, are susceptible to short-range endemism which describes endemic species with restricted ranges, arbitrarily defined in Western Australia as less than 10,000 km^2 (100 km x 100 km) (Harvey, 2002). Taxa that have been more commonly found to contain SRE invertebrate representatives include:

- Onychophorans (velvet worms);
- Crustaceans (Isopoda);
- Arachnids (mygalomorph spiders, pseudoscorpions, opiliones, scorpions, schizomids);
- Myriapods (millipedes and centipedes);
- Molluscs (land snails); and
- Insects (hemipterans, grasshoppers, butterflies).

SRE invertebrate fauna taxa are generally found in sheltered, relatively mesic environments such as isolated habitats (e.g. boulder piles, isolated hills, dense patches of vegetation, gullies) and can include microhabitats within these environments such as deep leaf litter accumulation, large logs, under bark, cave areas and springs and permanent water bodies. Many processes contribute to taxa being susceptible to short range endemism. Generally, these factors are related to the isolation of a species which can include the ability and opportunity to disperse, life history, physiology, habitat requirements, and habitat availability. Taxa that exhibit short range endemism generally exhibit poor dispersal, low growth rates, low fecundity and reliance on habitat types that are discontinuous (Harvey, 2002). Taxa that reside within easily isolated habitats surrounded by physical barriers such as islands, mountains, aquifers, lakes and caves are also more susceptible to becoming SRE species often including additional taxa not otherwise generally forming SREs.

Taxa that exhibit short range endemism are particularly vulnerable to disturbance, either natural or anthropogenic, as they are reliant upon specialised and often restricted habitats (often moist) (Framenau, *et al*., 2008). Short range endemic taxa are unable to disperse to *refugia* when their habitats are threatened or destroyed, thus making them a priority for conservation efforts.

The allocation of short range endemism status can be difficult due to the often incomplete taxonomic framework of many invertebrate groups and the often frequent need for substantial revision to enable accurate identification. Short Range Endemic status is assigned using the categories described in Table 1, based upon the available information from the Western Australian Museum (WAM) database and discussion with appropriate taxonomic authorities for various invertebrate groups. Insufficient information exists for many invertebrate species due to specimens being juvenile, the wrong sex to allow identification, damaged, or inadequate taxonomic frameworks, precluding the assignment of SRE status.

Table 1 Short Range Endemic Status of Species

SRE Status	Definition
Confirmed	A confirmed SRE species. A known distribution of < 10,000 km^2 (after Harvey 2002). Taxonomy of the group is well known. The group is well represented in collections, or via comprehensive sampling.
Likely	Likely to be a SRE species based upon knowledge of the family/genus, where other closely related species show evidence of short range endemism. Where habitats containing the specimens show discontinuity within the landscape.
Possible	Based upon existing knowledge of the genus / family there is a possibility that the species may have a restricted range. Where habitats containing the specimens may show discontinuity within the landscape. Possible SRE species may be assigned one of the sub categories below: A. Data deficient i.e. new species, lack of distribution, taxonomic or collecting knowledge, juvenile specimens, wrong sex for identification B. Habitat indicators C. Morphology indicators D. Molecular evidence E. Research and expertise of WAM staff/taxonomic specialists
Widespread	Not a SRE, a wide ranging distribution of > 10,000 km^2

1.5. Conservation Legislation and Guidance Statements

Terrestrial SRE species are protected under state legislation via the Wildlife Conservation (WC) Act (1950), the Environmental Protection Act (1986) and federally under the Environment Protection and Biodiversity Conservation (EPBC) Act (1999). The assessment of SRE fauna for environmental impact assessment (EIA) is undertaken in Western Australia with regard to the Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA2016).

At the state level, the WC Act provides a list of species that have special protection as species listed under the Wildlife Conservation (Specially Protected Fauna) Notice 2018 (DBCA 2018). This notice is updated periodically by the Department of Biodiversity, Conservation and Attractions (DBCA) (formerly Department of Parks and Wildlife, DPaW) and the current list (January 2018) includes numerous subterranean species, mainly from the Cape Range and Pilbara regions including crustaceans, arachnids and myriapods that are considered to be “rare or likely to become extinct, as critically endangered fauna, or are declared to be fauna that is in need of special protection” (DPaW 2016). In addition to the specially protected fauna, DBCA also maintains a list of Priority fauna that are considered to be of conservation significance but do not meet the criteria for formal listing under the WC Act as Scheduled species. The Priority fauna list is irregularly updated by DBCA with the current list being March 2018 (DBCA 2018) and, although it offers no formal legislative protection, these species are generally considered in the EIA process.

There is no current ability for the state government of Western Australia to formally list Threatened or Priority Ecological Communities (TECs/PECs), however, a list of such communities is maintained by DBCA and overseen by the Minister for the Environment. Communities that are not considered by DBCA to be threatened but may be vulnerable to future impacts are classed as PECs.

The WC Act is expected to be imminently replaced by the new Biodiversity Conservation Act that has yet to be enacted into law. This new act has been passed by the lower house of the State parliament and will be capable of protecting both species and ecological communities under legislation.

The federal EPBC Act protects both species and ecological communities. The most relevant listing for SRE fauna is the mygalomorph spider *Idiosoma nigrum* that occurs in the Wheatbelt region and is listed as Vulnerable. No terrestrial SRE species are currently listed under the EPBC Act.

1.6. Report Limitations and Exclusions

This study was limited to the written scope provided in Section 1.1. This study was limited to the extent of information made available to Invertebrate Solutions at the time of undertaking the work. Information not made available to this study, or which subsequently becomes available may alter the conclusions made herein.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Invertebrate Solutions has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by Invertebrate Solutions described in this report (this section and throughout this report). Invertebrate Solutions disclaims liability arising from any of the assumptions being incorrect.

Invertebrate Solutions has prepared this report on the basis of information provided by the Public Transport Authority and others (including Government authorities), which Invertebrate Solutions has not independently verified or checked beyond the agreed scope of work. Invertebrate Solutions does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Searches of the Western Australian Museum's database records may not return all species present in a search area as database records are sometimes incomplete, or missing. Invertebrate Solutions does not accept liability in connection with such omissions.

Site conditions may change after the date of this report. Invertebrate Solutions does not accept responsibility arising from, or in connection with, any change to the site conditions. Invertebrate Solutions is also not responsible for updating this report if the site conditions change.

1.7. Assumptions

Invertebrate Solutions has made the following assumptions in the writing of this report and its subsequent conclusions:

- The potential impacts identified and assessed in Section 4 and otherwise throughout this report are not necessarily exhaustive and may change with additional detail regarding the potential development.

2. Desktop Methods

The SRE invertebrate desktop review comprises of two distinct sections:

- An assessment of the likelihood that SRE invertebrate species are present in the habitats located within the Study Area.
- Consideration of the potential impacts to SRE invertebrate species that may occur as a result of the YRE Project.

2.1 Likelihood of SRE invertebrate occurrence

The likelihood of SRE invertebrate species occurring in the Study Area was assessed using a combination of regional and local botanical and landform information and database searches including:

- Analysis of published and unpublished reports concerning SRE invertebrate from the region.
- Botanical and vegetation mapping and other information available for the Study Area.
- Results of a Protected Matters Search from the Federal Government's Department of the Environment and Energy (DEE) website.
- Records of fauna held by the WAM.

When considering the likelihood of SRE invertebrates at the local scale the Yanchep National Park, Bush Forever Site 289 (Ningana bushland), and Neerabup National Park were specifically investigated whilst assessments at the regional scale included the entire Swan Coastal Plain.

Based on the analysis of all available information the Study Area was assigned a level of likelihood to support SRE invertebrates of either 'Very Low', 'Low', 'Moderate', 'High', or 'Definite'.

Table 2 SRE species likelihood of occurrence definitions

SRE Species Likelihood of occurrence	Definition
Definite	The species is confirmed to occur within the Study Area.
High	Habitat for the species is known to occur within the Study Area and known records of the species are within 20 km.
Moderate	Habitat for the species is known to occur within the Study Area and known records of the species are within 50 km.
Low	The species has been recorded from within 50 km, however, no habitat is present for the species within the Study Area.
Very low	No habitat exists for the species within the Study Area and no records of the species are within 50 km or the distribution of the species is known well enough to exclude its presence within the Study Area.

2.2 Potential Impacts to SRE invertebrates

The potential impacts of development on invertebrates may be categorised as:

- Direct impacts; and
- Indirect impacts.

Direct impacts are the obvious and unavoidable destruction or degradation of habitat, generally native vegetation that occurs due to clearing and earthworks (e.g. infrastructure areas etc.). Indirect impacts are generally gradational, and more difficult to predict and manage because they may occur at moderate to large distances from the project footprint. These impacts may be expressed some time after development has begun.

The zone of influence for indirect impacts may be considerably larger than areas of direct impact. Potential indirect impacts of development include:

- Risk of extinction from reduction and/or fragmentation in habitat;
- Dust deposition;
- Alteration of surface hydrology regimes, sedimentation, and water quality (e.g. under and proximal to roads and infrastructure);
- Surface water contamination from plant equipment and infrastructure; and
- Vibration disturbance from operational activities.

The proposed Project alignment and cut and fill plans contained with the Advisian (2017) geotechnical report and the EIA documentation (RPS 2017) were reviewed to assess the potential severity of impact to potential SRE habitats. In evaluating the relevance of these factors to the Project, consideration was given to the magnitude, duration and spatial extent of the impacts, where known. This assessment has taken the approach of considering these broad categories of potential impacts and evaluating their occurrence and relative severity. The impacts were then assigned a level of either 'Low', 'Moderate', or 'High' according to their potential degree to adversely affect the EPA's objective to maintain representation, diversity, viability and ecological function at the species, population and assemblage level for SRE fauna.

Where an impact is designated as 'Low' no further consideration to this factor is required if all assumptions made throughout this report are correct.

3. Desktop SRE invertebrate Review

3.1 SRE invertebrates of Swan Coastal Plain

The Swan Coastal Plain (SCP) has a limited occurrence of species considered to be short range endemics, however, due to urban sprawl and associated land clearance, much of the habitat that once occurred on the SCP has been lost or is now highly fragmented. The majority of the conservation significant terrestrial invertebrates on the SCP are insects, with native bees, Katydids (tree crickets) and the Graceful Sun-moth (*Synemon gratiosa*) being the most regularly encountered taxa. Many of these species are also considered SREs under the *sensu stricto* definition of Harvey (2002). In addition there are potential SRE species from the more traditional groups such as mygalomorph spiders, millipedes and land snails.

Graceful Sun-moths (GSM) are diurnal, and active on warm bright sunny days with low wind. GSM are generally restricted to the SCP but has also been recorded from the Geraldton sandplains and is known from 49 locations (Bishop *et al.* 2010). Extensive survey and genetic work undertaken throughout the SCP between 2010 – 2013 eventually saw their removal from the WC Act and the EPBC fauna list, however due to their limited distribution, small populations and rarity in nature the GSM is listed on the DBCA Priority fauna listing (Priority 4).

Plate 1 The P4 listed Graceful Sun-moth from within the YRE Project Envelope (After GHD 2011.).

3.2 Conservation Significant Fauna in the Study Area

A list of conservation significant fauna for the Study Area was compiled from the DBCA Wildlife Conservation (Specially Protected Fauna) Notice 2018 (DBCA 2018) and the DEE's Protected Matters Search Tool (PMST). SRE species that are listed under the WC Act and/or the EPBC Act and are likely to occur or have known habitat within the Study Area are shown in Table 3 along with their conservation code. The PMST results listed no known SRE fauna within the YRE Project Development Envelope. A full description of the WC and DBCA conservation codes are shown in Appendix 1. The full list of species obtained from the PMST search is shown in Appendix 2.

Table 3 Conservation significant SRE Invertebrates potentially within the Study Area.

Higher Classification	Genus and Species	DBCA/ WC Status	EPBC status
Gastropoda:	*Bothriembryon perobesus*	P1	-
Hexapoda: Collembola	*Australotomurus morbidus*	P3	-
Insecta: Orthoptera	*Austrosaga spinifer*	P2	-
	Pachysaga strobila	P1	-
	Throscodectes xiphos	P1	-
Insecta: Diptera	*Austroconops mcmillani*	P2	-
Insecta: Lepidoptera	*Synemon gratiosa*	P4	-
Insecta: Hymenoptera	*Hylaeus globuliferus*	P3	-
	Leioproctus contrarius	P3	-
	Leioproctus douglasiellus	EN/ Schedule 2	Critically Endangered
	Neopasiphae simplicior	EN/ Schedule 2	Critically Endangered

3.3 SRE Habitat in the Study Area

The vegetation and landform units identified in the biological assessment (GHD 2018) were used to assess the YRE Development Envelope for potential SRE habitat. None of the habitats identified would provide habitat isolates that would be likely to contain SRE taxa within the limited extent of the YRE Project Development Envelope. All the vegetation units are laterally continuous within the region and not limited to the YRE Development Envelope (Table 4).

The suitability of habitat for SRE species outside of the YRE Development Envelope has been mapped in Figure 2 and Figure 3 using desktop information and aerial photography only. This habitat mapping is indicative only and has not been ground truthed but it does provide an indication of native vegetation compared with urban and agricultural land. Generally on the SCP native vegetation has a Moderate likelihood of containing an SRE taxa , whilst on the Darling scarp the likelihood increases for high quality vegetation due to the presence of sheltered gullies, rocky granite outcrops and other potential habitat isolates and *refugia*. Although all urban areas have broadly been classified as Nil suitability for SRE fauna, small remnant bushland patches can and do support SRE fauna within the Perth metropolitan area (Rix *et al.* 2018), however, at the scale of the Desktop Study Area mapping in Figure 3 these small isolated patches have been ignored for the sake of overall clarity.

Table 4 Vegetation units in the YRE Development Envelope and SRE invertebrate habitat potential (after GHD 2018).

Landform	Vegetation Unit (after GHD 2018)	SRE Fauna Suitability
Slopes of dunes	*Acacia saligna* and *Xanthorrhoea preissii* tall shrubland (VT01)	Moderate
	Banksia sessilis and *Melaleuca systena* midshrubland (VT02)	
	Eucalyptus gomphocephala tall woodland (VT06)	
	Eucalyptus sp., *Agonis flexuosa* woodland (VT07)	
	Xanthorrhoea preissii shrubland (VT10)	
Dune swales	*Banksia sessilis* and *Spyridium globulosum* tall shrubland (VT03)	Moderate
Undulating plain	*Banksia attenuata*, *B. menziesii* low woodland (VT04)	Moderate
	Banksia attenuata woodland (VT09)	
	Eucalyptus decipiens woodland (VT11)	
	Scattered Natives (VT13)	
	Acacia rostellifera tall shrubland (VT14)	
Dunes ridges	*Lomandra* sp. herbland (VT05)	Moderate
Upper slopes and ridge of dunes with outcropping limestone.	*Melaleuca huegelii* and *M. systena* shrubland (VT08)	Moderate
Plain	*Banksia attenuata* and *B. grandis* low woodland (VT15)	Moderate

The YRE Development Envelope will overall remove approximately 95 ha (1.67 % of the locally available Medium habitat) of SRE habitat with Medium suitability and 46 ha (2.98 % of the locally available Low habitat) of SRE habitat with low suitability (Table 5, Table 6, Figure 2). In local conservation estate there is 2,965 ha (52.05 %) of additional Medium SRE habitat in conservation estate including Yanchep National Park, Bush Forever Site 289 (Ningana Bushland) and Neerabup National Park. Outside of conservation estate there is 2,636 ha (46.28 %) of additional Medium SRE habitat in the local area.

