

Survey for Short Range Endemic Fauna for the MRC Graphite Project, Munglinup, Western Australia.



MRC
MRC GRAPHITE PTY LTD



Report by Invertebrate Solutions Pty
Ltd for MRCG Graphite Ltd

October 2020

Dr Timothy Moulds
Director and Principal Ecologist
Invertebrate Solutions Pty Ltd
PO Box 14
Victoria Park, WA 6979
Australia
tim@invertebratesolutions.com
www.invertebratesolutions.com

Invertebrate Solutions. (2020). Survey for Short Range Endemic Fauna for the MRC Graphite Project, Munglinup, Western Australia. Unpublished report to MRC Graphite Ltd, October 2020.

Report Number 2019ISJ08_F04_20201020

Prepared for: MRC Graphite Ltd

Frontispiece: Mygalomorph spider *Aname sp. 'munglinup-DNA'* disturbed from her burrow

Image Copyright Invertebrate Solutions 2020.

COPYRIGHT: This document has been prepared to the requirements of the client identified above, and no representation is made to any third party. Copyright and any other Intellectual Property associated with the document belongs to Invertebrate Solutions and may not be reproduced without written permission of the Client or Invertebrate Solutions. It may be cited for the purposes of scientific research or other fair use, but it may not be reproduced or distributed to any third party by any physical or electronic means without the express permission of the client for whom it was prepared or Invertebrate Solutions.

Table of Contents

Executive Summary.....	vi
1. Introduction.....	7
1.1 Purpose of this report	8
1.2 Project area	8
1.3 Survey Effort and Timing	9
1.4 Introduction to SRE fauna	13
1.5 Conservation Legislation and Guidance Statements.....	14
1.6 Survey Staff Qualifications	15
1.7 Report Limitations and Exclusions.....	15
2. Methods	17
2.1 SRE Desktop Methodology	17
2.2 SRE Survey Methodology	18
2.3 Sorting and curation.....	19
2.4 Taxonomy and Nomenclature.....	19
2.5 Molecular sequencing	19
2.6 Short Range Endemic Status	19
3. Results	21
3.1 SRE Invertebrates of the South Coast Region.....	21
3.2 Conservation Significant Fauna in the Desktop Study Area.....	23
3.3 SRE Habitat in Project Area	23
3.4 Desktop SRE Assessment	26
3.5 SRE Field Survey	28
4. Discussion	32
4.1 SRE Invertebrate Assessment	32
4.2 Likely SRE species recorded within the SRE Survey Area.....	37
4.3 Likelihood of Occurrence of Confirmed SRE mygalomorph spider species within the SRE Survey area	38
5. Conclusions and Recommendations	41
6. References.....	42
Appendix 1	45
Conservation Codes from Department of Biodiversity, Conservation and Attractions	
Appendix 2	45

Protected Matters Search Tool Results

Appendix 3	65
SRE Site locations and habitats	
Appendix 4	80
Specimen abundance and tracking codes	
Appendix 5	84
Genotyping Australia Molecular Sequencing report	

List of Figures

Figure 1	Munglinup Graphite Project area.....	11
Figure 2	Munglinup Graphite Project area showing SRE sample locations	12
Figure 3	SRE Habitat and Vegetation Associations	25
Figure 4	Distribution of Likely SRE isopods within the SRE survey Area	35
Figure 5	Distribution of the Likely SRE millipede species <i>Antichiropus rex</i>	36

List of Tables

Table 1	Locations actively searched for SRE invertebrates.....	9
Table 2	Short Range Endemic Status of Species	14
Table 3	SRE species likelihood of occurrence definitions	18
Table 4	SRE habitats and species recorded by Biota (2018) from the Munglinup Graphite Project.	22
Table 5	Conservation significant invertebrates potentially within the Desktop Study Area.	23
Table 6	Vegetation units (modified after Woodman 2019), habitat suitability for SRE invertebrates and survey effort	24
Table 7	Desktop records from WAM and Biota (2018) of SRE Invertebrates in the Munglinup Desktop Search Area	27
Table 8	SRE invertebrates recorded during the field survey.	30
Table 9	Potential SRE invertebrates Likelihood of occurrence in the MRCG Graphite SRE Survey Area	33

List of Plates

Plate 1	Mean rainfall and rainfall recorded in 2019 for Munglinup West (Source www.bom.gov.au) 10
Plate 2	The widespread land snail <i>Bothriembryon dux</i> from within the MRCG Project Area 26
Plate 3	The mygalomorph spider <i>Proshermacha</i> sp.'MYG346' excavated from her burrow at site MUNSRE01 29
Plate 4	Regional distribution of <i>Bungulla fusca</i> along the south coast of Western Australia (After Rix et al. 2018a). The red star shows the approximate position of the Munglinup Graphite Project. 38
Plate 5	Regional distribution of <i>Eucanippe bifida</i> along the south coast of Western Australia (After Rix et al. 2018b). The red star shows the approximate position of the Munglinup Graphite Project. 39
Plate 6	Regional distribution of <i>Gaius hueyi</i> along the south coast of Western Australia (After Rix et al. 2018c). The red star shows the approximate position of the Munglinup Graphite Project. 40

Executive Summary

The Munglinup Graphite Project (the Project) is located 105 km west of Esperance, 85 km east of Ravensthorpe and 4 km north of the town of Munglinup in the South Coast region of Western Australia. Invertebrate Solutions has been requested by Integrate Sustainability Pty Ltd (Integrate Sustainability) on behalf of MRCG to provide a quote to undertake a field survey for Short Range Endemic (SRE) invertebrates for the MRCG Project. A pilot survey for SRE invertebrates for a portion of the MRCG tenements in September 2018 (Biota 2018). The pilot survey did not include the entire Development Envelope (Figure 1) and provided inconclusive results as to the diversity and presence of potential and confirmed SRE species within the MRCG tenements.

The desktop assessment of the Desktop Study area recorded three Confirmed SRE species, one Likely SRE species and three Possible SRE species. Of these seven species identified in the Desktop Study Area, one of these was recorded in the field survey; the millipede *Antichiropus rex*. The remaining six Confirmed and Possible SRE species (four mygalomorph spiders and two land snails) were not recorded.

The SRE field survey recorded 247 individual specimens representing 25 taxa of invertebrates from six classes, 11 orders and 19 families that have the potential to contain SRE taxa. No Confirmed SRE species were recorded during the field survey.

Four species were identified as Likely SRE species:

- the isopod *Acanthodillo sp. indet.*
- the isopod *Pseudodiploexochus sp. indet.*
- the isopod *Paraplatyarthus sp. indet.*
- the millipede *Antichiropus rex?*

Every Likely SRE species was recorded solely from leaf litter extracted in Tullgren funnel samples except for the single dead specimen of *Antichiropus rex?* that was recorded during active searching of leaf litter, however, juvenile specimens of *Antichiropus rex?* were recorded at a different site in leaf litter extracted in tullgren funnel samples. Two of the Likely SRE species (*Pseudodiploexochus sp. indet.* and *Paraplatyarthus sp. indet.*) were recorded from within the Development Area but within the laterally continuous Mallee Shrubland or Eucalyptus Woodland habitats, with only a single specimen of the Likely SRE isopod species *Acanthodillo sp. indet.* recorded from the Survey area, but outside of the Development Area in the Proteaceous Kwongan Shrubland habitat.

The majority of species recorded are widespread across the southern coast or the south west of Western Australia.

1. Introduction

The Munglinup Graphite Project (the Project) is located 105km west of Esperance, 85km east of Ravensthorpe and 4km north of the town of Munglinup in the South Coast region of Western Australia. The proposed Project is situated within Mining Reserve R24714 and is covered by mining and exploration tenure M74/245 and tenure L74/55, L74/56, G74/9. The proponent, MRC Graphite Pty Ltd (MRCG), proposes to mine for graphite open cut pits over a 10-15-year project life. Associated infrastructure including waste rock landforms, a tailings storage facility, processing plant and run-of-mine and low-grade stockpiles, power generation, workshops, administration buildings and roads (haul and LV) are proposed. The proposed activities encompass a development envelope of 650ha with an indicative disturbance footprint of 350ha within this development envelope.

The Project was referred to the Environmental Protection Authority (EPA) under Section 38 of the Environmental Protection Act 1986 (EP Act) and to DoEE (Department of the Environment and Energy) under Section 68 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) in November 2018. Additional baseline reports were provided to both the EPA and DoEE on the 28th of March 2019. On the 29th of May 2019 the level of assessment was set at Assessment on Referral Information with additional information required and a 4-week public consultation period (EPA Assessment number 2206). The DoEE determined the Project is a controlled action and will be assessed by the EPA on their behalf as an accredited assessment.

On the 12th of July the EPA provided the proponent with a letter outlining the additional work required to proceed with the assessment. As part of this letter the EPA, it has been determined that not all the Development Envelope was covered by the 2018 Pilot study and that the level of survey efforts is not appropriate to complete a formal impact assessment. The EPA has requested that a Level 2 detailed SRE Invertebrate survey be completed over the entire Development Envelope.

Invertebrate Solutions has been requested by Integrate Sustainability Pty Ltd (Integrate Sustainability) on behalf of MRC Graphite to provide a quote to undertake a field survey for Short Range Endemic (SRE) invertebrates for the MRC Graphite Project. A pilot survey for SRE invertebrates for a portion of the MRC Graphite tenements in September 2018 (Biota 2018). The pilot survey did not include the entire Development Envelope (Figure 1) and provided inconclusive results as to the diversity and presence of potential and confirmed SRE species within the MRCG tenements. The MRC Graphite Project now requires a Level 2 short range endemic (SRE) invertebrate survey for the entire Development Envelope to complete environmental approvals. The survey is required to support environmental approvals under Commonwealth and State legislation and must be of sufficient quality for review and critique by decision making authorities and the public.

Short range endemic (SRE) invertebrates occur within terrestrial habitats and possess naturally restricted ranges and poor dispersal capabilities. The high degrees of local endemism and lack of habitat connectivity makes SRE fauna susceptible to high levels impacts from sometimes localised projects, with species' extinction a real possibility if they are not adequately considered during project planning phases. The Project is located within and adjacent to heavily forested areas with

relatively moist areas and sheltered mesic slopes that have the potential to contain habitat isolates that may contain SRE species.

1.1 Purpose of this report

Invertebrate Solutions has been requested by Integrate Sustainability on behalf of MRCG to undertake the following scope of works within the MRCG project area, Munglinup, Western Australia:

- Undertake a desktop assessment for short range endemic (SRE) invertebrates to determine known SRE fauna in the area, as well as habitats in which they likely occur.
- Summarise previous SRE surveys for the MRCG tenements and other relevant studies from the region.
- Undertake a level 2 field survey for short range endemic (SRE) invertebrates within the entire Development Envelope and adjacent habitat areas (SRE Level 2 survey area as shown in Figure 1) to enable a thorough understanding of the local distribution of all previously identified and any newly recorded potential SRE taxa.
- Identify to the lowest practical taxonomic unit all relevant specimens recorded during the level 2 survey for SREs and any SRE specimens collected during the vertebrate fauna survey, including the use of molecular techniques as required.
- Where data are sufficient (more than three different locality records), map the occurrence and potential extent of SREs and their associated habitats.
- Provide SRE habitat mapping for the Level 2 survey area based upon supplied vegetation/and or vertebrate fauna habitat mapping.
- Provide an impact assessment for SRE taxa as a standalone memorandum.
- Provide recommendations and any suggested requirements for further work to comply with relevant legislation.
- Provide a written report containing the above items.
- Provide all spatial data in electronic format and data packages in accordance with the Index of Biodiversity Surveys for Assessments (IBSA) (EPA 2018).

The desktop assessment and field survey program will be undertaken with regard to Technical Guidance Sampling of short range endemic invertebrate fauna (EPA 2016).

1.2 Project area

The MRCG Munglinup Graphite Project is located north of the Munglinup townsite, approximately 105 km west of Esperance and 85 km east of Ravensthorpe on the southern coast region of Western Australia and is shown in Figure 1.

The Desktop Study area includes an approximately 50 km sided rectangle (~260,000 Ha) bounded by the north west corner (33.372463°S, 120.559931°E) and the south east corner (33.859188°S, 121.072575°E) centred on the Munglinup Graphite project and was used for the purposes of database searches and relevant literature.

The Project Survey area includes the vegetated area defined in Figure 1 and encompasses the proposed Development Envelope that the project will occur entirely within. The SRE field survey was undertaken within the Development Envelope and in similar adjacent vegetation inside the Project Survey area (Figure 1).

1.3 Survey Effort and Timing

Invertebrate Solutions completed a single season SRE survey at the MRCG Project area in October 2019. This comprised 30 sites throughout the Project Survey area were actively sampled for SRE invertebrates including litter sifting and hand searching of appropriate microhabitats (Table 1, Appendix 3). All coordinates in UTM are using datum GDA and located in Zone 51H. A map showing the locations of the SRE sampling sites is shown in Figure 2.

Table 1 Locations actively searched for SRE invertebrates

Sample Site	Easting	Northing	Habitat	Active search date
MUNSRE01	302227	6273985	Mallee Shrubland	13 th October 2019
MUNSRE02	302075	6273322	Eucalyptus Woodland	13 th October 2019
MUNSRE03	301548	6275134	Proteaceous Kwongan shrubland	13 th October 2019
MUNSRE04	301954	6271327	Eucalyptus Woodland	11 th October 2019
MUNSRE05	302065	6271377	Mallee Shrubland	11 th October 2019
MUNSRE06	301806	6271312	Major Drainage Line	12 th October 2019
MUNSRE07	301784	6272368	Low Mallee Woodland	12 th October 2019
MUNSRE08	301569	6272946	Eucalyptus Woodland	12 th October 2019
MUNSRE09	301406	6273712	Mallee Shrubland	12 th October 2019
MUNSRE10	301633	6273712	Mallee Shrubland	12 th October 2019
MUNSRE11	301354	6273491	Mallee Shrubland	12 th October 2019
MUNSRE12	301089	6274107	Proteaceous Kwongan shrubland	12 th October 2019
MUNSRE13	302174	6275027	Proteaceous Kwongan shrubland	13 th October 2019
MUNSRE14	302508	6274324	Proteaceous Kwongan shrubland	13 th October 2019
MUNSRE15	302370	6273380	Eucalyptus Woodland	13 th October 2019
MUNSRE16	302407	6272735	Low Mallee Woodland	13 th October 2019
MUNSRE17	304932	6274963	Eucalyptus Woodland	14 th October 2019
MUNSRE18	304934	6274644	Proteaceous Kwongan shrubland	14 th October 2019
MUNSRE19	304797	6274205	Proteaceous Kwongan shrubland	14 th October 2019
MUNSRE20	304527	6273919	Mallee Shrubland	14 th October 2019
MUNSRE21	303987	6273412	Eucalyptus Woodland	14 th October 2019
MUNSRE22	304621	6273355	Eucalyptus Woodland	14 th October 2019
MUNSRE23	301207	6274822	Major Drainage Line	15 th October 2019
MUNSRE24	300994	6274480	Eucalyptus Woodland	15 th October 2019
MUNSRE25	300947	6272979	Eucalyptus Woodland	15 th October 2019
MUNSRE26	301614	6271765	Mallee Shrubland	15 th October 2019
MUNSRE27	301998	6271107	Mallee Shrubland	15 th October 2019
MUNSRE28	302763	6271077	Mallee Shrubland	15 th October 2019
MUNSRE29	302650	6271491	Mallee Shrubland	16 th October 2019
MUNSRE30	302257	6272157	Eucalyptus Woodland	16 th October 2019

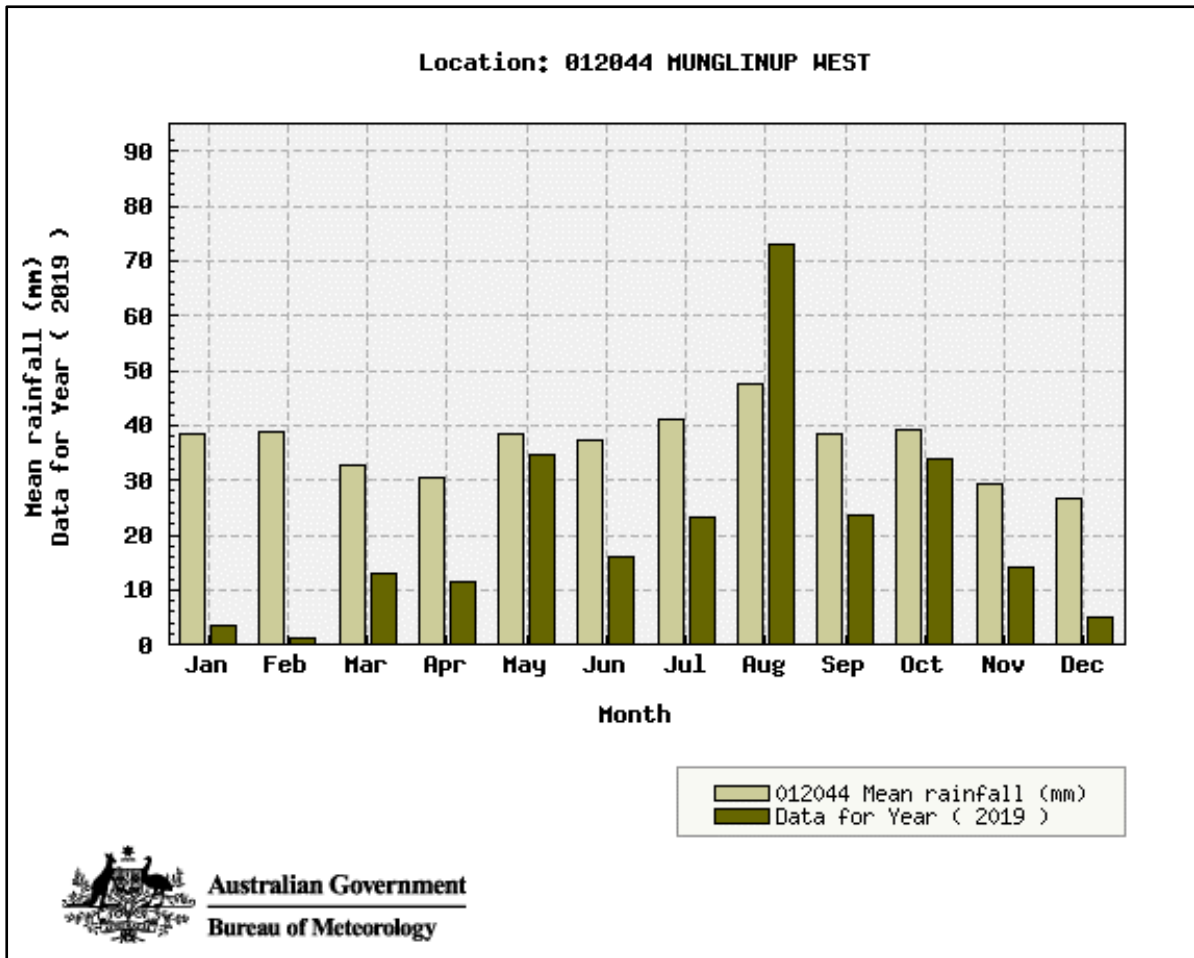
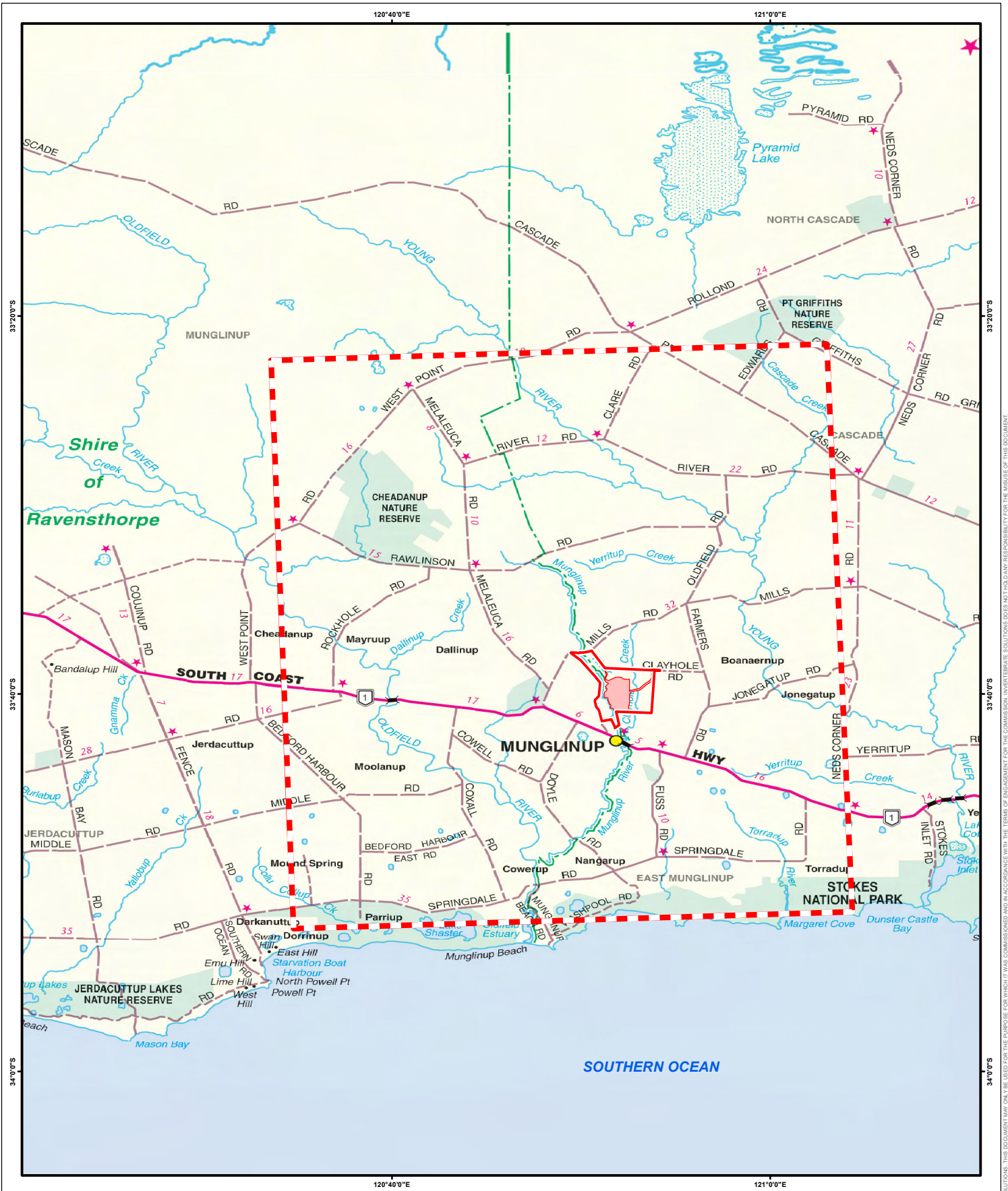


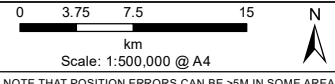
Plate 1 Mean rainfall and rainfall recorded in 2019 for Munglinup West (Source www.bom.gov.au)

Rainfall during 2019 was below average compared with the long term average for Munglinup (Location 012044) (Plate 1), however, substantial rainfall was recorded in August, followed by near average rainfall in October during the survey period, providing excellent conditions for the SRE survey undertaken in October in the context of EPA Technical guidance, sampling of short range endemic invertebrate fauna (EPA 2016).



Legend

- Dekstop Study Area
- SRE Survey Area
- Development Envelope



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

LOCALITY MAP



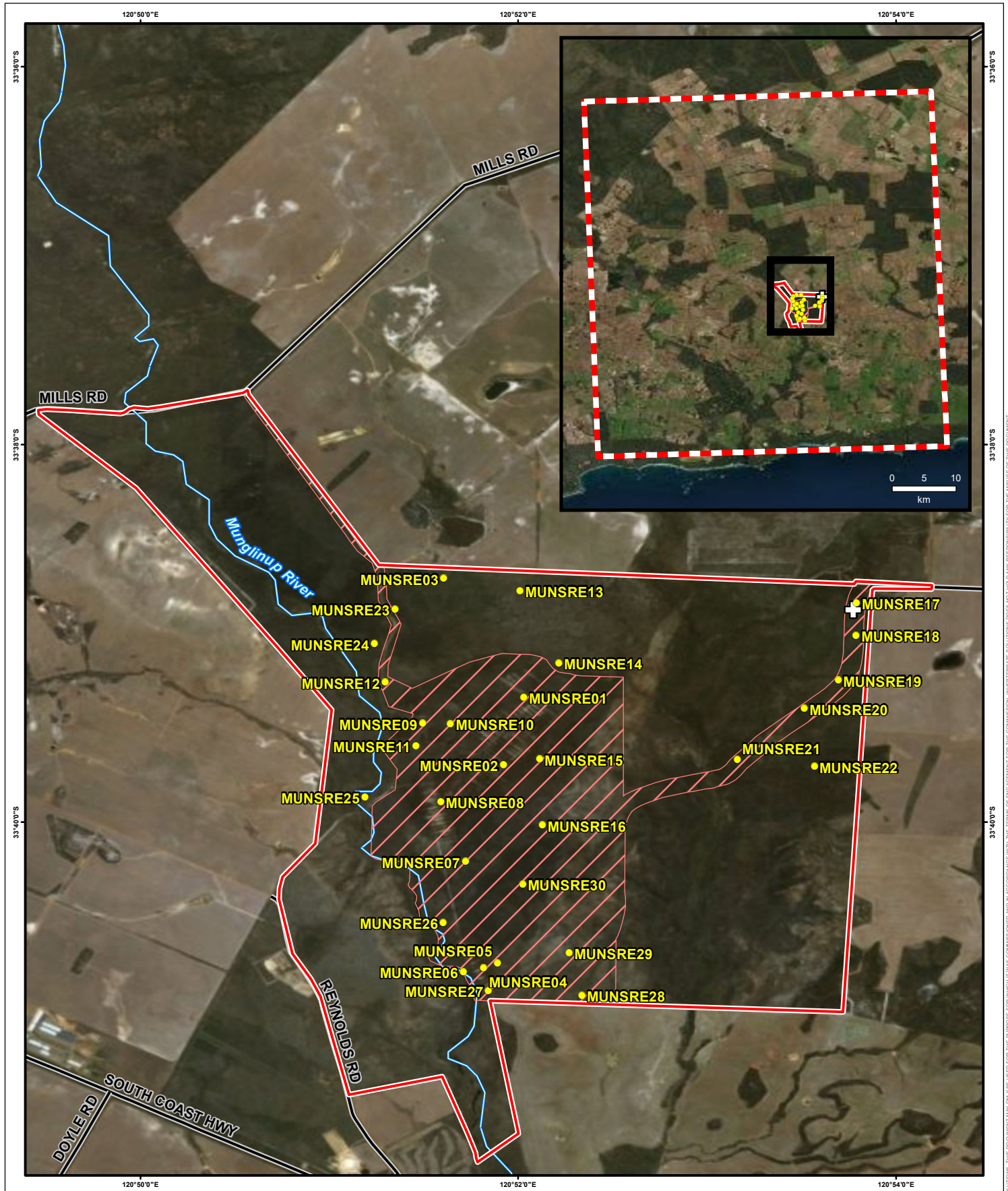
Invertebrate Solutions
 m +61 (0) 429 792 834
 s +61 (0) 405 561 978
 e tim@invertebratesolutions.com
 www.invertebratesolutions.com