Part 1 of the YRE Project will remove approximately 43 ha (0.75 % of the locally available Medium habitat) of SRE habitat with Medium suitability and 25 ha (1.65 % of the locally available Low habitat) of SRE habitat with low suitability (Table 5, Table 6, Figure 2).

Part 2 of the YRE Project will remove approximately 52 ha (0.92 % of the locally available Medium habitat) of SRE habitat with Medium suitability and 21 ha (1.33 % of the locally available Low habitat) of SRE habitat with low suitability (Table 5, Table 6, Figure 2).

At the regional scale of the Study Area that encompasses much of the northern SCP, the YRE Development Envelope (Part 1 and Part 2 combined) represents only 0.08 % of Medium and 0.04% of Low SRE suitable habitat, and no High SRE suitable habitat (Table 6, Figure 3).

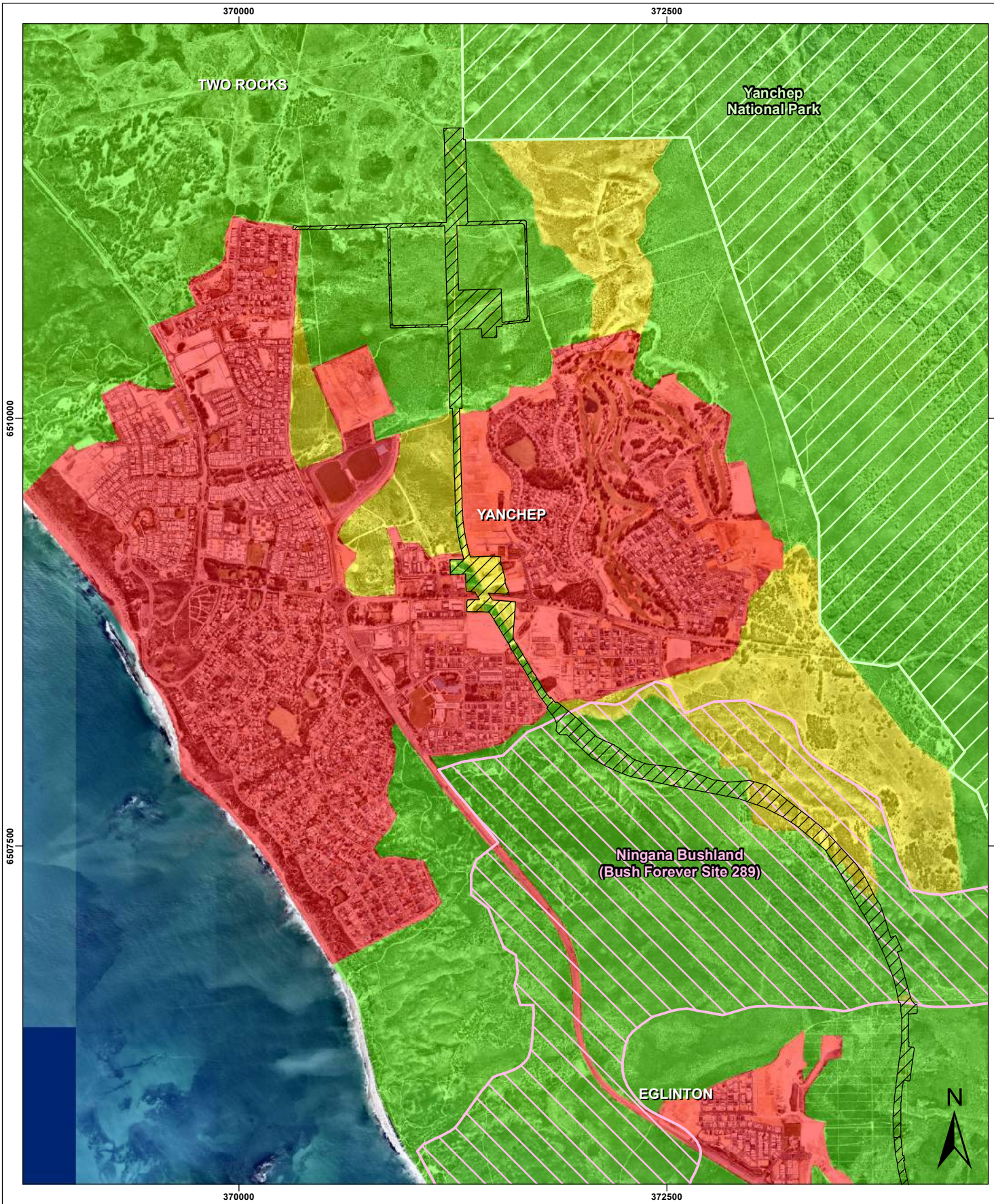
At the regional scale of the Study Area that encompasses much of the northern SCP, Part 1 and Part 2 of the YRE Project each individually represent only 0.04 % of Medium and 0.02% of Low SRE suitable habitat, and no High SRE suitable habitat (Table 6, Figure 3).

Table 5 SRE habitat availability in hectares at the local and regional scale

SRE Habitat Suitability	Local (Ha)						Regional (Desktop Study Area) (Ha)					
	YRE DE Part 1	YRE DE Part 2	YRE DE Total	Conservation estate	Non conservation estate	Total	YRE DE Part 1	YRE DE Part 2	YRE DE Total	Conservation estate	Non conservation estate	Total
High	0	0	0	0	0	0	0	0	0	4799	7098	11897
Medium	43	52	95	2965	2636	5696	43	52	95	4448	115499	120042
Low	25	21	46	52	1445	1543	25	21	46	52	125127	125225
Nil	0	0	0	11	1855	1866	0	0	0	11	42441	42452
N/A	2	0	2	0	0	2	2	0	2	0	0	2

Table 6 SRE habitat availability in percent of area at the local and regional scale

SRE Habitat Suitability	Local (percent of area)						Regional (Desktop Study Area) (percent of area)					
	YRE DE Part 1	YRE DE Part 2	YRE DE Total	Conservation estate	Non conservation estate	Total	YRE DE Part 1	YRE DE Part 2	YRE DE Total	Conservation estate	Non conservation estate	Total
High	0	0	0	0	0	0	0	0	0.00	40.34	59.66	100.00
Medium	0.75	0.92	1.67	52.05	46.28	100.00	0.04	0.04	0.08	3.71	96.22	100.00
Low	1.65	1.33	2.98	3.37	93.65	100.00	0.02	0.02	0.04	0.04	99.92	100.00
Nil	0	0	0.00	0.59	99.41	100.00	0	0	0.00	0.03	99.97	100.00
N/A	100.00	0	100.00	0.00	0.00	100.00	100.00	0	100.00	0.00	0.00	100.00



Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope
- National Park
- Parks and Recreation Area

SRE Habitat Likelihood

- Moderate
- Low
- Nil
- N/A

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- AERIAL PHOTOGRAPHY SOURCED NEARMAPS, 2018

0 0.25 0.5 1
km

Scale: 1:30,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP

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PROJECT ID	DATE
Yanchep Rail Extension Project	24/05/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

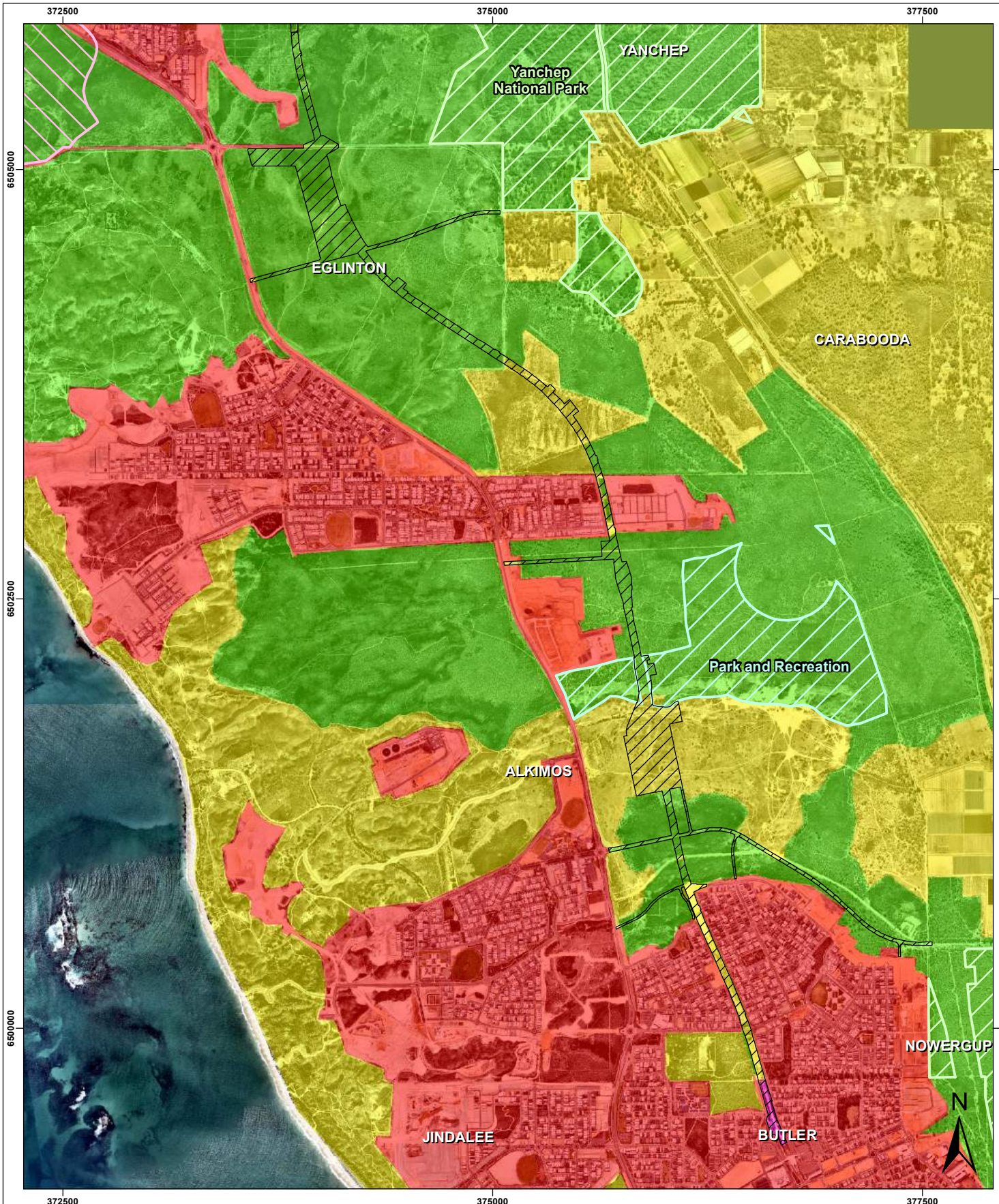
CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 2a

SRE Habitat Suitability in the YRE Development Envelope and Local Area Based on GHD 2018 Vegetation Mapping and Aerial Images

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F02a SRE Habitat Suitability in the YRE Development Envelope and Local Area Based on GHD 2018 Vegetation Mapping and Aerial Images_180524.mxd



Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope
- National Park
- Parks and Recreation Area

SRE Habitat Likelihood

- Moderate
- Low
- Nil
- N/A

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- AERIAL PHOTOGRAPHY SOURCED NEARMAPS, 2018

0 0.25 0.5 1
km

Scale: 1:30,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP

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PROJECT ID	DATE
Yanchep Rail Extension Project	24/05/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

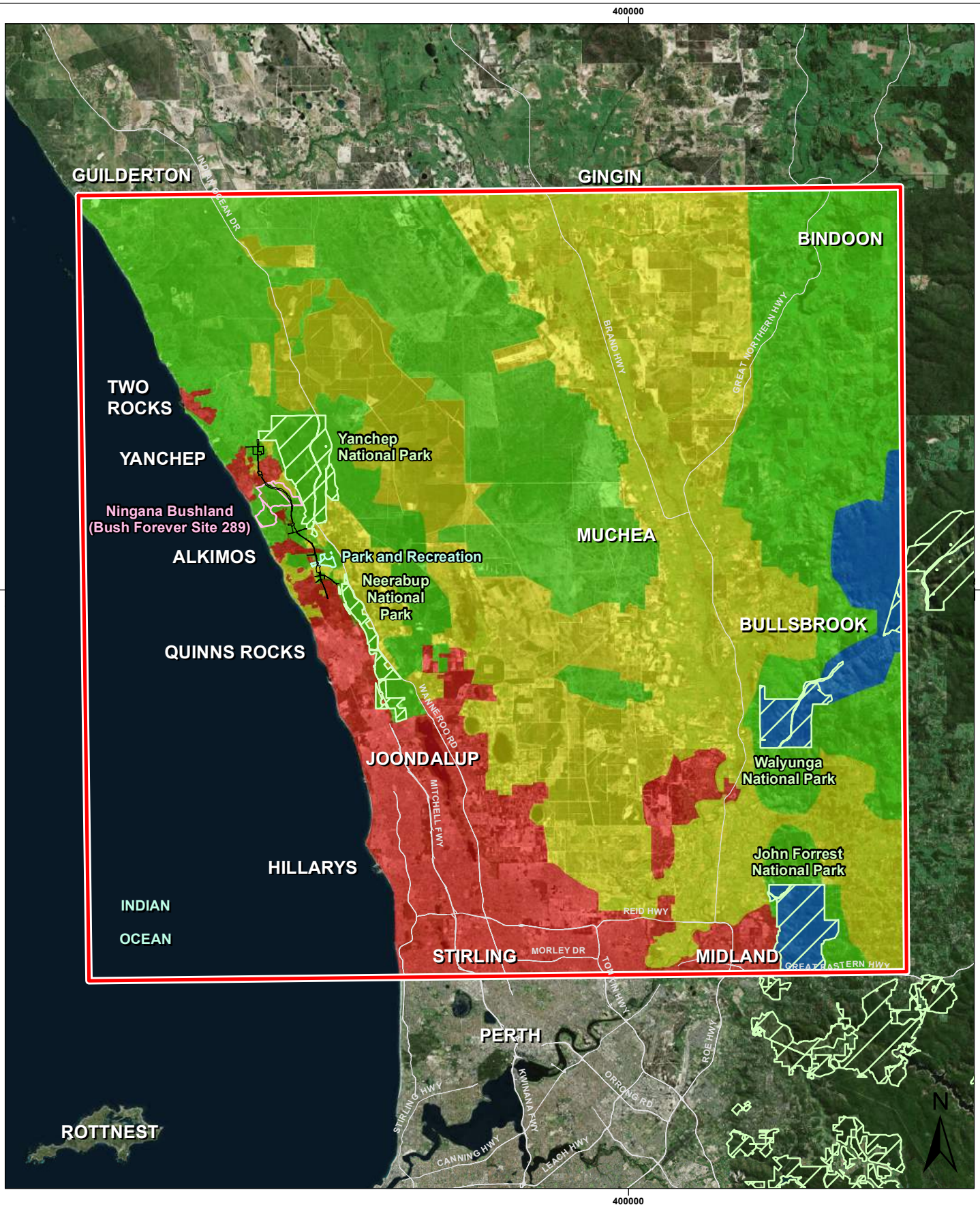
CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 2b