PROJECT ID MRC Graphite Project		DATE 9/01/2020	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED ENVIROMAPS	CHECKED TM	APPROVED TM	REVISION 0

Client: MRC Graphite

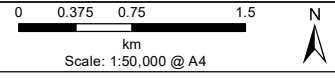
Figure 1
 Location of the MRC Graphite Project, Munglinup, W.A.

- LOCALITY MAP SOURCED FROM LANDGATE 2006
 - TRAVELLERS ATLAS 2006 9TH EDITION



Legend

- Dekstop Study Area
- SRE Survey Area
- Development Envelope
- Road
- Watercourse
- Opportunistic Mygalomorph Spider Record
- SRE Survey Site



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

LOCALITY MAP



Invertebrate Solutions
 m +61 (0) 429 792 834
 s +61 (0) 405 561 978
 e tim@invertebratesolutions.com
 w www.invertebratesolutions.com

PROJECT ID		DATE	
MRC Graphite Project		9/01/2020	
HORIZONTAL DATUM AND PROJECTION			
GDA 1994 MGA Zone 50			
CREATED	CHECKED	APPROVED	REVISION
ENVIROMAPS	TM	TM	0

Client: MRC Graphite

Figure 2
 Short Range Endemic Invertebrate Survey Sites at the Munjlinup Graphite Project

- LOCALITY MAP SOURCED FROM LANDGATE 2006
 - ORTHOPHOTO SOURCED FROM OPEN SOURCE

1.4 Introduction to SRE 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 km² (100 km x 100 km) (Harvey, 2002). Taxa that have been more commonly found to contain SRE 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 2, 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 2 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: <ul style="list-style-type: none"> 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 newly enacted *Biodiversity Conservation* (BC) Act (2016) which came into force on 1st January 2019, replacing the outdated *Wildlife Conservation* (WC) Act (1950). The new BC Act is aligned with the federal *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 Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

At the State level, the BC Act provides a list of species that have special protection as species listed under Part 2 of Biodiversity Conservation Act, 2016. This notice is updated periodically by the Department of Biodiversity, Conservation and Attractions (DBCA) (formerly the Department of Parks and Wildlife (DPaW)) and the current list (November 2019) includes numerous SRE species from the Wheatbelt, South Coast, Murchison and Pilbara regions. Included in the list are 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 2015). 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 BC Act. The Priority fauna list is irregularly updated by DBCA and is now part of the BC Act.

The BC Act now provides the ability for the state government of Western Australia to formally list Threatened Ecological Communities (TECs), along with threatening processes.

The federal EPBC Act protects both species and ecological communities. The most relevant Western Australian listing for SRE fauna is the mygalomorph spider *Idiosoma nigrum* that only occurs in the northern Wheatbelt region and is listed as Vulnerable.

1.6 Survey Staff Qualifications

Field sampling for invertebrates was undertaken by an experienced ecologist and comprised of:

- Dr Timothy Moulds *BSc (Hons) Geol., PhD. Invert. Ecol.* (Invertebrate Solutions)
- Mr Kevin Reynolds (Esperance Tjaltjraak Ranger)

Sampling for SRE invertebrates was undertaken by Dr Tim Moulds and Mr Kevin Reynolds. Invertebrate extraction, sorting and identification was completed by Dr Timothy Moulds. Survey work was undertaken under the collection licences issued by the Department of Biodiversity, Conservation and Attractions:

- BA27000131; Licensee Timothy Moulds (Invertebrate Solutions); Valid until 10/10/2020.

1.7 Report Limitations and Exclusions

This study was limited to the written scope provided to the client by Invertebrate Solutions (15th December 2018) and 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. Assessment of potential impacts to SRE fauna was based on proposed development plans provided by the client.

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 MRC Graphite Ltd 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.

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.

Species were identified to the lowest practical taxonomic level, taking into consideration that the taxonomic framework of many invertebrate groups is incomplete and often in need of substantial revision to enable accurate identification. Short Range Endemic status was assigned using the available information from the 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.

Field surveys for SRE invertebrates require multiple seasonal surveys to fully record all species that may be present in an area, and in varying weather conditions. The current survey was undertaken in a single seasons and additional surveys at different times of the year may record additional species, however, the combination of collection techniques and the intensity of the survey provides a high degree of certainty that majority of potential SRE invertebrates present within the survey area were recorded.

1.7.1 Survey Specific Limitations

The following specific comments are made with regard to project specific limitations for the Project:

- **Sampling effort** – The single phase survey included 30 hours of active searching and 30 leaf litter samples extracted in Tullgren funnels that provides a high degree of certainty that the majority of potential SRE invertebrates present at the time of survey were recorded from the Survey area.
- **Timing** – The survey was undertaken in October, which is within the suggested timing for the south coast region (May – October) according to the EPA Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016). Rainfall was above average in August making for excellent conditions for sampling SRE invertebrates in October.
- **Methods** – a wide variety of collecting techniques were used including active searching, leaf litter sieving, leaf litter extracted in Tullgren funnels, bark peeling, and dry pitfall trapping providing a high degree of certainty that the majority of potential SRE invertebrates present at the time of the survey were recorded from the Survey area. The dry pitfall trapping was undertaken as part of the vertebrate fauna survey by Western Ecological (2020) and all methods are outlined in detail the Western Ecological report. No potential SRE invertebrates were recorded during the pitfall trapping program.
- **Habitats sampled** – All significant potential SRE habitats within the Survey Area were sampled using a combination of techniques.
- **Access to areas** – Minor access restrictions were encountered for the western portion of the proposed haul road route where it meets the main Development Envelope, and the eastern edge of the main Development Envelope due to extremely dense regrowth vegetation following a fire. This habitat was extensively sampled elsewhere within the Survey area and Development Envelope and found to be homogeneous for potential SRE species. No other significant access issues were encountered in the October 2019 survey.

2. Methods

Invertebrate Solutions undertook the following tasks for the dual season SRE survey of the SFIS Project area:

- SRE desktop assessment based upon Western Australian Museum Records and previous survey reports by Biota (2018).
- SRE survey of the Project Area (30 sites – 1 hour active searching and leaf litter samples). Sites 1 – 12 were the same as those used by Biota (2018) for their SRE pilot survey.

The survey program was undertaken with regard to the Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

2.1 SRE Desktop Methodology

A search of the WAM databases for Arachnids, Crustacea and Molluscs was undertaken for potential SRE taxa occurring in the Munghlinup region. In addition, other published reports for the area were examined including the previous pilot survey for SRE invertebrates for the Project (Biota 2018). The desktop analysis was used to identify any potential SRE species that may occur in the Munghlinup region and target those taxa during the subsequent field survey of the Survey area.

2.1.1 Likelihood of SRE invertebrate occurrence

The likelihood of SRE invertebrate species occurring in the Project 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, primarily Biota (2018).
- Botanical and vegetation mapping (Woodman 2019) and other information available for the Project area.
- Results of a Protected Matters Search from the Federal Government’s Department of the Environment and Energy (DoEE) website.
- Records of fauna held by the WAM.

Based on the analysis of all available information, potential SRE invertebrate species were assigned a level of likelihood to be present within habitats contained in the Study area of either ‘Very Low’, ‘Low’, ‘Moderate’, ‘High’, or ‘Definite’.

Table 3 SRE species likelihood of occurrence definitions

SRE Species Likelihood of occurrence	Definition
Definite	The species is confirmed to occur within the Project area.
High	Habitat for the SRE species known to occur within the Project area and known records of the species are within 20 km.
Moderate	Habitat for the SRE species known to occur within the Project area and known records of the species are within 50 km.
Low	The SRE species has been recorded from within 50 km, however, no habitat is present for the species within the Project area.
Very low	No habitat exists for the species within the Project 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 Project area.

2.2 SRE Survey Methodology

The SRE survey was undertaken using a combination of sampling techniques and employed both systematic (timed active searching) and opportunistic (litter collection and transect) sampling. Sites were chosen to maximise SRE habitat including south-facing slopes, gullies, rocky outcrops, dense patches of trees and permanent water bodies. These were selected from previous vegetation mapping available for the Development Envelope, the results of previous SRE surveys and to provide a spatial spread of survey locations throughout the entire Survey area as much as possible whilst focussing on the best quality habitat as observed during the field survey.

2.2.1 Active searching

Active searching was undertaken at 30 sites within and adjacent to the proposed Development Envelope, focusing on areas more likely to contain SRE fauna (Appendix 3). Active searching consisted of sifting of soil and/or leaf litter from suitable habitat areas within each site (millipedes and land snails); the raking of leaf litter (millipedes, land snails, centipedes, mygalomorph burrows); examination of vegetative material below logs and bark (pseudoscorpions, centipedes, millipedes), and an examination of (if present) areas of rock outcrops and associated rock piles.

A minimum of one hour of active searching per site was undertaken.

2.2.2 Leaf Litter collection

Leaf litter was collected from each site surveyed and processed in Tullgren funnels for potential SRE fauna. Approximately 3L of leaf litter was collected from each site and stored in sealed plastic garbage bags.

2.2.3 Opportunistic collection

Various areas that may provide habitat for SRE invertebrates were also opportunistically sampled whilst undertaking other surveys in the survey area. This included searching for burrows of mygalomorph spiders and searching under tree bark and logs for potential SRE species.

2.3 Sorting and curation

Sorting for all SRE samples occurred in the Invertebrate Solutions laboratory using an Amscope 45x dissecting microscope and was undertaken by Dr Timothy Moulds. In the laboratory, fauna was extracted from SRE leaf litter samples using Tullgren funnels and preserved in 70% ethanol. Each taxon was identified to the lowest practical taxonomic rank using published keys and descriptions, and the numbers of each taxon recorded. Each identified taxon was kept in a separate labelled vial and assigned a specimen tracking code. Specimen and site collection data were recorded in an Excel spreadsheet. At the conclusion of the study, all specimens will be lodged at the Western Australian Museum.

2.4 Taxonomy and Nomenclature

Identification of collected invertebrate material was undertaken by Dr Timothy Moulds. Invertebrate groups collected that have no SRE representatives such as ants and flying insects were not identified or reported. The presence of winged adults in most insect groups suggests that they are more capable dispersers and, therefore, less likely to have a restricted range.

The level of specimen identification achievable is dependent on the level of taxonomic knowledge and expertise available. The majority of the taxonomic expertise relating to SRE taxa resides with the staff of the Western Australian Museum, while some groups are also worked on by researchers within other government departments and academic institutions. Taxonomic treatments are available for some invertebrate groups, but not all. The EPA expects that invertebrates collected for identification will be identified to the lowest taxonomic level possible. Ideally, this is to the species level, but there will be limits due to the nature of specimens and the availability of taxonomic keys.

2.5 Molecular sequencing

Specimens that were unable to otherwise be identified using traditional morphological taxonomic approaches due to specimens being the wrong sex, juvenile or damaged. Specimens selected for potential molecular identification had a portion of the individual dissected and stored in 100% reagent grade ethanol in a refrigerator to preserve DNA within the samples.

Molecular identification most commonly uses the mitochondrial gene Cytochrome Oxidase 1 (CO1) as 'barcoding' gene to determine species' limits. DNA sequences obtained are matched with those held within various online databases such as the National Center for Biotechnology Information (NCBI - <https://www.ncbi.nlm.nih.gov/>). Extensive sequencing (and subsequent taxonomic revision) of mygalomorph spiders in Western Australia has been undertaken over the past five years enabling credible matches of sequences to be obtained for various mygalomorph spiders (e.g. Castalanelli et al. 2014, Rix et al. 2015, Castalanelli et al. 2017, Harvey et al. 2018, Rix et al. 2017, Rix et al. 2018a,b,c). DNA extraction and sequencing was undertaken by Genotyping Australia Pty Ltd with detailed molecular methods listed in Genotyping Australia (2019), (Appendix 5).

2.6 Short Range Endemic Status

Taxonomic groups known to contain SRE representatives were examined in more detail to determine if the specimens collected in this study are potentially restricted forms. SRE status will be assigned after comparison with the morphology of other close relatives in the group and current

knowledge on their distribution and ecology, where known. Identifications of isopods was undertaken by Dr Simon Judd.

3. Results

3.1 SRE Invertebrates of the South Coast Region

The south west of Western Australia is a biodiversity hotspot and is a small temperate region on the world's most arid and insular populated continent bordered on two sides by ocean, and isolated by arid lands to the north, northeast, and east (Schwentner and Giribet 2018 and references therein). The south coast contains many existing mesic environments that become more xeric eastwards towards the Nullarbor Plain. These environments are a result of a series of geological and climatic events, including recent aridification and expansion and contraction of mesic environments that have resulted in numerous relic short range endemic invertebrate taxa (Rix et al. 2015).

There has been one broad scale survey for SRE invertebrates along the south coast region (Framenau et al. 2008), along with various taxonomic treatments of taxa that contain short range endemic representatives over the past two decades, (Reid 2002, Judd 2004, Harms 2014). Some of the key taxa with numerous short range endemic representatives includes numerous SRE slaters (Judd 2004), *Atelomastix* millipedes (Edwards and Harvey 2010), and pseudoscorpions (Harms 2014, 2018).

The Southdown Magnetite Project near Wellstead on the south coast of Western Australia has been extensively surveyed for SRE invertebrates by Ecologia (2006), Biota (2009) and GHD (2012), with five confirmed SRE species recorded from the three surveys including a Philoscid isopod, a *Bothriembryon* land snail, an *Atelomastix* millipede, and two Nemesiid mygalomorph spiders (*Kwonkan* – [formerly *Yilgarnia*], and *Proshermacha* – [formerly *Chenistonia*]).

The Munglinup area is poorly known, apart from the previous pilot survey for SRE invertebrates (Biota 2018) with the closest SRE surveys being associated with resources and infrastructure projects near Ravensthorpe to the west of Munglinup. A survey immediately to the north of Ravensthorpe Townsite (GHD 2014) for the proposed heavy haulage route identified one Confirmed SRE land snail (*Bothriembryon* 'ravensthorpe' n. sp.) and a Likely SRE isopod (Philoscoidea: *Laevophiloscia* 'ravensthorpe' n. sp.) and several undetermined female mygalomorph spiders (*Aname* and *Aurecocypta* spp.).

3.1.1 Biota (2018) Munglinup Graphite SRE Pilot Survey

Biota staff undertook a SRE pilot study in May 2018, surveying 12 sites using a combination of active searching methods, specifically targeting mygalomorph spiders, millipedes and terrestrial snails (Biota 2018). The pilot study identified seven different SRE habitats based upon previous vegetation mapping by Ecologica (2015) and an on ground assessment by Biota staff (Table 4).

The pilot survey identified 3 potential SRE mygalomorph spiders; *Aname* sp. indet. (Nemesiidae), *Proshermacha* sp. indet. (Nemesiidae) and Idiopidae sp. indet. (Idiopidae), however, due to the specimens being juvenile or female none were able to be identified beyond generic level or assigned any definite SRE status. Biota (2018) did, however, note that all potential SRE spiders were located within multiple habitat types that indicate that the species are not habitat specific and are not restricted to the study area.

Table 4 SRE habitats and species recorded by Biota (2018) from the Munglinup Graphite Project.

Biota (2018) SRE Habitat	Description (after Ecologia 2015)	Biota (2018) SRE Sites surveyed	SRE species recorded from the SRE habitat
Mallee Shrubland	<i>Eucalyptus flocktoniae</i> and <i>E. uncinata</i> low mallee over mixed <i>Acacia</i> and <i>Melaleuca</i> closed shrubland	MUNSRE01, MUNSRE05, MUNSRE10, MUNSRE11	<i>Aname</i> sp. indet., <i>Proshermacha</i> sp. indet.,
Eucalyptus Woodland	<i>Eucalyptus platypus</i> and <i>E. dielsii</i> closed woodland, over <i>Acacia</i> and <i>Melaleuca</i> open shrubland	MUNSRE02, MUNSRE04, MUNSRE08, MUNSRE09	<i>Aname</i> sp. indet., <i>Proshermacha</i> sp. indet.,
Proteaceous Shrubland	<i>Eucalyptus</i> spp. Open mallee shrubland, over <i>Acacia</i> spp., <i>Melaleuca</i> spp. and <i>Micromyrtus elobata</i> mixed shrubland	MUNSRE03, MUNSRE12,	-
Major Drainage Line	<i>Eucalyptus occidentalis</i> and <i>Allocasuarina huegeliana</i> woodland, over mixed <i>Acacia</i> spp. and <i>Allocasuarina</i> spp., over low shrubs, sedges and halophytes	MUNSRE06	Idiopidae sp. indet.
Eucalyptus Pleurocarpa Low Woodland	low <i>Eucalyptus pleurocarpa</i> low woodland over mixed low shrubs and sedges	-	-
Low Melaleuca Shrubland	<i>Eucalyptus</i> sp. scattered trees (dead), over <i>Melaleuca</i> sp. closed shrubland, (This habitat type occurs in a single isolated patch within the study area, adjacent to Mallee Shrubland habitat and <i>Eucalyptus</i> Woodland habitat)	MUNSRE07	-
Allocasuarina Woodland	<i>Allocasuarina huegeliana</i> , <i>Eucalyptus occidentalis</i> and <i>E. pileata</i> dense woodland. This habitat type occurs in a single isolated patch within the study area, associated with granite (Ecologia 2015). It lies adjacent to Mallee Shrubland habitat and the Major Drainage Line habitat	-	-

3.2 Conservation Significant Fauna in the Desktop Study Area

A list of conservation significant fauna for the Desktop Study Area was compiled from the DBCA Specially Protected Fauna Notice 2019 (DBCA 2019) and the DoEE's Protected Matters Search Tool (PMST). SRE species that are listed under the BC Act and/or the EPBC Act and are likely to occur or have known habitat within the Desktop Study Area are shown in Table 5 along with their conservation code. The PMST results listed no known SRE or conservation significant invertebrate fauna within 50 km of the Project area. A full description of the BC 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 5 Conservation significant invertebrates potentially within the Desktop Study Area.

Higher Classification	Genus and Species	DBCA/ BC Status	EPBC status
Insecta: Hymenoptera	<i>Glossurocolletes bilobatus</i>	Priority 2	-
	<i>Hylaeus globuliferus</i>	Priority 3	-

The bee *Leioproctus (Glossurocolletes) bilobatus*, is associated with Jarrah/Wandoo Forest nominally to the east of the Swan Coastal Plain (Houston 2018), and the species has a distribution from as far east as Christmas Tree Well off Brookton Highway and on the South Coast within the Stirling Ranges (Invertebrate Solutions 2019). *Leioproctus (Glossurocolletes) bilobatus* has so far been collected solely from the yellow flowering pea, *Gompholobium aristatum* which does not occur within the Munglinup Graphite SRE Survey area (Woodman 2019). It is therefore a Low probability that *Leioproctus (Glossurocolletes) bilobatus* is present within the Development Envelope.

The native bee *Hylaeus globuliferus* has distribution in Western Australia from north of Eneabba, through the southern Wheatbelt and the SCP, and east along the south coast to the Fitzgerald National Park (ALA 2019). *Hylaeus globuliferus* is known to be associated with *Adenanthos cygnorum* and *Banksia attenuata* amongst other native plants (Houston 2018) which are both absent from the Munglinup Graphite Development Envelope (Woodman 2019). It is therefore a Low probability that *Hylaeus globuliferus* is present within the Development Envelope.

3.3 SRE Habitat in Project Area

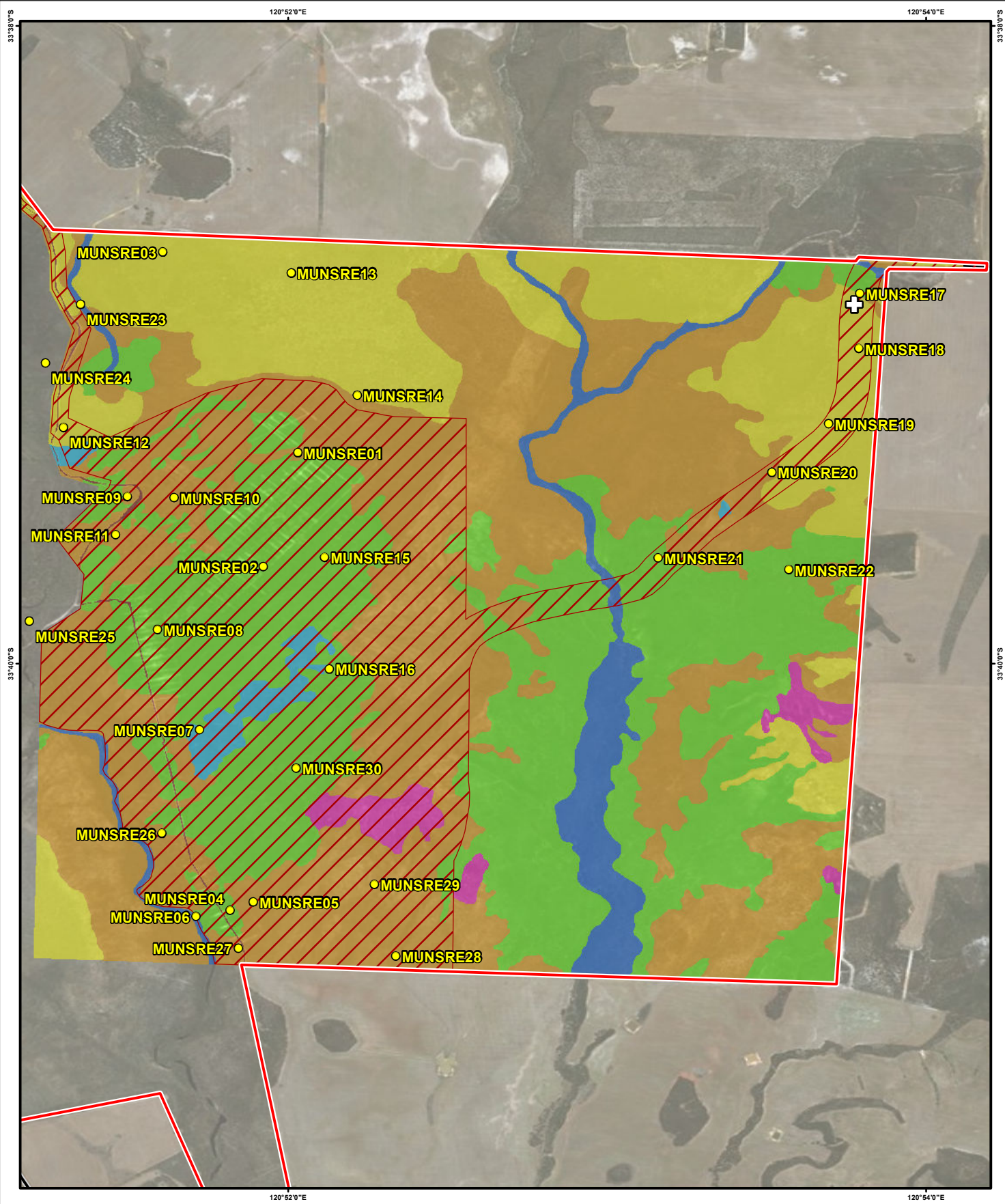
The vegetation units and condition mapping identified in the biological assessment (Woodman 2019) were used to assess the Project area for potential SRE habitat (Table 6). The gullies associated with rivers on either side of the Development envelope would provide potential cool moist microhabitats that are relied upon by SRE invertebrates, however, none appear to be particularly deep and the vegetation is largely laterally continuous across the SRE survey area that encompasses the Development Envelope with no vegetation units restricted to the Development Envelope.

The vegetation units within the SRE survey area are largely in pristine to very good condition (Woodman 2019), however, large areas of the Eucalyptus woodland and Melaleuca shrubland on the eastern side of the Development Envelope have been subject to fire, reducing their suitability for SRE invertebrates due to limited accumulation of leaf litter.