SRE Habitat Suitability in the YRE Development Envelope and Local Area Based on GHD 2018 Vegetation Mapping and Aerial Images

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F02b SRE Habitat Suitability in the YRE Development Envelope and Local Area Based on GHD 2018 Vegetation Mapping and Aerial Images_180524.mxd



Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope
- National Park
- Parks and Recreation Area

SRE Habitat Suitability

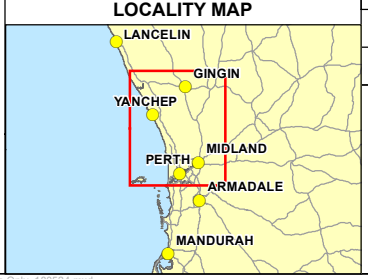
- High
- Moderate
- Low
- Nil
- NA

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- AERIAL PHOTOGRAPHY SOURCED ESRI, WORLD IMAGERY

0 3.75 7.5 15
km
Scale: 1:400,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP



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PROJECT ID	DATE
Yanchep Rail Extension Project	24/05/2018

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 3

SRE Habitat Suitability in the Desktop Study Area Based on Aerial Images Only

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\VREP_F03 SRE Habitat Suitability in the Desktop Study Area Based on Aerial Images Only_180524.mxd

3.4 Potential occurrence of SRE Invertebrates within the Study Area

A search was undertaken of the WAM databases for Crustaceans (WAM 2018a), Arachnids/Myriapods (WAM 2018b) and Molluscs (WAM 2018c). The searches were undertaken as an approximate 50 km x 65 km rectangle centred on the YRE Development Envelope (31°21'00"S 115°30'00"E, 31°54'00"S 116°10'15"E). The results of these were filtered for groups that potentially contain SRE species as shown in Table 7. Definitions for SRE status are found in Table 1.

Table 7 Potential SRE Invertebrates in WAM databases recorded from within the Study Area.

Higher Classification	Genus and Species	SRE status and Notes
Bivalvia		
Heterodonta: Sphaeriidae	*Sphaerium kendricki*	Confirmed
Gastropoda		
Pulmonata: Bothriembryontidae	*Bothriembryon perobesus*	Confirmed
	Bothriembryon serpentinus	Confirmed
Pulmonata: Succineidae	*Succinea contenta*	Confirmed
Onychophora		
Peripatopsidae	*Occiperipatoides gilesii*	Widespread
Crustacea		
Amphipoda		
Talitridae	*Chiltonia subtenuis*	Widespread
	Talitrus clarki	Widespread
Isopoda		
Amphisopodidae	*Paramphisopus palustris*	Widespread
Armadillidae	*Buddelundia opaca*	Likely
	Buddelundia cinerascens	Likely
	Buddelundia inaequalis	Widespread
	Buddelundia nigripes	Widespread
	Armadillidium vulgare	Widespread
Porcellionidae	*Porcellio scaber*	Widespread
	Porcellio laevis	Widespread
	Porcellionides pruinosus	Widespread
Arachnida		
Araneae: Mygalomorphae		
Actinopodidae	*Missulena granulosa*	Widespread
	Missulena hoggi	Widespread
	Missulena occatoria	Widespread
Barychelidae	*Aurecocrypta lugubris*	Widespread
	Idiommata blackwalli	Widespread
	Synothele durokoppin	Widespread
	Synothele lowei	Likely
	Synothele michaelseni	Likely
	Synothele mullaloo	Widespread
	Synothele taurus	Likely
Dipluridae	*Cethegus fugax*	Widespread
Idiopidae	*Eucyrtops`MYG142`*	Widespread
	Euoplos inornatus	Confirmed
	Idiosoma jarrah	Confirmed
	Idiosoma MYG473	Widespread
	Idiosoma sigillatum	Confirmed
	Idiosoma cupulifex	Widespread

Higher Classification	Genus and Species	SRE status and Notes
	Idiosoma rhaphiduca	Widespread
Nemesiidae	*Aname* `MYG184`	Widespread
	Aname mainae	Widespread
	Aname tepperi	Widespread
	Kwonkan`MYG060`	Widespread
	Teyl `MYG249`	Likely
	Teyl `waldockae`	Likely
Opiliones		
Phalangodidae	*Bindoona glauerti*	Possible (A)
Neopilionidae	*Ballarra longipalpus*	Widespread
Pseudoscorpionida		
Atemnidae	*Oratemnus curtus*	Widespread
Cheliferidae	*Protochelifer cavernarum*	Possible (D)
Garypidae	*Synsphyronus`sp. nov.`*	Possible (A)
	Synsphyronus callus	Widespread
Geogarypidae	*Geogarypus taylori*	Widespread
Olpiidae	*Beierolpium`sp.`*	Possible (A)
	Indolpium Sp.	Possible (A)
Chthoniidae	*Austrochthonius`grandis`*	Widespread
	Austrochthonius`pilbara`	Widespread
	Austrochthonius 'similis'	Widespread
	Austrochthonius australis	Widespread
	Lagynochthonius australicus	Widespread
	Tyrannochthonius sp.	Possible (A)
Scorpiones		
Bothriuridae	*Cercophonius granulosus*	Widespread
	Cercophonius squama	Widespread
Buthidae	*Isometroides vescus*	Widespread
Urodacidae	*Urodacus armatus*	Widespread
	Urodacus hartmeyeri	Widespread
	Urodacus novaehollandiae	Widespread
	Urodacus planimanus	Widespread
Diplopoda		
Iulomorphidae	*Dinocambala ingens*	Likely
Julidae	*Ommatoiulus moreletti*	Widespread
	Cylindroiulus latestriatus	Widespread
Paradoxosomatidae	*Antichiropus variabilis*	Widespread
	Antichiropus whistleri	Confirmed
	Oxidus gracilis	Widespread
	Solaenodolichopus pruvoti	Widespread
	Akamptogonus novarae	Widespread
Polyxenidae	*Unixenus attemsi*	Widespread
	Unixenus mjoebergi	Widespread
Chilopoda		
Lithobiida: Henicopidae	*Henicops dentatus*	Widespread
Scutigerida: Scutigeridae	*Cormocephalus aurantiipes*	Widespread
	Cormocephalus novaehollandiae	Widespread
	Cormocephalus rubriceps	Widespread
	Cormocephalus strigosus	Widespread
	Cormocephalus turneri	Widespread
	Ethmostigmus rubripes	Widespread

Higher Classification	Genus and Species	SRE status and Notes
	Notiasemus glauerti	Widespread
	Scolopendra laeta	Widespread
	Allothereua maculata	Widespread

The Study Area contains nine Confirmed SRE species (three land snails, three mygalomorph trapdoor spiders, one bivalve, one millipede and one tree cricket), 10 Likely SRE species (five mygalomorph trapdoor spiders, two terrestrial slaters, two tree crickets and one millipede), and eight Possible SRE species (five pseudoscorpions, one springtail, one midge, and one harvestman). The remainder of the species were found to be widespread.

Within the YRE Development Envelope, there are two Confirmed SRE species that have a High Likelihood of occurrence; the millipede (*Antichiropus whistleri*) and the trapdoor spider (*Idiosoma sigillatum*) (Table 8). In addition the conservation significant but widespread (*sensu stricto,* Harvey 2002) species the Graceful Sun-moth (*Synemon gratiosa*) was recorded in 2011 (GHD 2011). All Confirmed and Likely SRE species are considered in depth in Section 3.5.

There are also seven Likely SRE species (three mygalomorph spiders, two slaters and a tree cricket) that have a Moderate likelihood of occurring within the YRE Development Envelope, as well as the widespread but conservation significant bee (*Hylaeus globuliferus*). There are also two Possible SRE species, a harvestman arachnid and a pseudoscorpion that have a Moderate and High Likelihood respectively of occurring within the YRE Development Envelope (Table 8).

Table 8 SRE and conservation significant taxa within the YRE Development Envelope

Higher Classification	Genus and Species	SRE status	Likelihood of species within the YRE Development Envelope
Bivalvia			
Heterodonta: Sphaeriidae	*Sphaerium kendricki*	**Confirmed**	**Low**
Gastropoda			
Pulmonata: Bothriembryontidae	*Bothriembryon perobesus*	**Confirmed**	**Moderate**
	Bothriembryon serpentinus	**Confirmed**	**Low**
Pulmonata: Succineidae	*Succinea contenta*	**Confirmed**	**Low**
Isopoda			
Armadillidae	*Buddelundia opaca*	**Likely**	**Moderate**
	Buddelundia cinerascens	**Likely**	**Moderate**
Arachnida			
Araneae: Mygalomorphae			
Barychelidae	*Synothele lowei*	**Likely**	**Moderate**
	Synothele michaelseni	**Likely**	**Moderate**
	Synothele taurus	**Likely**	**Moderate**
Idiopidae	*Euoplos inornatus*	**Confirmed**	**Low**
	Idiosoma jarrah	**Confirmed**	**Very Low**
	Idiosoma sigillatum	**Confirmed**	**High**

Higher Classification	Genus and Species	SRE status	Likelihood of species within the YRE Development Envelope
	Teyl MYG249	**Likely**	**Low**
	Teyl 'sp. waldockae'	**Likely**	**Low**
Opiliones			
Phalangodidae	*Bindoona glauerti*	**Possible (A)**	**Moderate**
Pseudoscorpionida			
Cheliferidae	*Protochelifer cavernarum*	**Possible (D)**	**High**
Garypidae	*Synsphyronus sp. nov.*	**Possible (A)**	**Low**
Olpiidae	*Beierolpium sp.*	**Possible (A)**	**Low**
	Indolpium sp.	**Possible (A)**	**Low**
Chthoniidae	*Tyrannochthonius sp.*	**Possible (A)**	**Low**
Diplopoda			
Iulomorphidae	*Antichiropus whistleri*	**Confirmed**	**High**
	Dinocambala ingens	**Likely**	**Low**
Hexapoda			
Collembola	*Australotomurus morbidus*	**Possible (A)**	**Low**
Insecta			
Orthoptera	*Austrosaga spinifer*	**Likely**	**Moderate**
	Pachysaga munggai/strobila	**Likely**	**Confirmed***
	Throscodectes xiphos	**Confirmed**	**Very low**
Diptera	*Austroconops mcmillani*	**Possible (A)**	**Very Low**
Lepidoptera	*Synemon gratiosa*	**Widespread**	**Confirmed**
Hymenoptera	*Hylaeus globuliferus*	**Widespread**	**Moderate**
	Leioproctus contrarius	**Widespread**	**Low**
	Leioproctus douglasiellus	**Widespread**	**Low**
	Neopasiphae simplicior	**Widespread**	**Low**

*** A tree cricket was photographed by GHD (2012) within the YRE Project Envelope and identified using the photograph by Dr David Rentz (CSIRO ret.). It was unclear if the species was *Pachysaga munggai* or *P. strobila*.**

3.5 Distribution of Confirmed SRE species within the YRE Development Envelope

3.5.1 Bivalvia

Sphaerium kendricki

This species of bivalve are commonly known as pea clams and have thin white to transparent shells and are known from multiple wetlands on the SCP (Davis and Christidis 1997) and with isolated historical records from near Augusta and Bunbury (WAM 2018c) (refer Figure 4 and Figure 5). The closest records of *Sphaerium kendricki* to the YRE Development Envelope are from Lake Neerabup (Figure 5). This species will not be affected by the YRE Project as *Sphaerium kendricki* primary habitat are wetlands and no wetlands will be impacted by the Project.

3.5.2 Gastropoda

Bothriembryon perobesus

The land snail *Bothriembryon perobesus* occurs on the northern SCP and Geraldton sandplains (refer Figure 4 and Figure 5) from near Moore River to Geraldton (WAM 2018c). *Bothriembryon perobesus* is listed by DBCA as a Priority 1 species in Western Australia. There are no records of the species from within or adjacent to the YRE Development Envelope. The species occurs in the very north westerly extremity of the desktop Study Area near the Moore River and nearby vicinity and has a Moderate probability of occurring within the YRE Development Envelope, although species records would indicate that Moore River is the natural southern boundary of the species and hence no impacts are expected to this species as a result of the YRE Project.

Bothriembryon serpentinus

The land snail *Bothriembryon serpentinus* occurs on the Darling Scarp from Perth south to near Dwellingup (refer (refer Figure 4 and Figure 5, WAM 2018c). There are no records of the species from within or adjacent to the YRE Development Envelope. The species occurs in the very south eastern extremity of the desktop Study Area and has a Low probability of occurring within the YRE Development Envelope. There no records of this species in the vicinity of the YRE and hence no impacts are expected to this species as a result of the YRE Project.

Succinea contenta

The land snail *Succinea contenta* occurs on Rottnest Island, remnant bushland in the western Perth metropolitan area and on the Darling Scarp near John Forrest National Park (refer (refer Figure 4, Figure 5 and WAM 2018c). There are no records of the species from within or adjacent to the YRE Development Envelope. The species has a Low probability of occurring within the YRE Development Envelope and due to records immediately adjacent to John Forrest National Park it is anticipated that the species will also occur in this conservation estate and hence no impacts are expected to this species as a result of the YRE Project.

3.5.3 Araneae: Mygalomorphae

Euoplos inornatus

The trapdoor spider *Euoplos inornatus* occurs on the eastern edge of the SCP, although most records are from the Darling Scarp and the jarrah forest to the east (refer Figure 6, Figure 7 and WAM 2018b). There are no records of the species from within or adjacent to the YRE Development Envelope. The species has a Low probability of occurring within the YRE Development Envelope and due to records immediately adjacent to John Forrest National Park it is anticipated that the species will also occur in this conservation estate and hence no impacts are expected to this species as a result of the YRE Project.