All assessments for likelihood of occurrence of conservation significant and SRE invertebrate species were undertaken with regard to the Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

Table 6 Vegetation units (modified after Woodman 2019), habitat suitability for SRE invertebrates and survey effort

SRE Habitat	Description (modified after Woodman Environmental, 2019)	SRE Sites surveyed	Percent in Study Area / Development Envelope	Survey Methods		SRE habitat suitability
				Active Searching	Tullgren funnels	
Mallee Shrubland	<i>Eucalyptus leptocalyx/flocktoniae/uncinata/occidentalis</i> low mallee over mixed <i>Acacia</i> , <i>Melaleuca</i> and occasional <i>Hakea</i> sp and, <i>Hibbertia</i> sp. closed shrubland (Woodman 2019 vegetation units 1,2,8,9)	MUNSRE01, MUNSRE05, MUNSRE09, MUNSRE10, MUNSRE11, MUNSRE20, MUNSRE26, MUNSRE27, MUNSRE28, MUNSRE29	42% / 50%	+	+	Moderate
Eucalyptus Woodland	Low mallee woodland to open forest dominated by <i>Eucalyptus densa</i> , <i>E. conglobata</i> , <i>E. phaenophylla</i> <i>Euca</i> over tall to mid open shrubland of mixed species dominated <i>Banksia media</i> , <i>Gastrolobium</i> over low sedgeland of mixed species (Woodman 2019 vegetation units 3, 4, 5, 6, 10, 14, 15)	MUNSRE02, MUNSRE04, MUNSRE08, MUNSRE15, MUNSRE17, MUNSRE21, MUNSRE22, MUNSRE24, MUNSRE25, MUNSRE30	32% / 39%	+	+	Moderate
Proteaceous Shrubland	Proteaceous shrubland with <i>Eucalyptus pleuorcarpa</i> , and occasional <i>E. uncinata</i> , <i>Nyctia floribunda</i> , <i>Banksia baueri</i> , over <i>Adenanthos cuneatus</i> , <i>Acacia</i> spp., <i>Melaleuca</i> spp. <i>Allocasuarina humilis</i> , and <i>Micromyrtus elobata</i> mixed shrubland (Woodman 2019 vegetation units 16, 17)	MUNSRE03, MUNSRE12, MUNSRE13, MUNSRE14, MUNSRE18, MUNSRE19	19% / 5%	+	+	Moderate
Major Drainage Line	Drainage line with low woodland to open forest of <i>Eucalyptus occidentalis</i> and <i>Melaleuca cuticularis</i> and over tall open shrubland of mixed species dominated by <i>Acacia</i> spp. (Woodman 2019 vegetation units 12, 13)	MUNSRE06, MUNSRE23	4% / 0.4%	+	+	Moderate
Low Melaleuca Shrubland	Tall to mid open to sparse shrubland dominated by <i>Melaleuca uncinata</i> over mid to low shrubland to open shrubland of mixed species dominated by <i>Acacia sulcata</i> var. <i>platyphylla</i> , <i>Melaleuca elliptica</i> and <i>Astus tetragonus</i> over low sparse shrubland (Woodman 2019 vegetation unit 11)	-	2% / 2%	-	-	Low
Low Mallee Woodland	Low mallee woodland to open forest dominated by <i>Eucalyptus densa</i> subsp. <i>densa</i> and occasionally <i>Eucalyptus flocktoniae</i> subsp. <i>flocktoniae</i> and <i>Eucalyptus phaenophylla</i> subsp. <i>interjacens</i> over tall to mid open shrubland of mixed species dominated by <i>Gastrolobium parviflorum</i> , <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i> , <i>Hakea lissocarpha</i> and occasionally <i>Melaleuca hamata</i> over low sparse shrubland (Woodman 2019 vegetation unit 7)	MUNSRE07, MUNSRE16	1% / 3%	+	+	Low
Cleared / Degraded	Cleared or degraded land	-	0% / 0.6%	-	-	Nil



- Legend**
- Dekstop Study Area
 - SRE Survey Area
 - Development Envelope
 - Road
 - Watercourse
 - Opportunistic Mygalomorph Spider Record
 - SRE Survey Site

- SRE Habitats**
- Eucalyptus Woodland
 - Low Mallee Woodland
 - Low Melaleuca Shrubland
 - Mallee Shrubland
 - Proteaceous Shrubland
 - Major Drainage Line
 - Cleared

0 0.25 0.5 1 km
Scale: 1:30,000 @ A4

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



Invertebrate Solutions
m +61 (0) 429 792 834
s +61 (0) 405 561 978
e tim@invertebratesolutions.com
w www.invertebratesolutions.com

PROJECT ID		DATE	
MRC Graphite Project		9/01/2020	
HORIZONTAL DATUM AND PROJECTION			
GDA 1994 MGA Zone 50			
CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

Client: MRC Graphite

Figure 3
SRE Sampling Locations and SRE Habitat Values

3.4 Desktop SRE Assessment

A search of the WAM databases for potential SRE taxa occurring in the broader Desktop Study Area centred on the Munmlinup Graphite project was undertaken (WAM 2019a, b, c). The desktop study area comprised a rectangle of approximately 50 km (~260,000 Ha) bounded by the north west corner (33.372463°S, 120.559931°E) and the south east corner (33.859188°S, 121.072575°E) centred on the Munmlinup Graphite project. The results of these were filtered for SRE species as shown in Table 7. Definitions for SRE status are found in Table 2.

In addition to the results of the WAM database searches, SRE species identified within Biota (2018) were also considered. The records held by the WAM are not exhaustive and represent only specimens within the WAM collections that have been databased. The Entomology, Mollusc and Crustacean collections remain largely undatabased. Specimens identified to genus level only have been excluded from the analysis as it is impossible to determine if they represent a SRE taxa.

The Desktop Study Area contains three Confirmed SRE species, one Likely SRE species and three Possible SRE species (Table 7). The species are summarised below:

- Two land snails (*Bothriembryon bradshawi*, and *B. aff. praecelsus*) – Possible SRE species
- Three Idiopid trapdoor spiders (*Bungulla fusca*, *Eucanippe bifida* and *Gaius hueyi*) – Confirmed SRE species
- One Idiopid trapdoor spider (Idiopidae sp. indet.) – Possible SRE species
- One Paradoxosomatid millipede (*Antichiropus rex*) – Likely SRE species

The remaining species identified from desktop resources were found to be widespread.



Plate 2 The widespread land snail *Bothriembryon dux* from within the MRCG Project Area

Table 7 Desktop records from WAM and Biota (2018) of SRE Invertebrates in the Munglinup Desktop Search Area

Higher Order	Genus and species	Data Source		SRE Status	Likelihood of occurrence
		Biota 2018	WAM		
Mollusca					
Gastropoda					
Bothriembryontidae	<i>Bothriembryon balteolus</i>	+		Widespread	Moderate
	<i>Bothriembryon bradshawi</i>	+		Possible (A)	Moderate
	<i>Bothriembryon dux</i>	+	+	Widespread	High
	<i>Bothriembryon aff. praecelsus</i>	+		Possible (A)	Moderate
	<i>Bothriembryon melo</i>	+		Widespread	Moderate
	<i>Bothriembryon cf. rhodostomus</i>	+		unknown	Low
	<i>Gastrocopta cf. margaretae</i>	+		unknown	Low
Pupilidae	<i>Gastrocopta cf. margaretae</i>	+		unknown	Low
Succineidae	<i>Succinea scalanina</i>	+		Widespread	Moderate
Arachnida					
Mygalomorphae					
Barychelidae	<i>Synothele rastelloides</i>	+		Widespread	Moderate
Idiopidae	<i>Bungulla fusca</i>	+	+	Confirmed	High
	<i>Eucanippe bifida</i>	+		Confirmed	Moderate
	<i>Gaius hueyi</i>	+	+	Confirmed	High
	<i>Idiopidae sp. indet.</i>	+	+	Possible (A)	High
Anamidae	<i>Aname mainae</i>	+	+	Widespread	High
Pseudoscorpiones					
Chthoniidae	<i>Lagynochthonius australicus</i>	+	+	Widespread	High
Garypidae	<i>Synsphyronus callus</i>			Widespread	High
Scorpiones					
Urodacidae	<i>Urodacus novaehollandiae</i>		+	Widespread	High
Diplopoda					
Paradoxosomatidae	<i>Antichiropus rex</i>	+	+	Likely SRE	Moderate
Julidae	<i>Ommatoiulus moreleti</i>	+	+	Widespread	High

3.5 SRE Field Survey

The SRE field survey recorded 247 individual specimens representing 25 taxa of invertebrates from six classes, 11 orders and 19 families that have the potential to contain SRE taxa (Appendix 4). Species that are considered to be SRE are summarised in Table 8. No Confirmed SRE species were recorded during the field survey.

Four species were identified as Likely SRE species:

- the isopod *Acanthodillo sp. indet.*
- the isopod *Pseudodiploexochus sp. indet.*
- the isopod *Paraplatyarthrus sp. indet.*
- the millipede *Antichiropus rex?*

Ten Possible SRE species were recorded primarily due to the groups being considered data deficient:

- Three isopods *Buddelundia sp. 'munglinup A'*, *Buddelundia sp. 'munglinup B'* and *Laevophiloscia sp. indet.*
- the mygalomorph spiders *Aname sp. 'munglinup-DNA'* and *Teyl sp. 'MYG355 - DNA'*
- the pseudoscorpions *Amblyolpium sp. 'WA1'*, *Nesidiochernes sp. 'south coast'* and *Indolpium sp.*
- the geophilid centipedes *Mecistocephalus sp. '47 legs'*
- the cryptopid centipede *Cryptops sp. 'south coast'*

The taxonomy of the Pseudoscorpion family Olpiidae is poorly known and, until further taxonomic resolution has been obtained, all species are considered to be Possible SRE species in Western Australia due to a deficiency in data. Molecular sequencing of Pilbara and other Western Australian specimens is currently being undertaken by the Western Australian Museum and these data will be used in the future to determine if species are widespread or restricted in distribution. It must be stated, however, there is considerable difference between molecular and morphological data, with generic and species boundaries highly uncertain making meaningful results unlikely, except in the medium to long term. Due to the unreliable existing taxonomic framework olpiid specimens are not identified beyond family level.

Eight mygalomorph spider specimens were identified using molecular sequencing of the CO1 gene (Appendix 5). Results were obtained for seven of the eight specimens and sequences were matched with sequences previously uploaded to the NCBI database. Three specimens matched with the Nemesiid *Proshermacha sp. 'MYG346'* that is now known to be widespread in distribution (Genotyping Australia 2019). Three specimens most closely matched with the speciose Nemesiid genus *Aname* but not to any previously sequenced specimens and are hence regarded as an undescribed species (Genotyping Australia) and is considered to be a Possible SRE species.



Plate 3 The mygalomorph spider *Proshermacha* sp. 'MYG346' excavated from her burrow at site MUNSRE01

A single opportunistic specimen recorded from the proposed haul road was identified as potentially being from the genus *Aname* by Genotyping Australia (2019), however, on further analysis the sequence most closely matched the Nemesiid species *Teyl* sp. 'MYG355' that is known to occur at a single locality near Bremer Bay and the specimen from Munglinup is tentatively assigned to this species and is considered to be a Possible SRE species.

The single Barychelid mygalomorph spider recorded during active searching at site MUNSRE20 was the only male mygalomorph specimen recorded during the SRE survey and shows a morphological match to *Synothele rastelloides*, however, no molecular data is available for this species and males are previously unknown so the identification is tentative although the species is known to occur in the local region (Biota 2018) and is considered to be widespread.

The Likely SRE taxa identified in Table 8 are discussed further in Sections 4.1 – 4.4. The majority of species recorded are widespread across the southern coast of Western Australia and beyond.

The details of all specimens recorded during the survey including abundance data and individual specimen tracking numbers is shown in Appendix 4.

Table 8 SRE invertebrates recorded during the field survey.