Idiosoma jarrah

The trapdoor spider *Idiosoma jarrah* is endemic to the Jarrah Forest bioregion, where it occurs east of the Darling Escarpment, from Bullsbrook south to at least Boddington and Arthur River (refer Figure 6, Figure 7) (WAM 2018b, Rix *et al.* 2018). There are no records of the species from within or adjacent to the YRE Development Envelope. *Idiosoma jarrah* has a known range of 3,907 km^2,making the species a short range endemic accordingly to the definition by Harvey (2002), although the

known range is likely to be an underestimate due to the paucity of records throughout the south of its range (Rix *et al.* 2018). *Idiosoma jarrah* is known to occur in at least two conservation estates; Walyunga National Park and John Forrest National Park (Figure 7). This species has a Very Low probability of occurring within the YRE Development Envelope as its distribution is reasonably well known and restricted to the Jarrah forest bioregion and as such there is expected to be no impact to Idiosoma jarrah from the PRE Project.

Idiosoma sigillatum

Idiosoma sigillatum is the dominant idiopid trapdoor spider on the Swan Coastal Plain, where it occurs from Dalyellup north to at least Ledge Point (including Rottnest Island and Garden Island) with the eastern limit of its range along the sandy foothills of the Darling Escarpment, from Boyanup north to at least Gingin (refer (refer Figure 6, Figure 7) (WAM 2018b, Rix *et al.* 2018). Many of these records are historical in nature and occur within the Perth metropolitan area. It is highly likely that much of the habitat for this species within the Perth metropolitan area has been cleared for urban development and the species is unlikely to occur through much of its historical distribution in urban areas except in remnant habitats (e.g. Kings Park, Bold Park, and Shenton Park bushland) (Rix et al 2018).

Idiosoma sigillatum was assessed as Vulnerable according to IUCN criteria (Rix *et al.* 2017). It has a known range of 7,100 km^2, and an area of occupancy within that range of < 3,000 km^2 (Rix *et al.* 2017). It is considered to be locally extinct throughout most of its range due to extensive land clearing (Rix *et al.* 2018).

Burrows of *Idiosoma sigillatum* usually occur in *Banksia* woodland and heathland on sandy soils (Rix *et al.* 2018) such as within areas of the YRE Development Envelope (refer Table 4), and the adjacent Yanchep National Park (Figure 7), giving the species a High probability of occurring within the YRE Development Envelope.

Whilst the YRE Project would potentially have a direct local impact upon burrows of *Idiosoma sigillatum* within the clearing area, this is anticipated to be minor compared with available habitat in nearby conservation estates (refer Sections 4.1 and 4.2).

3.5.4 Diplopoda

Antichiropus whistleri

The confirmed SRE millipede species *Antichiropus whistleri* has a known distribution based upon records in the WAM (2018b) from the Perth suburb of Morley north to past Muchea with another cluster of records near Cataby (refer Figure 6 and Figure 7). Many of these records are historical in nature and occur within the Perth metropolitan area. It is highly likely that much of the habitat for this species within the Perth metropolitan area has been cleared for urban development and the species is unlikely to occur through much of its historical distribution in urban areas. It is, however, likely to be more extensively distributed in suitable habitat on the outer urban areas of Perth, despite the absence of verified records due to the requirement for adult male specimens to obtain a species level identification. This would likely include Yanchep National Park, where numerous *Antichiropus* specimens have been recorded but not identified beyond generic level, Bush Forever Site 289 (Ningana bushland) and Neerabup National Park (WAM 2018b).

3.5.5 Insecta: Orthoptera

Throscodectes xiphos

The tree cricket *Throscodectes xiphos* is known only from its type locality in the southern Perth suburb of Jandakot (Figure 6) where it was originally collected in the axial leaf bases of grass trees (X*anthorrhoea preissei*). There are no records of the species from within or adjacent to the YRE Development Envelope. The species is currently classified by DBCA as Priority 1 (refer Table 3). It has not been recorded from within the YRE Development Envelope, although suitable habitat does occur on dune slopes (refer Table 4). It is not anticipated that *Throscodectes xiphos* will be impacted by the YRE Project as no other records of this species have historically been recorded within the Study Area.

3.6 Distribution of Likely SRE species within the YRE Development Envelope

3.6.1 Diplopoda: Iulomorphidae

Dinocambala ingens

The millipede *Dinocambala ingens* occurs mainly in the Darling Scarp and adjacent jarrah forests, although its historical distribution does encompass some central Perth suburbs and Garden Island (refer Figure 8, Figure 9 and WAM 2018b). There are no records of the species from within or adjacent to the YRE Development Envelope. There are numerous records of this species from conservation areas on the Darling Scarp including John Forrest and Walyunga National Parks. The species has a Low probability of occurring within the YRE Development Envelope and hence no impacts are expected to this species as a result of the YRE Project.

3.6.2 Araneae: Mygalomorphae

Synothele lowei

The trapdoor spider *Synothele lowei* occurs in the north eastern edge of the SCP, north of Bullsbrook (Raven 1994) and another record between Chittering and Pearce (refer Figure 10 Figure 11, WAM 2018b). There are no records of the species from within or adjacent to the YRE Development Envelope. The species has a sympatric distribution with another Likely SRE species *Synothele taurus* (Raven 1994) The species has a Low probability of occurring within the YRE Development Envelope and hence no impacts are expected to this species as a result of the YRE Project.

Synothele michaelseni

The trapdoor spider *Synothele michaelseni* occurs on the SCP from Bibra Lake to near Hillarys Boat Harbour and on the Darling Scarp from Serpentine to north of Bindoon (refer Figure 10, Figure 11, WAM 2018b). There are no records of the species from within or adjacent to the YRE Development Envelope. Many of these records are historical in nature and occur within the Perth metropolitan area. It is highly likely that much of the habitat for this species within the Perth metropolitan area has been cleared for urban development and the species is unlikely to occur through much of its historical distribution in urban areas except in remnant habitats. The species has a Low probability of occurring within the YRE Development Envelope and hence no impacts are expected to this species as a result of the YRE Project.

Synothele taurus

The trapdoor spider *Synothele taurus* occurs in the north eastern margin of the SCP, north of Bullsbrook (refer Figure 10 and Figure 11) (Raven 1994). The species is known only from its type locality and not been recorded since the original collection event (Raven 1994, WAM 2018b). The species has a sympatric distribution with another Likely SRE species *Synothele lowei* (Raven 1994) There are no records of the species from within or adjacent to the YRE Development Envelope. The species has a Low probability of occurring within the YRE Development Envelope and hence no impacts are expected to this species as a result of the YRE Project.

Teyl 'MYG249'

The trapdoor spider *Teyl* 'MYG249' occurs on the SCP and Rottnest Island from Cardup near the Darling Scarp to Woodman Point and Trigg Bushland along the coast. (refer Figure 10, Figure 11, WAM 2018b). There are no records of the species from within or adjacent to the YRE Development Envelope. It is highly likely that much of the habitat for this species within the Perth metropolitan area has been cleared for urban development and the species is unlikely to occur through much of its historical distribution in urban areas except in remnant habitats. The species has a Low probability of occurring within the YRE Development Envelope and hence no impacts are expected to this species as a result of the YRE Project.

Teyl sp. 'waldockae'

The trapdoor spider *Teyl* 'waldockae' occurs along the coastal trip of the SCP from East Rockingham, Woodman Point and Trigg Bushland. (refer Figure 10, Figure 11, WAM 2018b). There are no records of the species from within or adjacent to the YRE Development Envelope. It is highly likely that much of the habitat for this species within the Perth metropolitan area has been cleared for urban development and the species is unlikely to occur through much of its historical distribution in urban areas except in remnant habitats. The species has a Low probability of occurring within the YRE Development Envelope and hence no impacts are expected to this species as a result of the YRE Project.

3.6.3 Insecta: Orthoptera

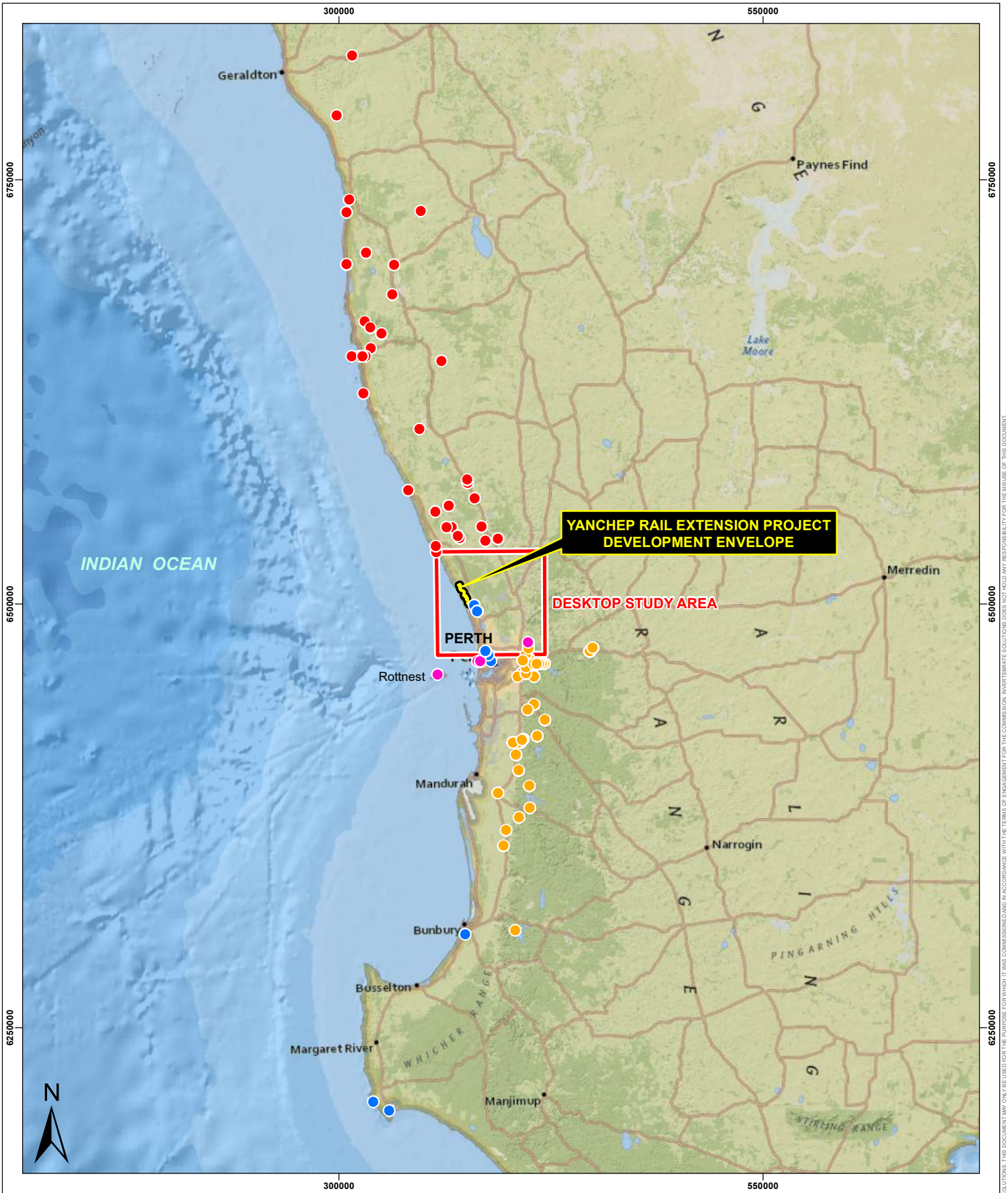
Pachysaga munggai/strobila

The orthopteran family Tettigoniidae are commonly known as Katydids inhabit tree and shrubs and can be found mostly in the southern half of Australia in heath or mixed woodland and often host plant species or genus specific (Rentz 1993).Two closely related and visually similar members of the Austrosagine genus *Pachysaga*; the Vasse Pachysaga (*Pachysaga strobila*), and *Pachysaga munggai* occur in the south west of Western Australia with limited distributional data (Rentz 1993). The Vasse Pachysaga occurs as the name suggests near the townsite of Vasse in the far south west, whilst *P. munggai* occurs from Margaret River to at least Serpentine on the SCP (Figure 8) The Vasse Pachysaga (*Pachysaga strobila)* is listed by DBCA as a Priority 1 species in Western Australia.

During the 2012 biological survey by GHD (2012) an individual from the genus *Pachysaga* was photographed but not collected within the YRE Development Envelope. The photographs were subsequently examined by Dr David Rentz (CSIRO ret.) and identified as either being *P. munggai* or *P. strobila* and the location is shown on Figure 9. Due to the larger distribution of *P. munggai*, and

the fact that *P. strobila* is only known the type locality, it is more likely that the specimen observed in the YRE Development Envelope was *P. munggai*, however, both these species have poorly known distributions and it is impossible to certain which species was observed with the currently available knowledge. Given the narrow linear nature of the project, and given similar habitat values are likely to be present in surrounding vegetation and surrounding conservation estates, it is considered unlikely that the YRE project would result in local extinction of this katydid.