Higher Order	Genus and species	Sites recorded	SRE Status
Mollusca			
Gastropoda			
Charopidae	<i>Insullaoma predicta?</i>	MUNSRE4, MUNSRE16, MUNSRE26	Widespread
Bothriembryontidae	<i>Bothriembryon balteolus</i>	MUNSRE06, MUNSRE07, MUNSRE08, MUNSRE30	Widespread
	<i>Bothriembryon dux</i>	MUNSRE01, MUNSRE09, MUNSRE10, MUNSRE11	Widespread
Crustacea			
Isopoda:			
Armadillidae	<i>Acanthodillo</i> sp. indet.	MUNSRE13	Likely
	<i>Buddelundia</i> sp 'munglinup A'	MUNSRE01, MUNSRE02, MUNSRE04, MUNSRE06, MUNSRE08, MUNSRE09, MUNSRE10, MUNSRE11, MUNSRE12, MUNSRE15, MUNSRE16, MUNSRE20, MUNSRE21, MUNSRE22, MUNSRE23, MUNSRE24, MUNSRE25, MUNSRE27, MUNSRE28, MUNSRE30.	Possible (A)
	<i>Buddelundia</i> sp 'munglinup B'	MUNSRE19, MUNSRE20, MUNSRE25, MUNSRE27.	Possible (A)
	<i>Pseudodiploexochus</i> sp. indet.	MUNSRE04, MUNSRE16 MUNSRE21, MUNSRE27, MUNSRE28, MUNSRE30.	Likely
Paraplatyarthridae	<i>Paraplatyarthrus</i> sp. indet.	MUNSRE01	Likely
Philosciidae	<i>Laevophiloscia</i> sp. indet.	MUNSRE01, MUNSRE02, MUNSRE06, MUNSRE07, MUNSRE08, MUNSRE10, MUNSRE11, MUNSRE19, MUNSRE21, MUNSRE22, MUNSRE23.	Possible (A)
Arachnida			
Mygalomorphae			
Barychelidae	<i>Synothele rastelloides?</i>	MUNSRE20	Widespread
Anamidae	<i>Aname</i> sp. 'munglinup-DNA'	MUNSRE01, MUNSRE02, MUNSRE10.	Possible (A)
	<i>Proshermacha</i> sp. 'MYG346'	MUNSRE01, MUNSRE06, MUNSRE15.	Widespread
	Teyl sp. 'MYG355 - DNA'	Opportunistic collection (Haul road)	Possible (A)
Pseudoscorpiones			
Garypinidae	<i>Amblyolpium</i> sp. 'WA1'	MUNSRE17	Possible (A)
Geogarypidae	<i>Geogarypus taylori</i>	MUNSRE06, MUNSRE07, MUNSRE14, MUNSRE15, MUNSRE23, MUNSRE27	Widespread
Chernetidae	<i>Nesidiochernes</i> sp. 'south coast'	MUNSRE23	Possible (A)

Higher Order	Genus and species	Sites recorded	SRE Status
Olpidae	<i>Indolpium sp.</i>	MUNSRE01, MUNSRE04, MUNSRE12, MUNSRE23, MUNSRE28.	Possible (A)
Scorpionida			
Urodacidae	<i>Lychas sp.</i> 'austroccidentalis'	MUNSRE16	Widespread
Chilopoda			
Lithobiomorpha			
Henicopidae	<i>Lamyctes africanus</i>	MUNSRE09, MUNSRE13	Widespread
Geophilomorpha			
Mecistocephalidae	<i>Mescitocephalus sp.</i> '47 legs'	MUNSRE01, MUNSRE06, MUNSRE07, MUNSRE08, MUNSRE09, MUNSRE10, MUNSRE12, MUNSRE13, MUNSRE15, MUNSRE16, MUNSRE20, MUNSRE21, MUNSRE24, MUNSRE27, MUNSRE28, MUNSRE29	Possible (A)
Scolopendromorpha			
Cryptopidae	<i>Cryptops sp.</i> 'south coast'	MUNSRE23	Possible (A)
Scolopendridae	<i>Scolopendra laeta</i>	MUNSRE06, MUNSRE12, MUNSRE16, MUNSRE18, MUNSRE21, MUNSRE23, MUNSRE24, MUNSRE29.	Widespread
Diplopoda			
Polydesmida			
Paradoxosomatidae	<i>Antichiropus rex?</i> (juvenile and dead specimen)	MUNSRE24, MUNSRE26	Likely
Polyxenida			
Polyxenidae	<i>Unixenus mjobergi</i>	MUNSRE01, MUNSRE04, MUNSRE08, MUNSRE16, MUNSRE23.	Widespread
Insecta			
Orthoptera			
Tettigonidae	<i>Pachysaga croceopteryx</i>	MUNSRE24	Widespread

4. Discussion

4.1 SRE Invertebrate Assessment

The SRE field survey recorded 14 potential SRE invertebrate species from within the SRE Survey Area. These 14 taxa included no Confirmed SRE species, four Likely SRE species and 10 Possible SRE species (Figure 4, Figure 5, Table 9, Appendix 4). The majority of the species determined to be Possible SRE taxa is due to incomplete taxonomy and unknown species distributions. All the Possible SRE species are known to occur more widely in the region or were often recorded at multiple locations during the survey indicating that their distributions are wider than the current survey could determine.

The desktop assessment of the Desktop Study Area recorded two Confirmed SRE species that have a High Likelihood of occurrence within the SRE Survey area, and one Confirmed SRE species with a Moderate Likelihood of occurrence. None of these species were recorded during the SRE survey or during the previous pilot survey undertaken by Biota (2018). The single Likely SRE species, the millipede *Antichiropus rex* identified during the desktop assessment was recorded during the field survey (Figure 5).

All Likely SRE species were recorded within the project area were collected from leaf litter extracted in a Tullgren funnel (Appendix 4). Every Likely SRE species was recorded solely from leaf litter extracted in Tullgren funnel samples except for the single dead specimen of *Antichiropus rex*?. The Possible SRE species were generally recorded from both active searching and from leaf litter extracted in Tullgren funnels.

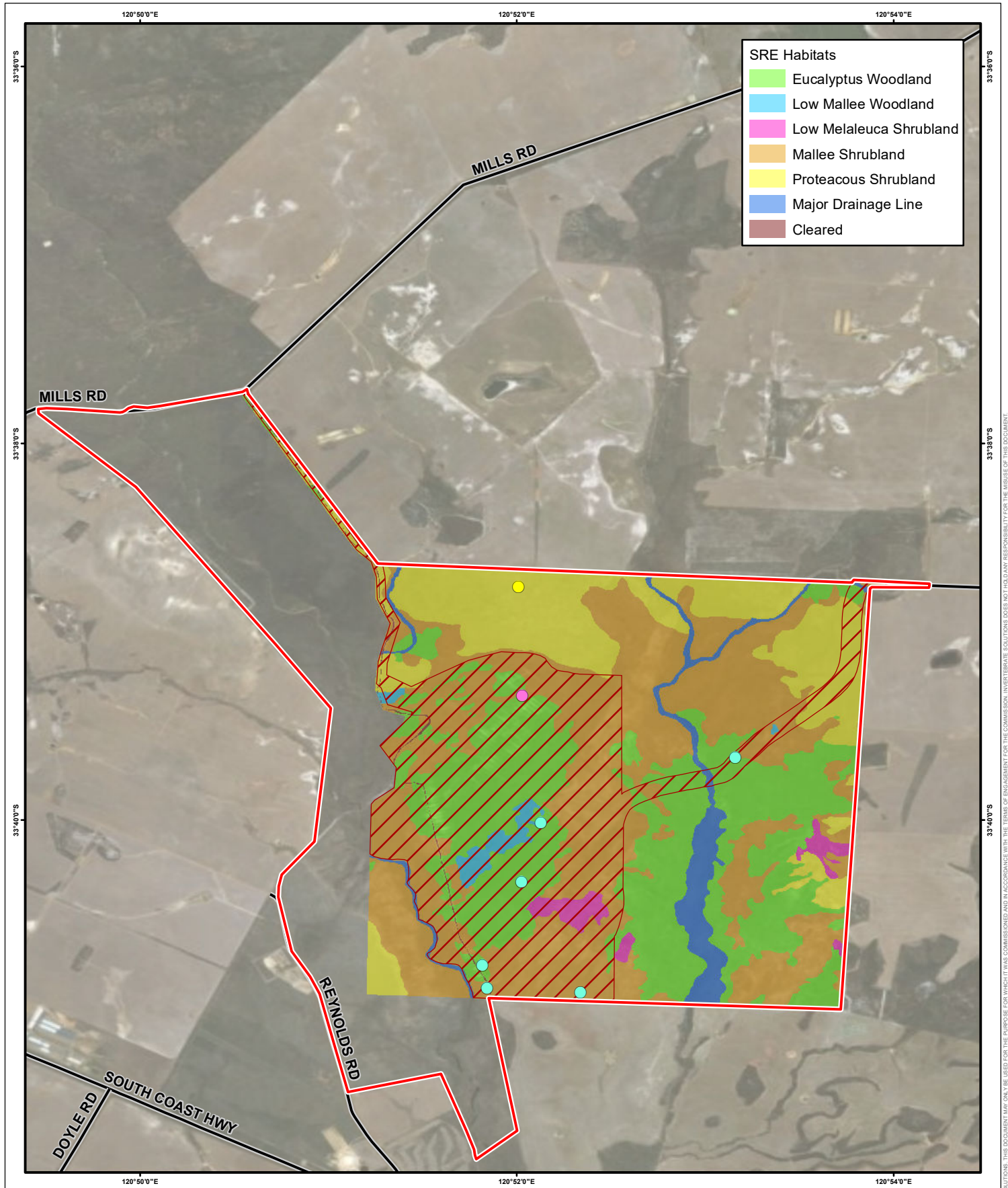
The Likely SRE species were recorded within the laterally continuous Mallee Shrubland or Eucalyptus Woodland habitats, with only a single specimen of the Likely SRE isopod species *Acanthodillo* sp. indet. recorded from the Proteaceous Kwongan Shrubland habitat.

All Confirmed and Likely SRE species with a Moderate or higher likelihood of occurrence within the Project area, are considered in depth in Section 4.2 – 4.3 respectively.

Table 9 Potential SRE invertebrates Likelihood of occurrence in the MRCG Graphite SRE Survey Area

Higher Order	Genus and species	Collection records (Biota 2018) and known distribution (WAM or published records)		Recorded during current 2019 survey		SRE Status	Likelihood of species within the Survey area
		Recorded by Biota 2018 from survey area	Known Distribution (WAM or Published records)	Development Area (DE)	Outside DE		
Mollusca							
Gastropoda							
Bothriembryontidae	<i>Bothriembryon bradshawi</i>	No	Stirling Ranges to Munglinup	No	No	Possible (A)	Moderate
	<i>Bothriembryon aff. praeceus</i>	No	11 km NE of survey area in remnant <i>Eucalyptus</i> open mallee shrubland.	No	No	Possible (A)	Moderate
Crustacea							
Isopoda:							
Armadillidae	<i>Acanthodillo</i> sp. indet.	No	Survey area	No	Yes	Likely	Present
	<i>Buddelundia</i> sp. 'munglinup A'	No	Survey area	Yes	Yes	Possible (A)	Present
	<i>Buddelundia</i> sp. 'munglinup B'	No	Survey area	Yes	Yes	Possible (A)	Present
	<i>Pseudodiploexochus</i> sp. indet.	No	Survey area	Yes	No	Likely	Present
Paraplatyarthridae	<i>Paraplatyarthrus</i> sp. indet.	No	Survey area	Yes	No	Likely	Present
Philosciidae	<i>Laevophiloscia</i> sp. indet.	No	Survey area	Yes	Yes	Possible (A)	Present
Arachnida							
Mygalomorphae							
Idiopidae	<i>Bungulla fusca</i>	Rix et al. 2018a	Munglinup to Coolinup in open <i>Eucalyptus</i> mallee shrubland	No	No	Confirmed	High
	<i>Eucanippe bifida</i>	Rix et al. 2018b	Ravensthorpe to Cape Arid in open <i>Eucalyptus</i> mallee shrubland	No	No	Confirmed	Moderate
	<i>Gaius hueyi</i>	WAM record / Rix et al. 2018c	Ravensthorpe to point Dempster.	No	No	Confirmed	High
	<i>Idiopidae</i> sp. indet.	Biota 2018	Survey area	No	No	Possible (A)	Present
Anamidae	<i>Aname</i> sp. 'munglinup-DNA'	No	Survey area	Yes	No	Possible (A)	Present

Higher Order	Genus and species	Collection records (Biota 2018) and known distribution (WAM or published records)		Recorded during current 2019 survey		SRE Status	Likelihood of species within the Survey area
		Recorded by Biota 2018 from survey area	Known Distribution (WAM or Published records)	Development Area (DE)	Outside DE		
	Teyl sp.'MYG355 - DNA'	No	Waychinicup to Munglinup	Yes	No	Possible (A)	Present
Pseudoscorpiones:							
Garypinidae	<i>Amblyolpium</i> sp. 'WA1'	No	Ravensthorpe to Munglinup	Yes	Yes	Possible (A)	Present
Chernetidae	<i>Nesidiochernes</i> sp. 'south coast'	No	Ravensthorpe to Munglinup	Yes	Yes	Possible (A)	Present
Olpiidae	<i>Indolpium</i> sp.	No	Insufficient taxonomy	Yes	Yes	Possible (A)	Present
Chilopoda							
Geophilomorpha							
Mecistocephalidae	<i>Mescitocephalus</i> sp. '47 legs'	No	Insufficient taxonomy	Yes	Yes	Possible (A)	Present
Scolopendromorpha							
Cryptopidae	<i>Cryptops</i> sp. 'south coast'	No	Insufficient taxonomy	Yes	Yes	Possible (A)	Present
Diplopoda							
Polydesmida							
Paradoxosomatidae	<i>Antichiropus</i> <i>rex?</i>	No	Munglinup to Grass Patch	Yes	Yes	Likely	Present

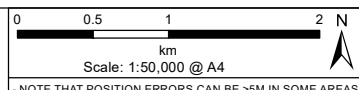


Legend

- SRE Survey Area
- Development Envelope
- Road

SRE isopod locations

- Armadillidae: *Acanthodillo* sp. indet.
- Armadillidae: *Pseudodiploexochus* sp. indet.
- Paraplatyarthridae: *Paraplatyarthus* sp. indet.