Plate 2 *Pachysaga munggai/strobila* from the YRE Development Envelope (Image after GHD 2012)



Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope

SRE Mollusc Species Locations

- Bothriembryontidae: *Bothriembryon perobesus*
- Bothriembryontidae: *Bothriembryon serpentinus*
- Sphaeriidae: *Sphaerium kendricki*
- Succineidae: *Succinea contenta*

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- BASE DATA SOURCED ESRI NATGEO WORLD MAP

0 25 50 100
km
Scale: 1:3,000,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP

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HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

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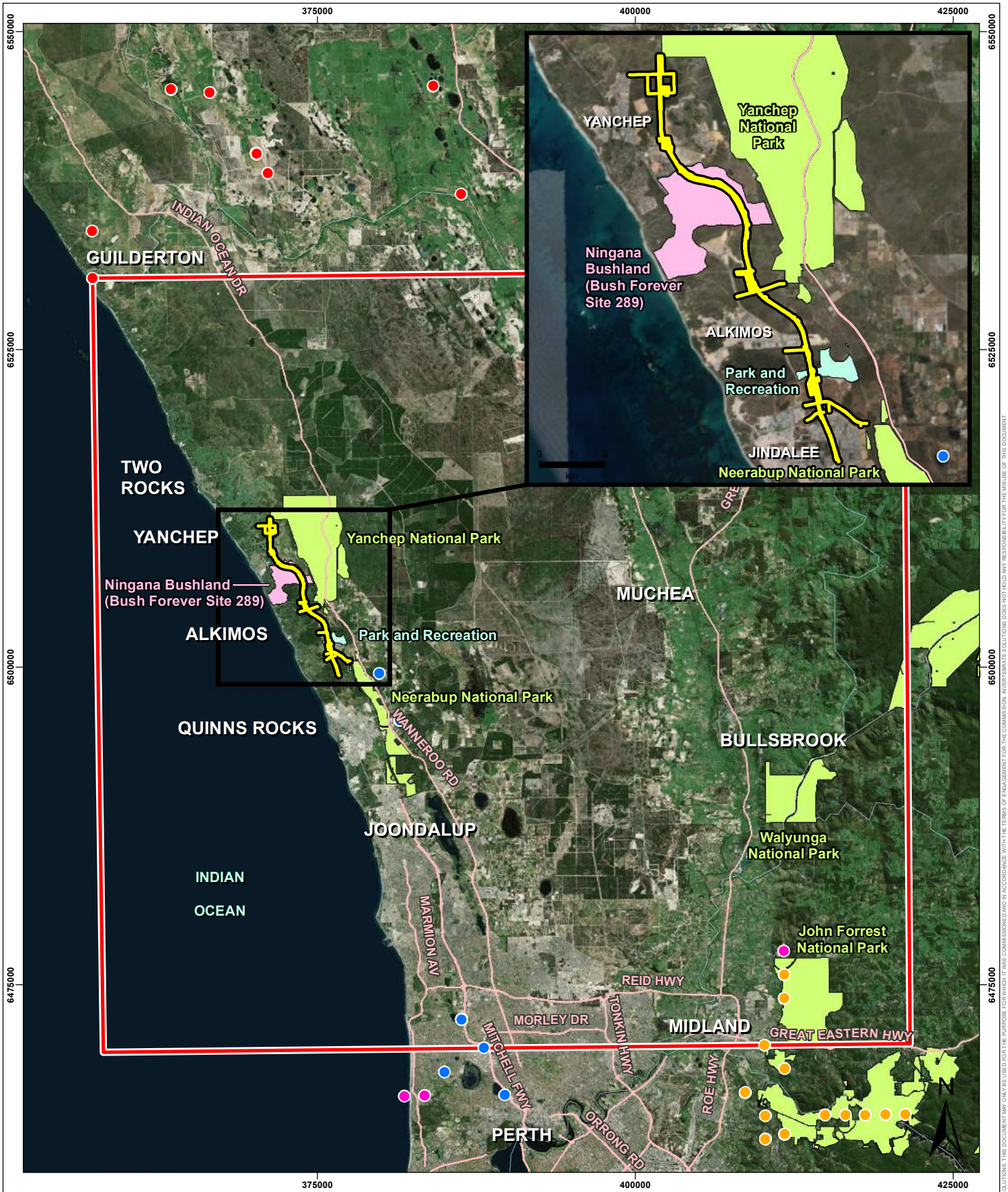
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 4
Distribution of the Confirmed SRE Mollusc Species

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F04 Distribution of the Confirmed SRE Mollusc Species_180524.mxd



Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope
- National Park
- Parks and Recreation Area

SRE Mollusc Species Locations

- Bothriembryontidae: *Bothriembryon perobesus*
- Bothriembryontidae: *Bothriembryon serpentinus*
- Sphaeriidae: *Sphaerium kendricki*
- Succineidae: *Succinea contenta*

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- AERIAL PHOTOGRAPHY SOURCED ESRI WORLD IMAGERY

0 3.75 7.5 15 km

Scale: 1:400,000 @ A4

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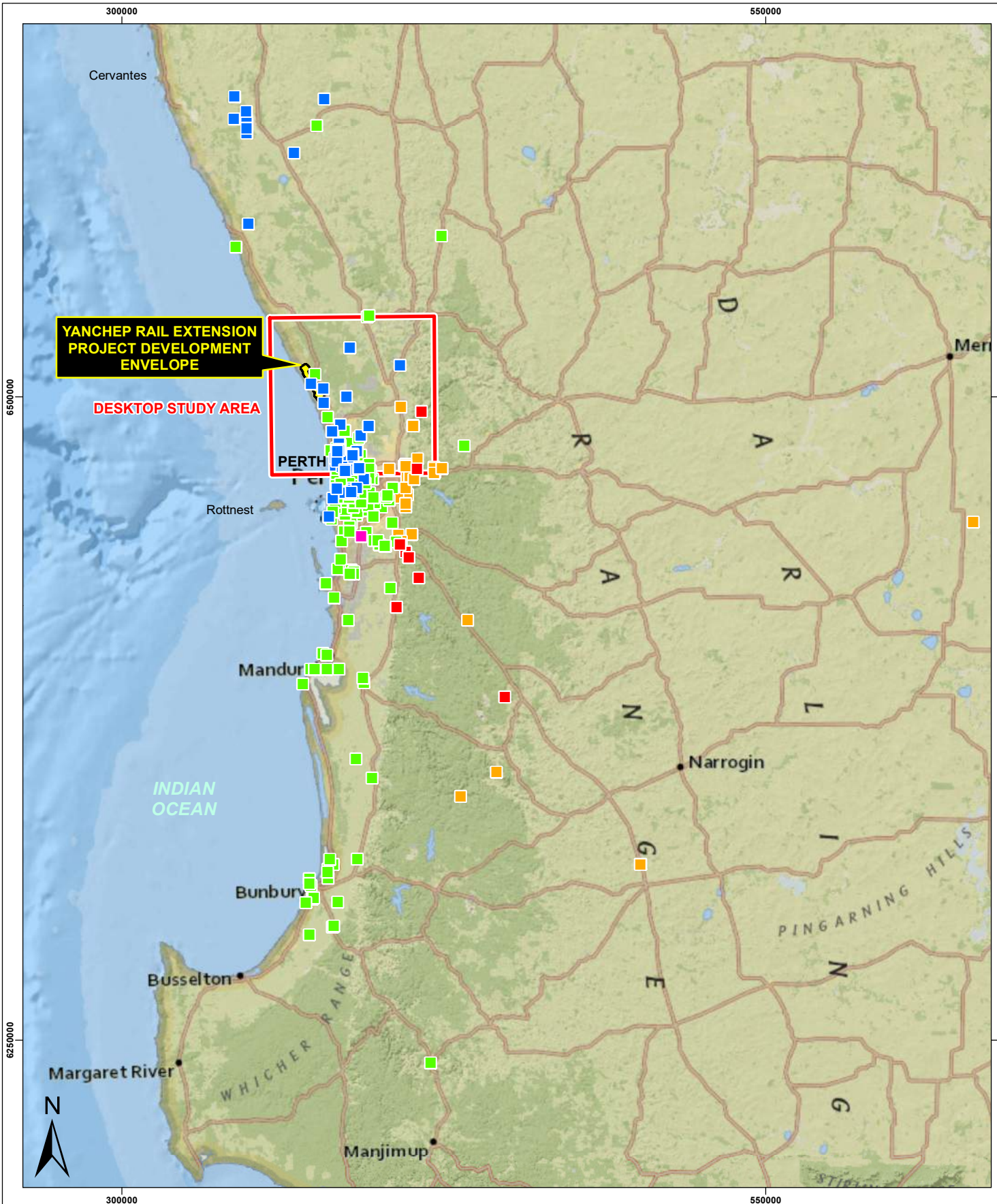
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 5

Distribution of the Confirmed SRE Mollusc Species in Relation to the YRE Development Envelope

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F05 Distribution of the Confirmed SRE Mollusc Species in Relation to the YRE Development Envelope_180524.mxd



Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope

SRE Mygalomoph Spiders, Millipedes and Tree Cricket Species Locations

- Idiopidae: *Euoplos inornatus*
- Idiopidae: *Idiosoma jarrah*
- Idiopidae: *Idiosoma sigillatum*
- Paradoxosomatidae: *Antichiropus whistleri*
- Tettigonidae: *Throscodectes xiphos*

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- BASE DATA SOURCED ESRI NATGEO WORLD MAP

0 15 30 60
km
Scale: 1:2,000,000 @ A4

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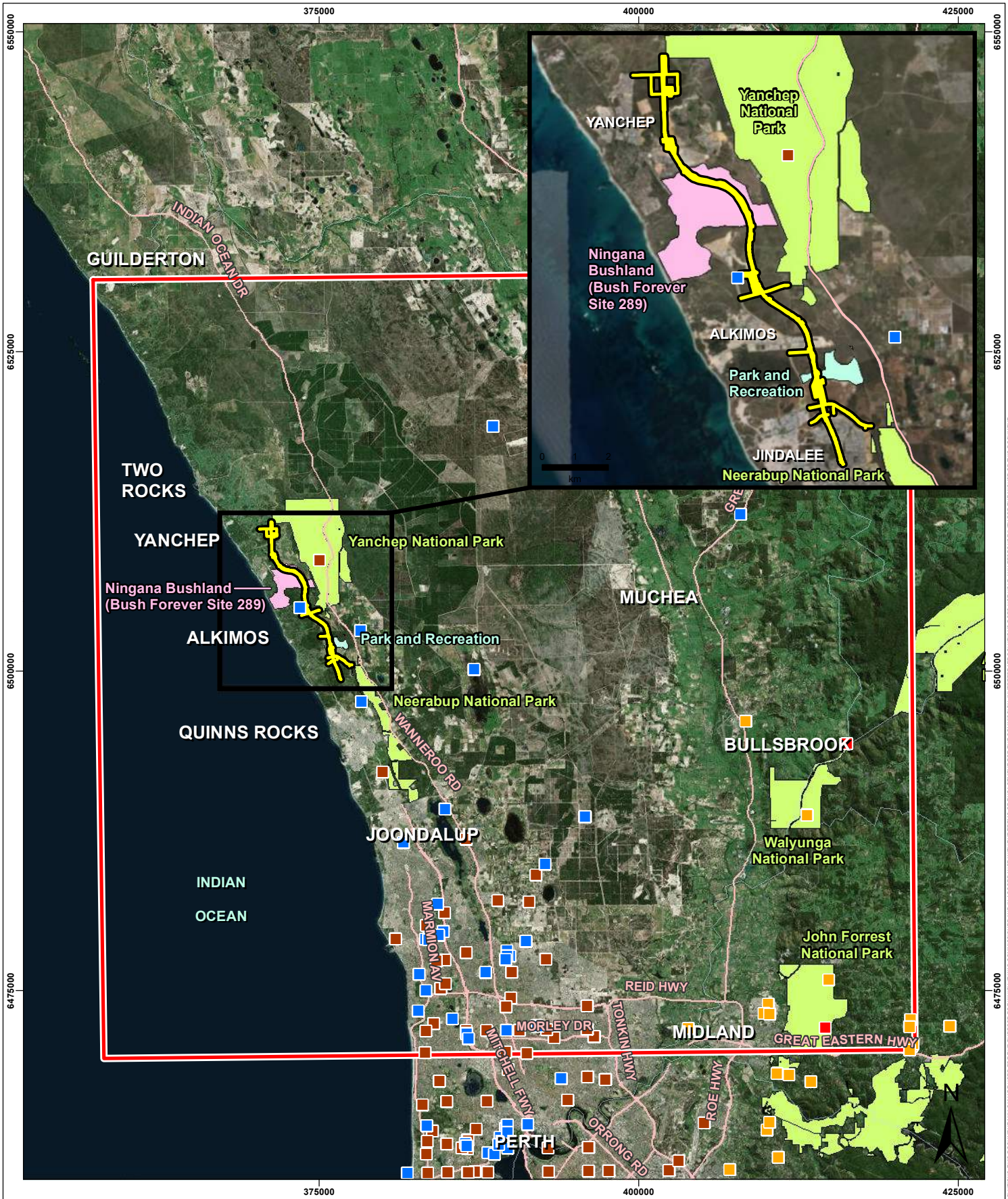
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 6

Distribution of the Confirmed SRE *mygalomorph* spider, millipede and tree cricket species in relation to the YRE Development Envelope

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F06 Distribution of the Confirmed SRE mygalomorph spider, millipede and tree cricket species_180524.mxd



Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope
- National Park
- Parks and Recreation Area

SRE Mygalomoph Spiders, Millipedes and Tree Cricket Species Locations

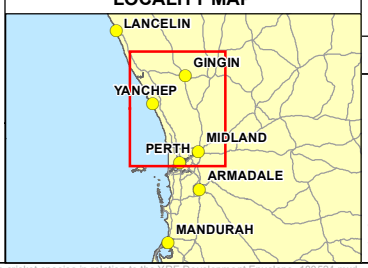
- Idiopidae: *Euoplos inornatus*
- Idiopidae: *Idiosoma jarrah*
- Idiopidae: *Idiosoma sigillatum*
- Paradoxosomatidae: *Antichiropus whistleri*
- Tettigonidae: *Throscodectes xiphos*

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- AERIAL PHOTOGRAPHY SOURCED ESRI WORLD IMAGERY

0 3.75 7.5 15
km
Scale: 1:400,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP



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GDA 1994 MGA Zone 50

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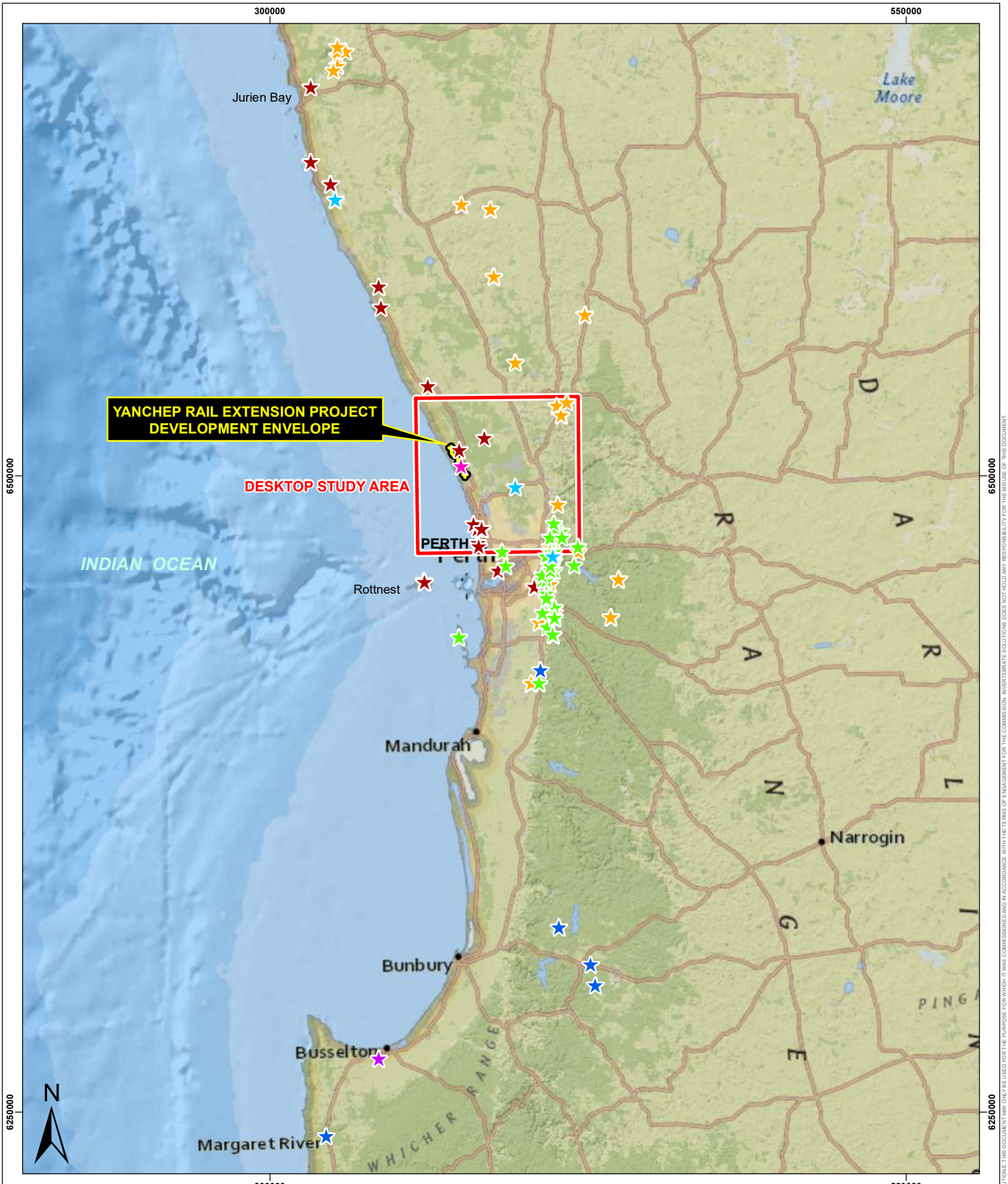
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 7

Distribution of the Confirmed SRE *mygalomorph* spider, millipede and tree cricket species in relation to the YRE Development Envelope

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F07 Distribution of the Confirmed SRE mygalomorph spider, millipede and tree cricket species in relation to the YRE Development Envelope_180524.mxd



Desktop Study Area

Yanchep Rail Extension Project Development Envelope

SRE Slaters, Millipedes and Tree Cricket Species Locations

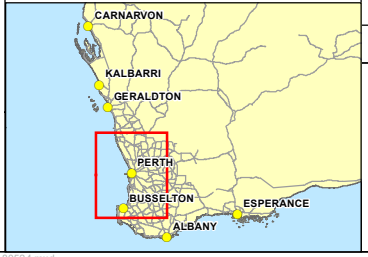
- Armadillidae: *Buddelundia cinerascens*
- Armadillidae: *Buddelundia opaca*
- Iulomorphidae: *Dinocambala ingens*
- Tettiogonidae: *Austrosaga spinifer*
- Tettiogonidae: *Pachysaga munggai*
- Tettiogonidae: *Pachysaga strobila*
- Tettiogonidae: *Pachysaga munggai / strobila*

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- BASE DATA SOURCED ESRI NATGEO WORLD MAP

0 15 30 60
km
Scale: 1:2,000,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP



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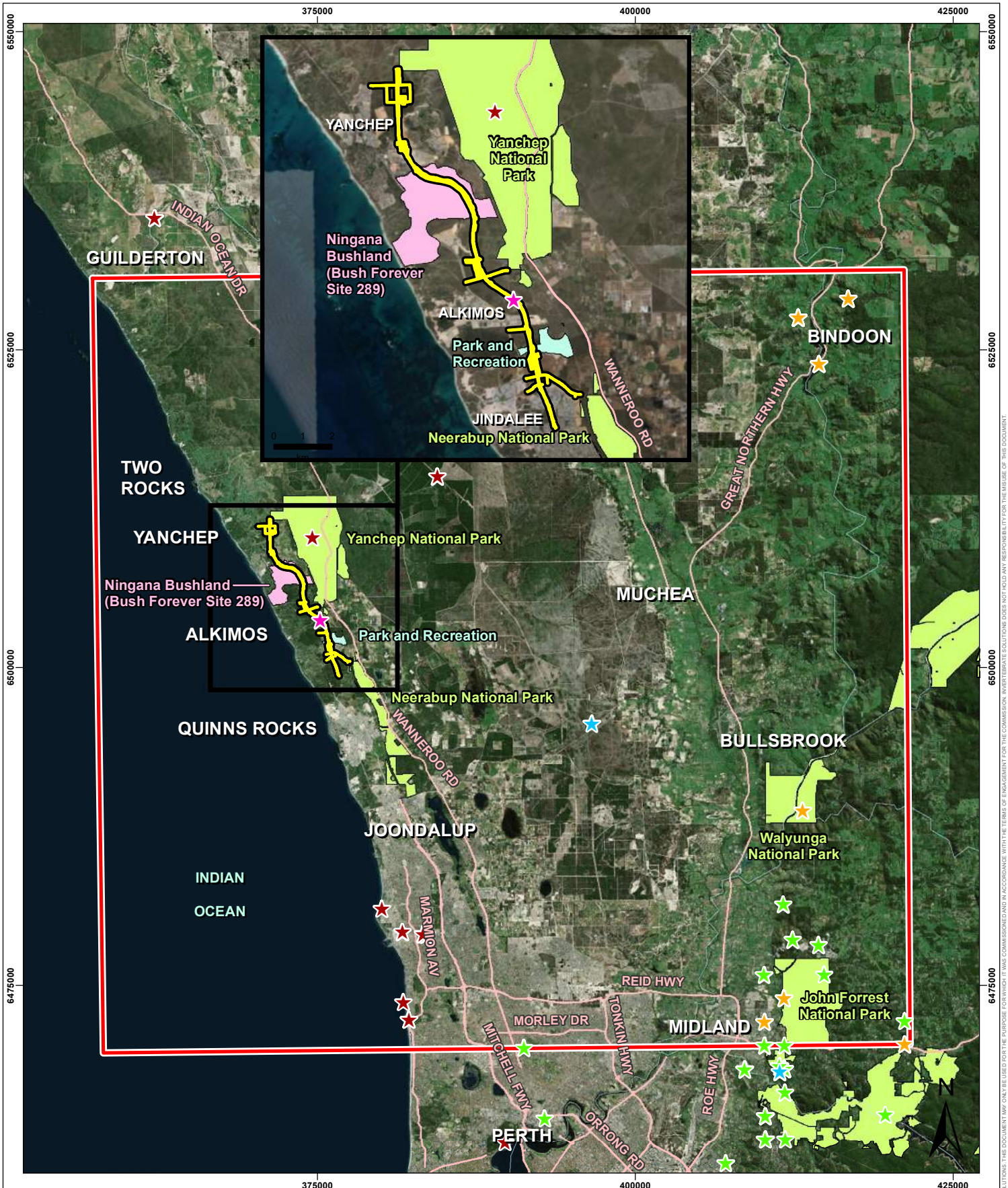
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 8
Distribution of the Likely SRE isopod, millipede and tree cricket species

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F08 Distribution of the Likely SRE isopod, millipede and tree cricket species_180524.mxd



Desktop Study Area

Yanchep Rail Extension Project Development Envelope

National Park

Parks and Recreation Area

SRE Slaters, Millipedes and Tree Cricket Species Locations

- Armadillidae: *Buddelundia cinerascens*
- Armadillidae: *Buddelundia opaca*
- Iulomorphidae: *Dinocambala ingens*
- Tettiogonidae: *Austrosaga spinifer*
- Tettiogonidae: *Pachysaga munggai*
- Tettiogonidae: *Pachysaga strobila*
- Tettiogonidae: *Pachysaga munggai / strobila*

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- AERIAL PHOTOGRAPHY SOURCED ESRI WORLD IMAGERY

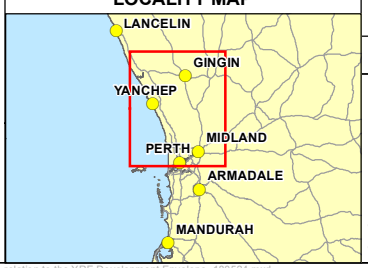
0 3.75 7.5 15

km

Scale: 1:400,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP



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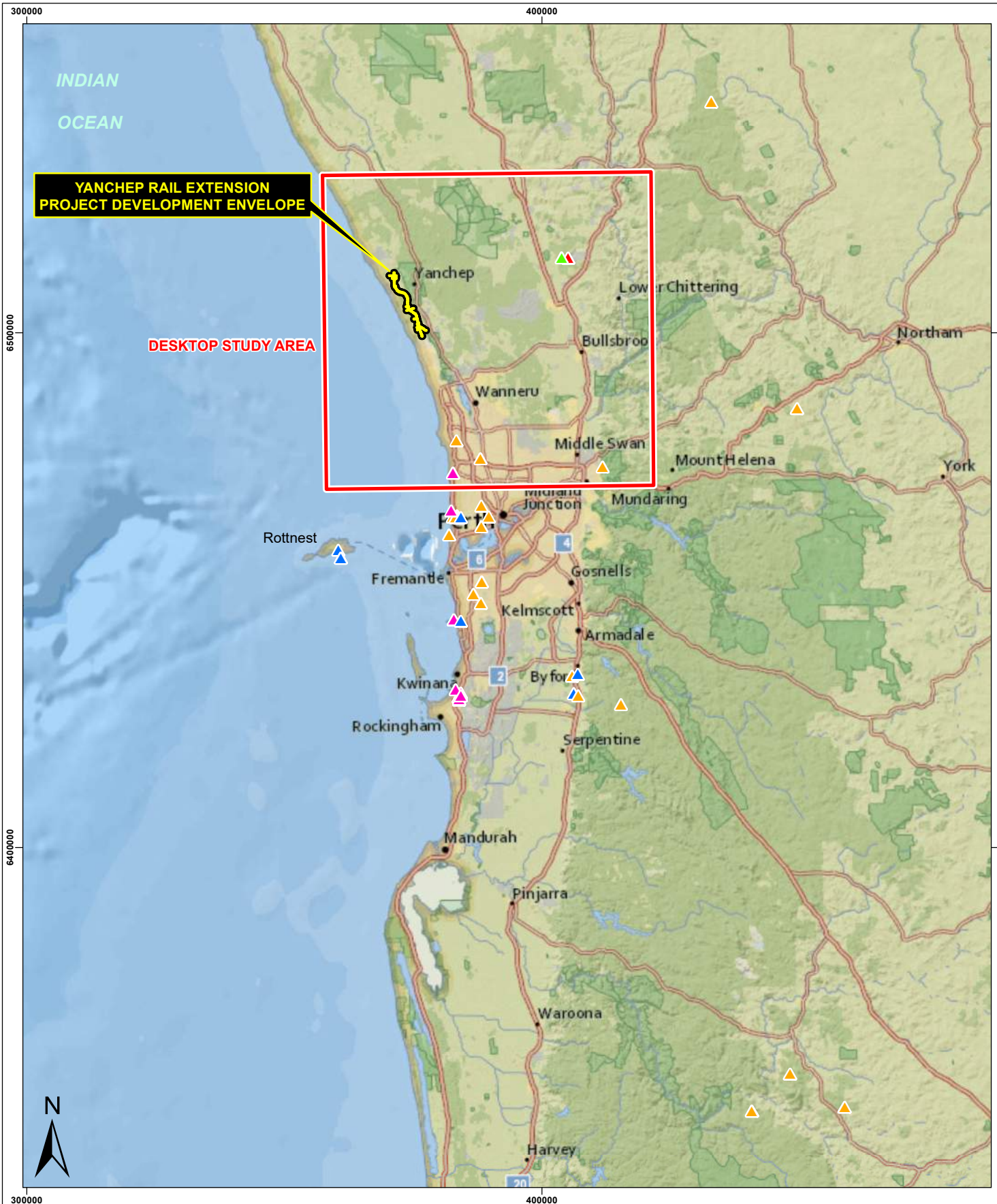
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 9

Distribution of the Likely SRE isopod, millipede and tree cricket species in relation to the YRE Development Envelope

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F09 Distribution of the Likely SRE isopod, millipede and tree cricket species in relation to the YRE Development Envelope_180524.mxd



Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope

SRE Mygalomorph Species Locations

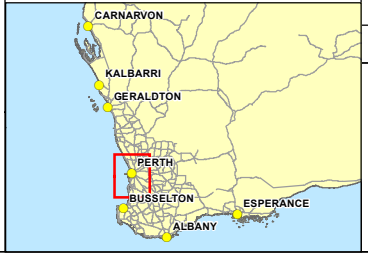
- Barychelidae: *Synothele lowei*
- Barychelidae: *Synothele michaelseni*
- Barychelidae: *Synothele taurus*
- Nemesiidae: *Teyl* 'MYG249'
- Nemesiidae: *Teyl* 'waldockae'

- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- BASE DATA SOURCED ESRI NATGEO WORLD MAP

0 5 10 20
km
Scale: 1:1,000,000 @ A4

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP



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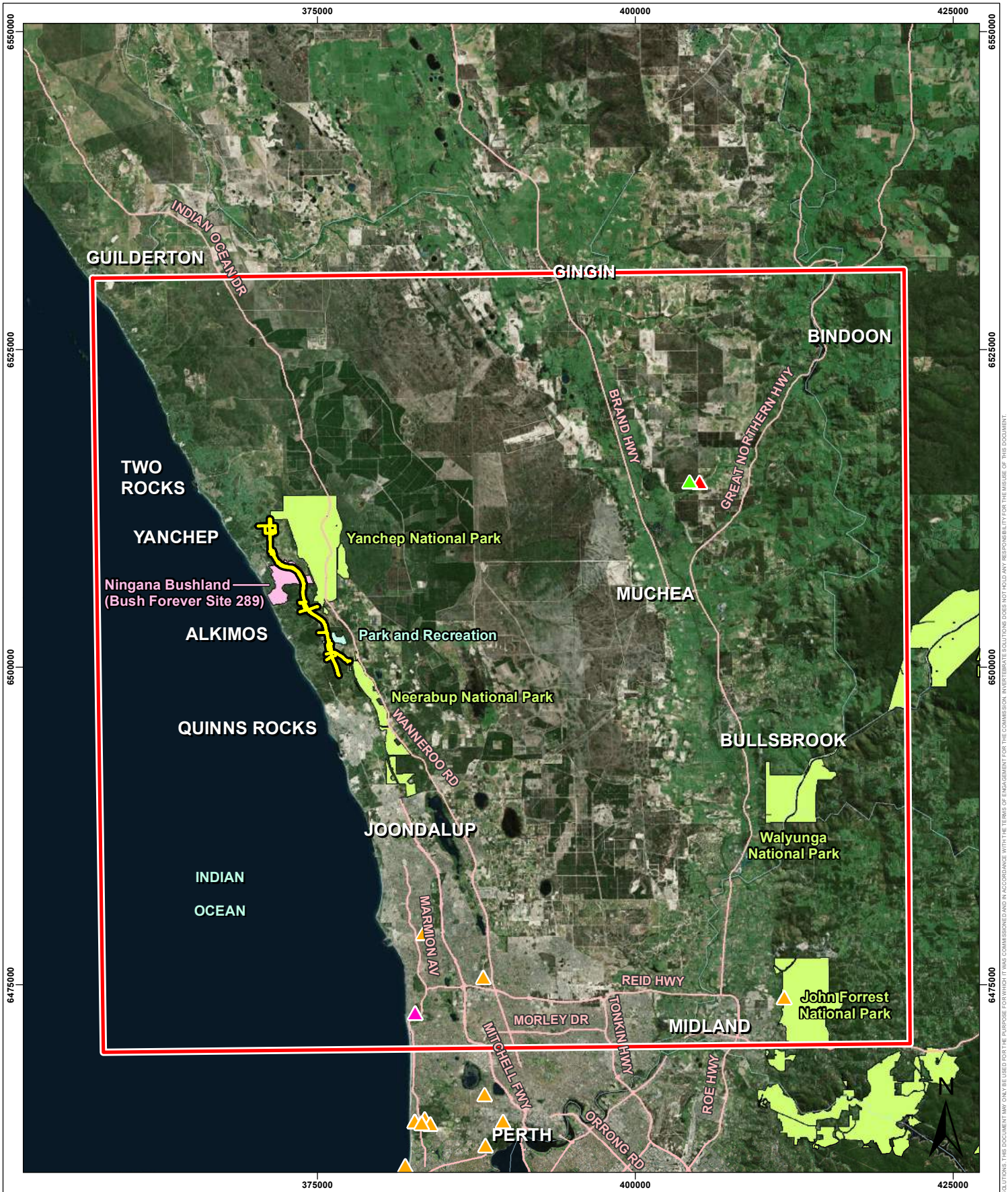
ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 10
Distribution of the Likely SRE *mygalomorph* species