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

LOCALITY MAP



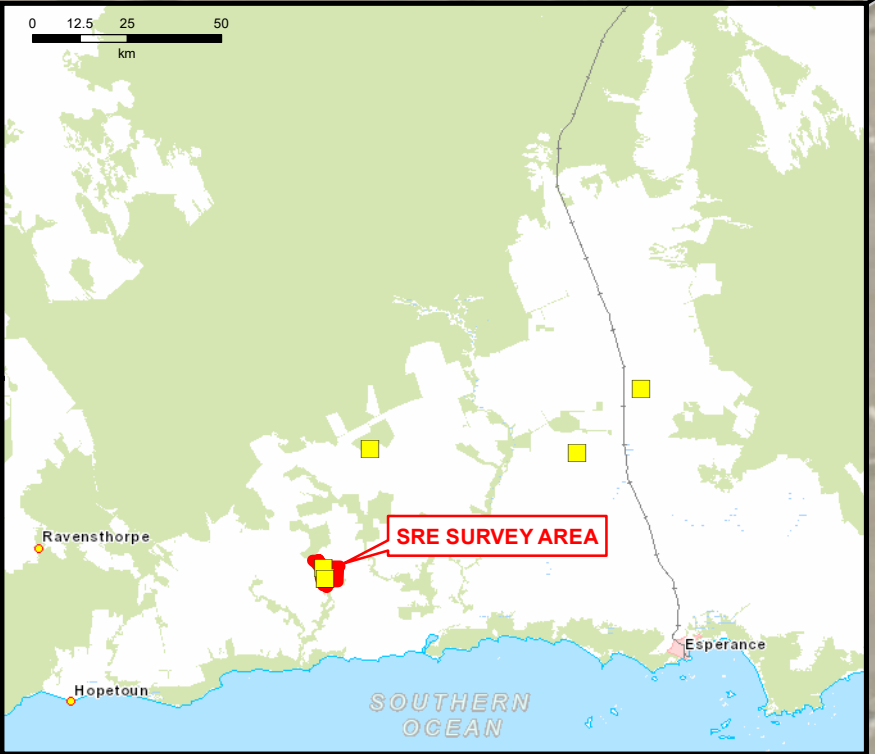
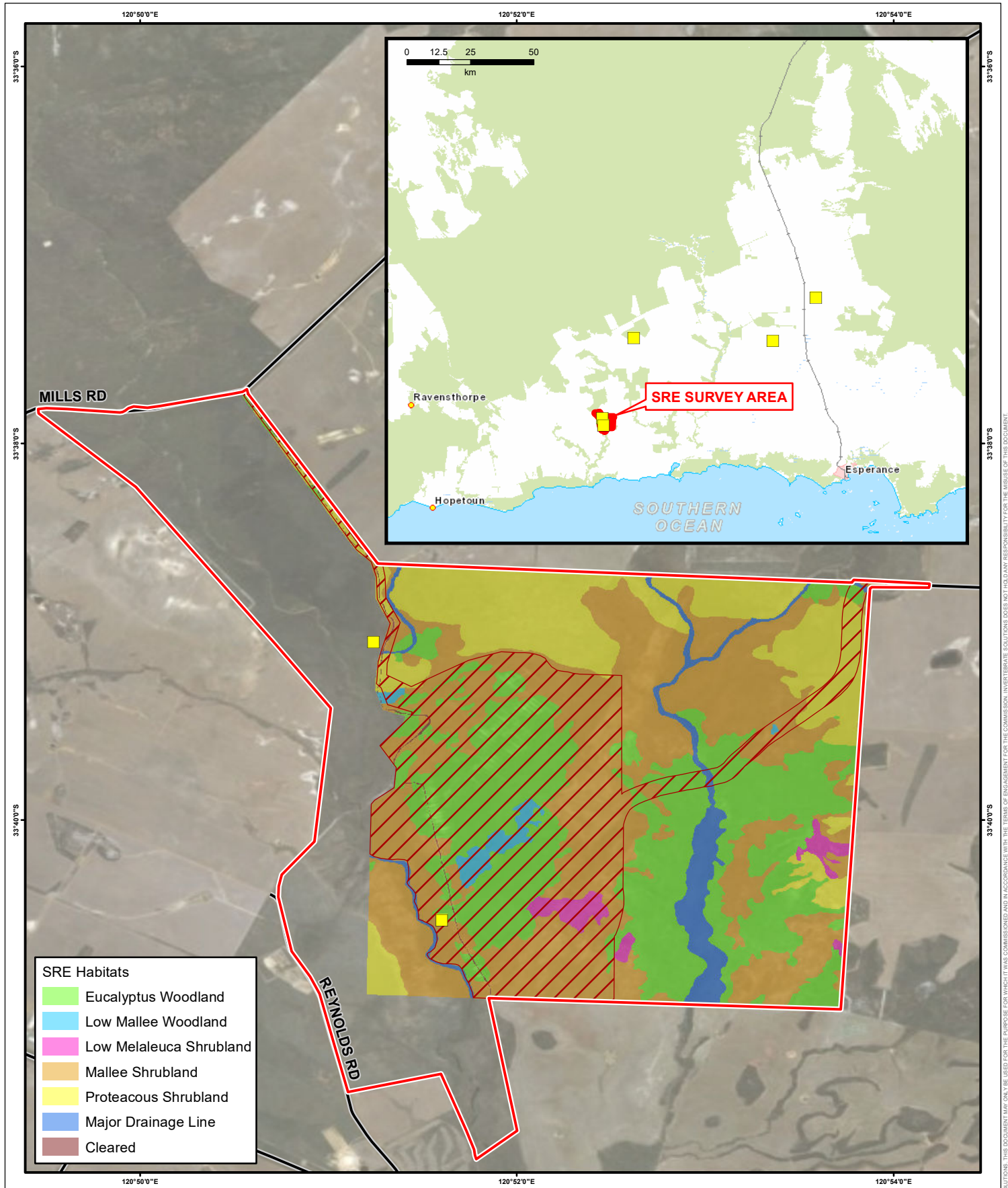
Invertebrate Solutions
 m +61 (0) 429 792 834
 s +61 (0) 405 561 978
 e tim@invertebratesolutions.com
 www.invertebratesolutions.com

PROJECT ID MRC Graphite Project		DATE 9/01/2020	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED ENVIRONMAPS	CHECKED TM	APPROVED TM	REVISION 0

Client: MRC Graphite

Figure 4
Distribution of Likely SRE isopods
Within the SRE Survey Area

- LOCALITY MAP SOURCED FROM LANDGATE 2006
 - ORTHOPHOTO SOURCED FROM OPEN SOURCE




- SRE Habitats**
- Eucalyptus Woodland
 - Low Mallee Woodland
 - Low Melaleuca Shrubland
 - Mallee Shrubland
 - Proteaceous Shrubland
 - Major Drainage Line
 - Cleared

- Legend**
- SRE Survey Area
 - Development Envelope
 - Road
 - SRE millipede species locations**
 - Paradoxosomatidae: *Antichiropus rex*

Scale: 1:50,000 @ A4
 - NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS



		m +61 (0) 429 792 834 s +61 (0) 405 561 978 e tim@invertebratesolutions.com w www.invertebratesolutions.com	
PROJECT ID		DATE	
MRC Graphite Project		9/01/2020	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

Client: MRC Graphite

Figure 5
 Distribution of the Likely SRE millipede species *Antichiropus rex*

4.2 Likely SRE species recorded within the SRE Survey Area

4.2.1 Crustacea: Isopoda

Armadillidae:

***Acanthodillo sp. indet.* – Likely SRE**

A single female specimen of this taxon was collected at Site MUNSRE13 outside of the proposed Development Envelope within the Proteaceous Kwongan Shrubland (Figure 4). All species within this genus are morphologically very similar and reliable morphological characters for determining species are not yet available thus it is currently impossible to identify the taxa beyond generic level (Judd 2019). The genus is cryptic and much less frequently collected than *Buddelundia* and *Acanthodillo* are considered Likely SRE species (Judd 2019).

***Pseudodiploexochus sp. indet.* – Likely SRE**

This genus contains very small, primitive Armadillidae. They are rarely collected outside the wet forest areas of south-west region of Western Australia. The entire genus are considered to be Likely SRE species (Judd 2019).

Paraplatyarthridae

***Paraplatyarthrus sp. indet.* – Likely SRE**

The family Paraplatyarthridae was first described in 2015 (Javidkar et al. 2015) using molecular evidence and is highly cryptic and most of the described species are located in subterranean environments in the Yilgran calcrete habitats (Javidkar et al. 2017). One epigean species has been described from near Laverton. All described species are known SRE taxa and all subterranean forms show highly restricted distributions to a single calcretes (Javidkar et al. 2017).

The specimens assigned as *Paraplatyarthrus sp. indet.* were recorded from a single location (MUNSRE01) and extracted from leaf litter extracted in a tullgren funnel. This species is considered a Likely SRE species (Judd 2019). There is accumulating unpublished evidence to suggest that probably all species within WA are Likely SRE species (Judd 2019). They are partially subterranean and highly cryptic.

4.2.2 Diplopoda

Diplopoda: Paradoxosomatidae: *Antichiropus rex?* – Likely SRE

Millipedes from the genus *Antichiropus* all have limited powers of dispersal and conservative ecological requirements (Car et al. 2013). In addition, the above-ground activity of most *Antichiropus* species are limited to a very small window of opportunity when there is sufficient moisture for them to forage and mate during wetter winter months (Car et al. 2013). *Antichiropus* species are, consequently, short range endemics with very small distributions *sensu* Harvey 2002.

The millipede *Antichiropus rex?* was recorded at Site MUNSRE24, and MUNSRE26 (Figure 5), as juvenile specimens (MUNSRE24) recorded from leaf litter samples occurring outside of the Development Envelope, and a single dead specimen at MUNSRE26 from active searching of leaf

litter. The specimens have been tentatively identified as *A. rex?* due to their morphology and proximity to other records of this species from similar habitats in the immediate area (Biota 2018). *Antichiropus rex?* is considered a Likely SRE for the reasons outlined above but it occurs both inside and outside of the proposed Development Envelope (Figure 5).

4.3 Likelihood of Occurrence of Confirmed SRE mygalomorph spider species within the SRE Survey area

Idiopidae: *Bungulla fusca*

Bungulla fusca (Rix et al. 2018a) has a relatively restricted distribution in the Esperance Plains (Recherche) and south-eastern Mallee bioregions of southern Western Australia, from near Munglinup in the west, east to Coolinup Nature Reserve (Plate 4). Only five male individuals have been recorded from four locations and nothing is known of the biology of this species (Rix et al. 2018a). *Bungulla fusca* is considered to be a SRE species.

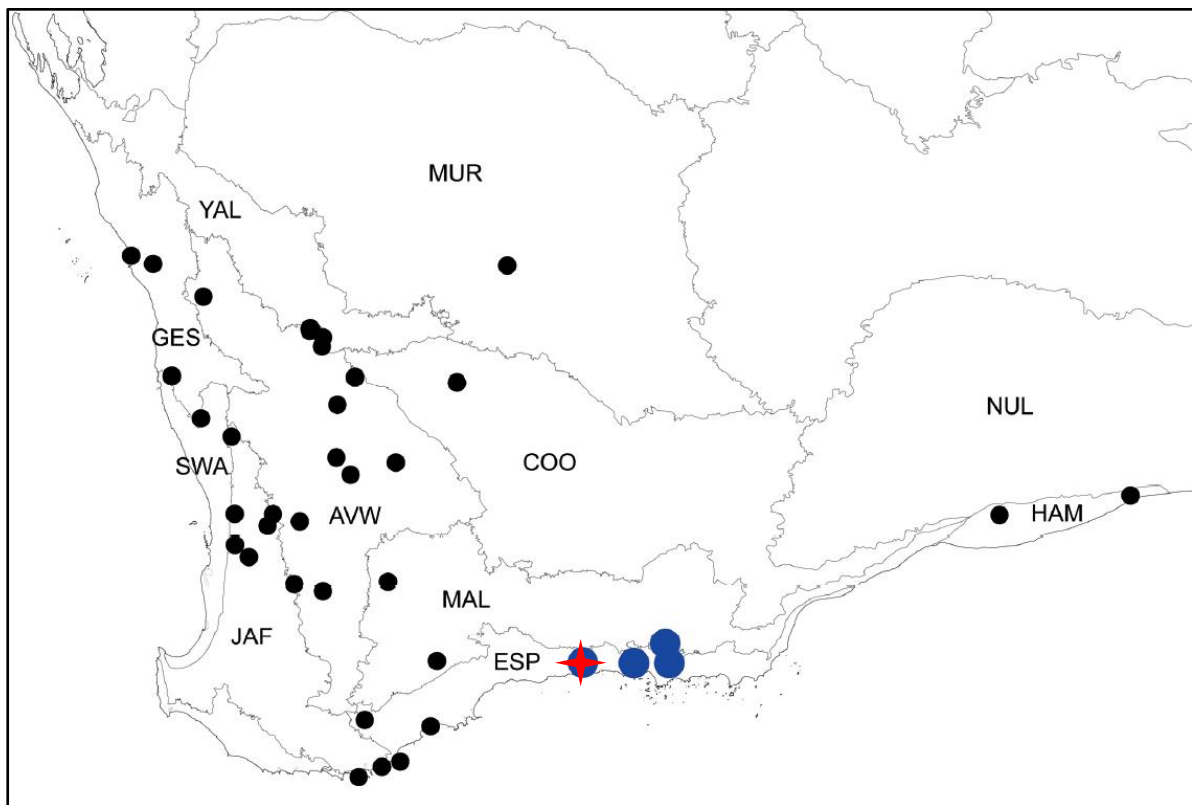


Plate 4 Regional distribution of *Bungulla fusca* along the south coast of Western Australia (After Rix et al. 2018a). The red star shows the approximate position of the Munglinup Graphite Project.