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F10 Distribution of the Likely SRE mygalomorph Species_180524.mxd



Legend

- Desktop Study Area
- Yanchep Rail Extension Project Development Envelope
- National Park
- Parks and Recreation Area

SRE Mygalomorph Species Locations

- Barychelidae: *Synothele lowei*
- Barychelidae: *Synothele michaelseni*
- Barychelidae: *Synothele taurus*
- Nemesiidae: *Teyl* 'MYG249'
- Nemesiidae: *Teyl* 'waldockae'

0 3.75 7.5 15
km
Scale: 1:400,000 @ A4
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ENVIRONMAPS	TM	TM	0

Yanchep Rail Extension Project

Figure 11

Distribution of the Likely SRE *mygalomorph* species in relation to the YRE Development Envelope

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- LOCALITY MAP SOURCED FROM LANDGATE 2006
- STREET DIRECTORY MAP SOURCED STREETSMART 2008
- AERIAL PHOTOGRAPHY SOURCED ESRI WORLD IMAGERY

C:\GIS\Jobs\Invertebrate Solutions\Yanchep Rail Extension Project\Figures\YREP_F11 Distribution of the Likely SRE mygalomorph species in relation to the YRE Development Envelope_180524.mxd

4. SRE preliminary impact assessment

This preliminary impact assessment is based primarily upon alignment and cut and fill plans contained with the Advisian (2017) geotechnical report, the EIA documentation (RPS 2018) and the project components as outlined by the PTA (Appendix 3). The main components of the overall project consist of the following:

- Underground and overhead utility service identification, relocations and protection.
- Construction of two new narrow gauge tracks (including associated infrastructure such as overhead line equipment, signalling and telecommunications), as part of extending the Butler line to Yanchep.
- Construction of nine road bridge crossings.
- Construction of three new stations; Alkimos Station, Eglinton Station and Yanchep Station.
- Connection of existing narrow gauge tracks to Butler at Butler Station, with infrastructure modifications (such as turnouts, overhead line equipment, signalling and telecommunications) to the station to accommodate for the newly imposed train operation.
- Upgrading existing traction sub-station from 15MVA to 25MVA either at Nowergup or Edgewater.

4.1 Local impacts during construction and operation

The potential impacts to SRE fauna within the YRE Development Envelope are summarised in Table 9 and Table 10. The assessment of the impact to SRE fauna at both the local and regional (SCP) scale from each disturbance mechanism takes into account both the likelihood of the impact occurring, its duration and severity, the potential consequence to SRE fauna and the likelihood of SRE fauna being present.

Direct impacts

The only direct impact to SRE fauna is from vegetation clearing within the YRE Development Envelope that will directly remove habitat used by SRE species. This direct impact is relevant for the confirmed SRE millipede species (*Antichiropus whistleri*) as it has been recorded within 120 m of the YRE Development Envelope (Figure 7) and is therefore highly likely to occur within both the Development Envelope and the surrounding vegetation. Given the narrow linear nature of the project, and given similar habitat values are likely to be present in surrounding vegetation and surrounding conservation estates, it is considered unlikely that the YRE project would result in local extinction.

Table 9 Risk of direct impact to SRE invertebrates from the YRE Project

Direct disturbance mechanism	Likelihood of impact occurring	Potential of Impact to SRE Fauna locally	Potential of Impact to SRE Fauna Regionally (SCP)
Vegetation clearing directly removing and/or disturbing SRE habitat	**High**	**Low**	**Low**

Indirect impacts

The indirect impact of the clearing of native vegetation causing fragmentation of the remaining vegetation may lead to the restriction of genetic flow for SRE species that have limited dispersal capabilities. This indirect impact is considered to be the most significant impacts from the YRE Project. Habitat fragmentation has a much greater potential to impact upon SRE species due to their inherent lack of dispersal capability that allows other more mobile species to move between remnant vegetation patches in an urban mosaic. This impact is largely unavoidable but is mitigated by the the PTA constructing four fauna underpasses through Ningana Bushland (Bush Forever Site 289) and one in the Parks and Recreation area to the north of the proposed Alkimos Station. These fauna underpasses will allow some limited dispersion of species such as the SRE millipede *Antichiropus whistleri* that will assist in maintaining local connectivity between the coastal vegetation and National Parks to the east of the Development Footprint, and ultimately maintain genetic connectivity.

Table 10 Risk of indirect impact to SRE invertebrates from the YRE Project

Indirect disturbance mechanism	Likelihood of impact occurring	Potential of Impact to SRE Fauna locally	Potential of Impact to SRE Fauna Regionally (SCP)
Habitat fragmentation and genetic isolation due to vegetation clearing and construction works	**High**	**Moderate/High**	**Moderate**
Weed incursion during construction works	**Moderate**	**Low/Moderate**	**Low**
Increased sedimentation during construction works?	**Low**	**Moderate**	**Low**
Alteration of surface hydrology during construction works	**Moderate**	**Low**	**Low**
Hydrocarbon spills during construction and/or operations	**Very Low**	**Moderate**	**Low**
Vibration disturbance from operational activities	**Low**	**Low**	**Low**
Vibration disturbance from construction activities	**Low**	**Low**	**Low**
Noise during construction works	**Low**	**Low**	**Low**
Noise during operations	**Low**	**Low**	**Low**

Increased local weed incursion into native bushland can have a significant impact upon SRE species that rely on sometimes small microhabitats within the landscape. This has the potential to cause a Moderate impact to SRE fauna and is considered to be the second most significant indirect impact to

SRE fauna. This impact can be managed through management and mitigation measures including general ongoing weed control.

If not managed appropriately, increasing sedimentation and alteration of surface hydrology has the potential to affect SRE fauna such as mygalomorph spiders that live in burrows at ground level. Sedimentation can be managed by appropriate stormwater runoff design and during construction via management and mitigation measures.

Contamination of surface and groundwater during construction and operations may also impact significantly upon SRE habitat, but risks of contamination can be minimised by employing management and mitigation measures to minimise and prevent contamination. The potential for contamination during construction is limited to isolated areas of chemical storage and small quantities of hydrocarbons where machinery or generators are working. Risks will be minimised by measures included in a CEMP. The risk of contamination during operations is minimal as the passenger railway runs off overhead electrified wires rather than stored fuel on the trains themselves. The trains contain only small quantities of transmission oil with minimal risk of contamination impacts. Where management measures are implemented, the risk of hydrocarbon contamination to SRE species and habitat is anticipated to be Low, however, should a major spill occur and not adequately contained and remediated, then the impacts would be significant.

Vibration and noise from the construction and ongoing operation of the rail line is expected to be minimal, especially beyond the immediate vicinity of the rail line itself. These impacts are considered to be Low.

4.2 Regional significance and cumulative impacts

At a regional scale across the SCP, the direct and indirect impacts are generally considered to be low due to the narrow linear nature of the YRE Project, and given similar habitat values are likely to be present in surrounding vegetation and surrounding conservation estates. At the regional scale of the Study Area that encompasses much of the northern SCP the YRE Development Envelope represents only 0.08 % of Medium and 0.04% of Low SRE suitable habitat, and no High SRE suitable habitat (Table 5, Table 6, Figure 3). Habitat fragmentation is the only impact, either direct or indirect, that is considered to have a potentially Moderate impact at a regional scale. This indirect impact is substantially mitigated through the PTA's construction of five fauna underpasses that will allow genetic connectivity of species at the SCP scale. Other anticipated impacts including altering local hydrology and vibration are considered to be relatively small in the scale of the northern SCP.

Cumulative impacts on the SCP will be low, albeit increasing fragmentation on the urban fringe (Table 10). The primary cumulative impacts from the YRE developments are land clearance and habitat fragmentation. It is anticipated that the YRE Project will not add significantly to the cumulative impacts to SRE fauna in the local area, especially since none of the habitats identified would provide habitat isolates that would be likely to contain SRE taxa within the limited extent of the YRE Project Development Envelope. All the vegetation units are laterally continuous within the region and not limited to the YRE Development Envelope.

The YRE Development Envelope will remove approximately 95 ha (1.67 % of the locally available Medium habitat) of SRE habitat with Medium suitability and 46 ha (2.98 % of the locally available

Low habitat)of SRE habitat with low suitability (Table 5, Table 6, Figure 2). In local conservation estate there is 2965 ha (52.05 %) of additional Medium SRE habitat in conservation estate including Yanchep National Park, Bush Forever Site 289 (Ningana Bushland) and Neerabup National Park. Outside of conservation estate there is 2636 ha (46.28 %) of additional Medium SRE habitat in the local area.

The cumulative impacts at the regional scale are also considered to be low due to the narrow linear nature of the YRE Project and the construction of fauna underpasses that mitigates habitat fragmentation. Other anticipated impacts including altering local hydrology and vibration are considered to be relatively small in the scale of the northern SCP.

5. Conclusions and Recommendations

The desktop assessment for SRE invertebrates recorded five Confirmed SRE species (three land snails, one bivalve and 1 millipede), 10 Likely SRE species (seven mygalomorph spiders, two terrestrial slaters and one millipede), and six Possible SRE species (5 pseudoscorpions and one harvestman) within the broader Study Area.

Within the YRE Development Envelope, there are two Confirmed SRE species that have a High Likelihood of occurrence; the millipede (*Antichiropus whistleri*) and the trapdoor spider (*Idiosoma sigillatum*). There are also seven Likely SRE species (three mygalomorph spiders, two slaters and a tree cricket) that have a Moderate likelihood of occurring within the YRE Development Envelope as well as the widespread but conservation significant bee (*Hylaeus globuliferus)*. There are also two Possible SRE species, a harvestman arachnid and a pseudoscorpion that have a Moderate and High Likelihood respectively of occurring within the YRE Development Envelope (Table 8).

The only direct impact to SRE fauna is from vegetation clearing within the YRE Development Envelope that will directly remove habitat used by SRE species. This direct impact is relevant for the confirmed SRE millipede species (*Antichiropus whistleri*) as it has been recorded within 120 m of the YRE Development Envelope (Figure 7) and is therefore highly likely to occur within both the Development Envelope and the surrounding vegetation. Given the narrow linear nature of the project, and given similar habitat values are likely to be present in surrounding vegetation and surrounding conservation estates, it is considered unlikely that the YRE project would result in local extinction.

The indirect impact of the clearing of native vegetation causing fragmentation of the remaining vegetation may lead to the restriction of genetic flow for SRE species that have limited dispersal capabilities. This indirect impact is considered to be the most significant impacts from the YRE Project. This impact is largely unavoidable but is mitigated by the the PTA constructing four fauna underpasses through Ningana Bushland (Bush Forever Site 289) and one in the Parks and Recreation area to the north of the proposed Alkimos Station. These fauna underpasses will allow some limited dispersion of species such as the SRE millipede (*Antichiropus whistleri*) and mygalomorph spider (*Idiosoma sigillatum*) that will assist in maintaining local connectivity between Yanchep National Park and the coastal vegetation and ultimately maintain genetic connectivity.

At a regional scale across the SCP the direct and indirect impacts are generally considered to be low due to the narrow linear nature of the YRE Project, and given similar habitat values are likely to be present in surrounding vegetation and surrounding conservation estates. At the regional scale of the Study Area that encompasses much of the northern SCP, the YRE Development Envelope represents only 0.08 % of Medium and 0.04% of Low SRE suitable habitat, and no High SRE suitable habitat. The impact of habitat fragmentation is substantially mitigated through the PTA's construction of five fauna underpasses that will allow genetic connectivity of species at the SCP scale. Other anticipated impacts including altering local hydrology and vibration are considered to be relatively small in the scale of the northern SCP.

The majority of other anticipated impacts are generally Low or able to be managed through standard construction and operational management and mitigation measures.

5.1 Recommendations

The following recommendations are made with regard to construction of the YRE Project:

- Should the PTA be required to confirm the SRE millipede *Antichiropus whistleri* and mygalomorph spider *Idiosoma sigillatum* occurrence in the Development Envelope or locally within nearby conservation estates, a field survey will be required with regard to Technical guidance sampling of SRE invertebrate fauna (EPA 2016).
- Include appropriate management and mitigation measures to reduce and/or manage the risk of impacts to SREs from weed incursion and increased sedimentation during construction and operations.

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Appendix 1

Department of Parks and Wildlife Conservation Codes (November 2015)

Department of Parks and Wildlife

CONSERVATION CODES

For Western Australian Flora and Fauna

Specially protected fauna or flora are species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Categories of specially protected fauna and flora are:

T **Threatened species**

Published as Specially Protected under the *Wildlife Conservation Act 1950,* and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act.

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR **Critically endangered species**

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN **Endangered species**

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU **Vulnerable species**

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX **Presumed extinct species**

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA **Migratory birds protected under an international agreement**

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 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.

2 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.

3 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.

4 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.

*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).

Appendix 2

Protected Matters Search Tool results

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

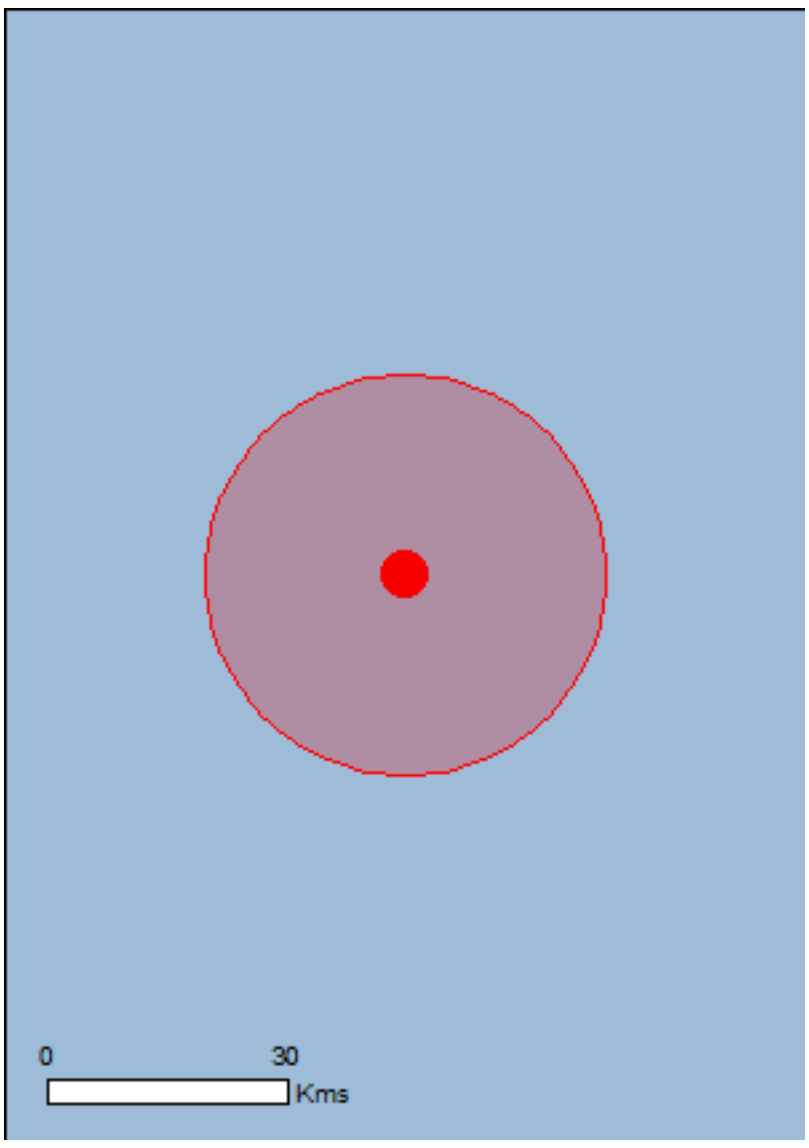
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 05/03/18 16:24:28

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



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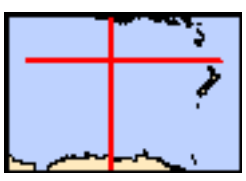

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	54
Listed Migratory Species:	42

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:	3
Commonwealth Heritage Places:	None
Listed Marine Species:	78
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	2

Extra Information

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

State and Territory Reserves:	10
Regional Forest Agreements:	None
Invasive Species:	43
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	2

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
South-west

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
Aquatic Root Mat Community in Caves of the Swan Coastal Plain	Endangered	Community known to occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	Endangered	Community known 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 likely 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 known 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

Name	Status	Type of Presence
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 likely 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 [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Thalassarche cauta steadi		
White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Neophoca cinerea		
Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Anigozanthos viridis subsp. terraspectans		
Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat likely to occur within area
Caladenia huegelii		
King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6)		
Gingin Wax [88881]	Endangered	Species or species habitat may 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 known 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 may occur within area
Eucalyptus argutifolia		
Yanchep Mallee, Wabling Hill Mallee [24263]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat may occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may 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
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat 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
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
Hydroprogne caspia		
Caspian Tern [808]		Foraging, feeding or related behaviour 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]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta		
Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Species or species habitat may 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	Species or species habitat 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

Name	Threatened	Type of Presence
		habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
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 known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Tringa glareola		
Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known 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 - GIN GIN SATELLITE AIRFIELD
Defence - MUCHEA ARMAMENT RANGE

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

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius ruficapillus Red-capped Plover [881]		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
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
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat 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
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta 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

Name	Threatened	Type of Presence
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Reptiles		
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[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

Name	Status	Type of Presence
		area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common 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. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Commonwealth Reserves Marine	[Resource Information]
Name	Label
Two Rocks	Marine National Park Zone (IUCN II)
Two Rocks	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Jandabup	WA
Lake Joondalup	WA
Neerabup	WA
Neerabup	WA
Unnamed WA21176	WA
Unnamed WA43290	WA
Unnamed WA49994	WA
Woodvale	WA
Yanchep	WA
Yeal	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

Name	Status	Type of Presence
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 linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		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

Name	Status	Type of Presence within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Joondalup Lake	WA
Loch McNess System	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Commonwealth marine environment within and	South-west
Western rock lobster	South-west

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

-31.59493 115.68048

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 3

Components of the Yanchep Rail Extension Project Part 1 and 2

The main components of the overall project consist of the following:

- Underground and overhead utility service identification, relocations and protection.
- Construction of two new narrow gauge tracks (including associated infrastructure such as Overhead Line Equipment [OLE], signalling and telecommunications), as part of extending the Butler line to Yanchep.
- Construction of nine road bridge crossings, eight of which will be funded by the PTA.
- Construction of three new stations; Alkimos Station, Eglinton Station and Yanchep Station.
- Connection of existing narrow gauge tracks to Butler at Butler Station, with infrastructure modifications (such as turnouts, OLE, signalling and telecommunications) to the station to accommodate for the newly imposed train operation.
- Upgrading existing traction sub-station from 15MVA to 25MVA either at Nowergup or Edgewater.

Horizontal Design

The horizontal alignment complies with the recommended parameters in PTA Code of Practice for Narrow Gauge and minimum radius of curve is 1100m. Because of this the horizontal geometry allows for maximum design speeds of 140 km/hr on tangent track and 130km/h for curved track in majority of the extension.

Vertical Design

It was intended in the DPI study that the railway will be in a cutting of four to five meters deep throughout the future residential areas. This will assist in minimising the noise and vibration effect, improve the visual aesthetics and allow future grade separated crossings to be constructed without major modifications. However, cuttings for the majority of the alignment would result in a large excess of spoil. The alignment has sought to balance earthwork quantities where possible by incorporating desirable limit gradients and vertical curves.

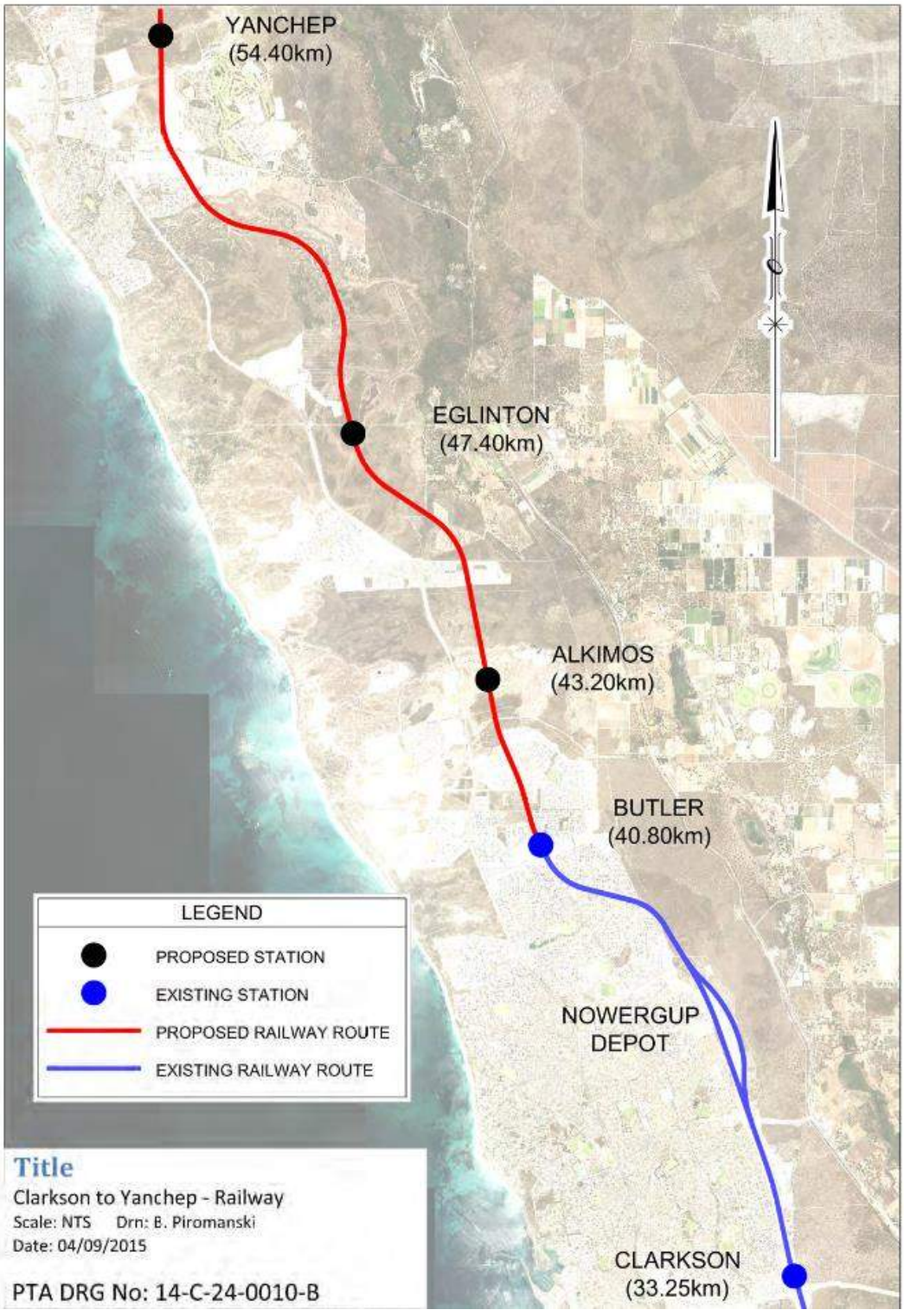
Butler to Alkimos

From Butler (Ch. 40.8) to Alkimos (Ch. 43.2) the alignment mostly passes through the urban development on both sides with developer's roads running parallel to the corridor. The section is mostly in cut with approximate depths ranging from 4m to 7m. Alkimos is a secondary centre with a station at Ch. 43.3.

Alkimos to Eglinton

North of Alkimos from Ch. 43.2 to Ch. 47.4, the route passes through a Parks and Recreation reserve which is proposed for conversion to Bush forever. The majority of the railway alignment is in cut excluding a short section of 190m from Ch. 43.7 to Ch. 43.85, which is on an embankment of approximately 5m in height. This continues before transitioning into cut again due to proposed higher earthworks levels by the developer on both sides. Eglinton station at Ch. 47.4 is within

Eglinton District Centre just south of Pipidinny Road. Drainage basins No. 1 to 3 are situated in this section.



Eglinton to Yanchep

Urban development has been proposed north of Eglinton station up to Ch. 49.02. The section from Ch. 49.0 to Ch. 81.9 passes through bush forever and an effort has been made to balance the earthwork quantity in cut and fill in this section. The urban development commences south of

Yanchep Beach Road and continues up to Yanchep. Yanchep station is located in the Yanchep city centre. Drainage basins 4 to 7 are situated in this section.

Yanchep and beyond

Yanchep station is also in cut similar to Alkimos and Eglinton. The adjacent developer has proposed financial contribution for covering Yanchep station to create green walking areas on top. The proposal is currently under review by PTA. Two stowage roads, with a dead end at Ch. 55.15 have been planned north of Toreopango Ave with the capacity to store 4 train sets for morning service provisions. A future traction substation has also been proposed adjacent to the stowage roads. Drainage basin No. 8 has been relocated from Ch. 53.99 to Ch. 55.18.

Part 2

The proposal is to extend the Joondalup railway line from Eglinton Station to Yanchep Station and includes a turnback facility to the north of the Yanchep Station to allow for the turning and stowage of trains. The proposal also includes the construction of a new station at Yanchep with intermodal rail, bus, 'park and ride', 'kiss and ride' and active mode (cycling and walking) facilities at the Yanchep Station.

- Part 2: Eglinton Station to Yanchep Station includes the northern portion of the YRE project area to the north of the Eglinton Station and generally coincides with the land reserved "Railway" under the MRS before terminating within the northern section of the Yanchep City LSP. The Part 2 development footprint includes a turnback facility to the north of the Yanchep Station to allow for the turning and stowage of trains. The 72.89 Part 2 Development Envelope is comprised of a 60.31 ha development footprint and 12.58 ha of construction and access areas.

Yanchep Rail Extension: Part 2 – Eglinton Station to Yanchep Station Infrastructure Layout and Extent of Physical and Operational Elements

Element	Location	Proposed Extent / Description
Physical Elements		
Railway Extension	The dual narrow-gauge track will begin from a connection with the Joondalup railway line, north of the Eglinton Station. The railway will generally follow the land reserved "Railway" under the MRS before terminating with the northern section of the Yanchep City LSP.	The 7.19 km of dual narrow-gauge track will be located within a 60.31 ha Part 2 development footprint. The railway will generally be cut approximately 5 metres (m) below the surrounding ground level. The railway corridor will be constrained either through battering the excavation or using retaining walls. The corridor is approximately 40m wide. Within Bush Forever Site No. 289: *Ningana Bushland, Yanchep/Eglinton* the railway is not situated adjacent to any sensitive premises. Hence the railway will be constructed at grade (rather than being cut below the ground level to

Element	Location	Proposed Extent / Description
		mitigate noise and vibration impacts) to reduce engineering and sand excavation requirements. The railway corridor increases to be approximately 73 metres wide through Bush Forever Site No. 289: *Ningana Bushland, Yanchep/Eglinton* to allow for the railway to be constructed at grade.
Yanchep Station	The proposed Yanchep station is located within the north of the Yanchep City LSP area.	Yanchep Station will be an at grade station which will serve the Yanchep locality and surrounding future suburbs. Yanchep Station development footprint is included within the Part 2 development footprint and is approximately 6.37 ha in extent. Provision has been made for an intermodal rail, bus, 'park and ride', 'kiss and ride' and active mode facilities.
Construction and Access Areas	Construction and access areas have been selected to coincide with proposed future urban development or roads either reserved by the MRS or as detailed within approved and draft LSPs.	The construction and access areas will be located within a 12.58 ha extent outside of the Part 2 development footprint but within the Part 2 Development Envelope.
Operational Elements		
Railway Line	The dual narrow-gauge track will begin from a connection with the Joondalup railway line, north of the Eglinton Station. The railway will generally follow the land reserved "Railway" under the MRS before terminating with the northern section of the Yanchep City LSP.	The constructed railway line will operate train services between the Eglinton and Yanchep stations.
Yanchep Station	The proposed Yanchep station is located within the north of the Yanchep City LSP area.	Bus and train services will operate from the Yanchep station.