Idiopidae: *Eucanippe bifida*

Eucanippe bifida (Rix et al. 2018b) has a relatively restricted distribution in the Esperance Plains and southeastern Mallee bioregions of south-western Australia, from the Ravensthorpe Range east to Cape Arid National Park (Rix et al. 2017d)(Plate 5). The species is known from 23 male individuals, collected from pitfall traps collected wandering in search of females in late autumn and winter (Rix et al. 2018b). The females are unknown (Rix et al. 2018b). *Eucanippe bifida* is considered to be a SRE species.

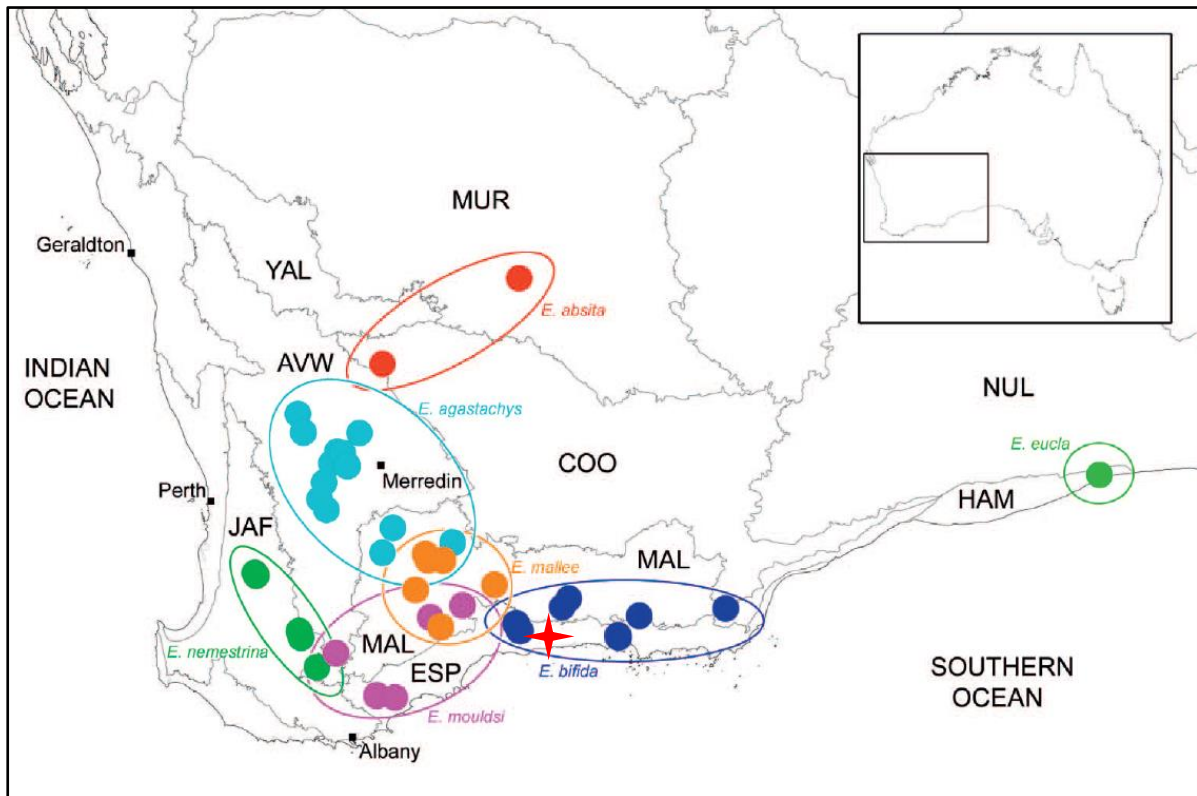


Plate 5 Regional distribution of *Eucanippe bifida* along the south coast of Western Australia (After Rix et al. 2018b). The red star shows the approximate position of the Munglinup Graphite Project.

Idiopidae: *Gaius hueyi*

Gaius hueyi (Rix et al. 2018c) is a large species with a restricted distribution in the Esperance Plains bioregion of southern Western Australia, from Ravensthorpe east to Point Dempster (Plate 6). The species is known from eight males collected in pitfall traps between January and March, in search of females presumably after heavy rain (Rix et al. 2018c). *Gaius hueyi* has a known extent of occurrence (EOO) of approximately 14,000 km², however, within this extent the estimated area of occupancy (AOO) is less than 2,000 km² in severely fragmented sites (Rix et al. 2018c) and is considered to be a SRE species

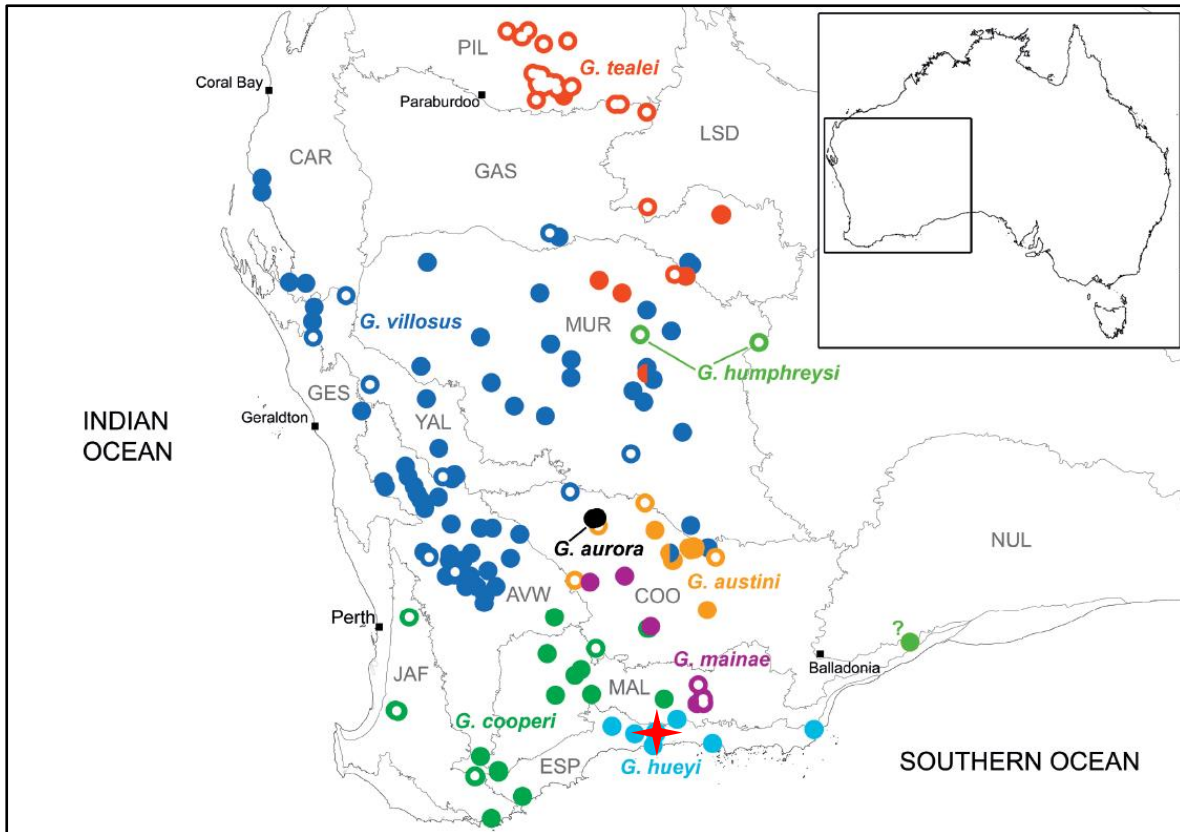


Plate 6 Regional distribution of *Gaius hueyi* along the south coast of Western Australia (After Rix et al. 2018c). The red star shows the approximate position of the Munglinup Graphite Project.

5. Conclusions and Recommendations

The desktop assessment of the Desktop Study area recorded three Confirmed SRE species, one Likely SRE species and three Possible SRE species. Of these seven species identified in the Desktop Study Area, one of these was recorded in the field survey; the millipede *Antichiropus rex*. The remaining six Confirmed and Possible SRE species (four mygalomorph spiders and two land snails) were not recorded.

The SRE field survey recorded 247 individual specimens representing 25 taxa of invertebrates from six classes, 11 orders and 19 families that have the potential to contain SRE taxa. No Confirmed SRE species were recorded during the field survey.

Four species were identified as Likely SRE species:

- the isopod *Acanthodillo sp. indet.*
- the isopod *Pseudodiploexochus sp. indet.*
- the isopod *Paraplatyarthus sp. indet.*
- the millipede *Antichiropus rex?*

Every Likely SRE species was recorded solely from leaf litter extracted in Tullgren funnel samples except for the single dead specimen of *Antichiropus rex?* that was recorded during active searching of leaf litter, however, juvenile specimens of *Antichiropus rex?* were recorded at a different site in leaf litter extracted in tullgren funnel samples. The Likely SRE species were recorded within the laterally continuous Mallee Shrubland or Eucalyptus Woodland habitats, with only a single specimen of the Likely SRE isopod species *Acanthodillo sp. indet.* recorded from the Proteaceous Kwongan Shrubland habitat.

The majority of species recorded are widespread across the southern coast or the south west of Western Australia.

6. References

- Biota (2009). Summary of activities and suggested ongoing studies relating to the Southdown *Yilgarnia*. Unpublished report to Grange Resources, 6 p.
- Biota (2018). Munglinup Graphite Project Terrestrial Short Range Endemic Fauna Pilot Study Unpublished report for MRCG Graphite Pty Ltd September 2018, 42p.
- Car, C.A., Wojcieszek, J.M. and Harvey, M.S. (2013). The millipede genus *Antichiropus* (Diplopoda: Polydesmida: Paradoxosomatidae), part 1: redefinition of the genus and redescriptions of existing species. *Records of the Western Australian Museum*, 28: 83-118. DOI: 10.18195/issn.0312-3162.28(2).2013.083-118
- Castalanelli, M.A., R. Teale, M.G. Rix, W.J. Kennington & M.S. Harvey. (2014). Barcoding of mygalomorph spiders (Araneae: Mygalomorphae) in the Pilbara bioregion of Western Australia reveals a highly diverse biota. *Invertebrate Systematics* 28:375–385. *Systematic Biology* 56:879–886.
- Castalanelli, M.A., J.A. Huey, M.J. Hillyer & M.S. Harvey. (2017). Molecular and morphological evidence for a new genus of small trapdoor spiders from arid Western Australia (Araneae: Mygalomorphae: Nemesiidae: Anaminae). *Invertebrate Systematics* 31:492–505.
- Ecologia (2006). Short Range Endemic invertebrate survey. Southdown Magnetite Project. Unpublished report to Grange Resources, 99 p.
- Ecologia (2008). Targeted trap-door spider and land snail survey. Southdown Magnetite Project. Unpublished report to Grange Resources, 61 p.
- Ecologia (2015). Munglinup Graphite Project Flora and Fauna Assessment. Unpublished report prepared for Gold Terrace Pty Ltd, Ecologia Environment, Perth.
- Edward K.L. and Harvey M.S. (2010). A review of the Australian millipede genus *Atelomastix* (Diplopoda: Spirostreptida: Iulomorphidae). *Zootaxa* 2371: 1–63.
- EPA (2016). Technical guidance. Sampling of short range endemic invertebrate fauna. Environmental Protection Authority: Perth. 35 pp.
- Framenau, V.W., Moir, M.L. & Harvey, M.S. (2008) Terrestrial Invertebrates of the south coast NRM region of Western Australia: short-range endemics in Gondwanan relictual habitats. Unpublished Report to the Southcoast Natural Resource Management Inc.
- Genotyping Australia (2019). Certificate of molecular analysis for Munglinup SRE specimens. Unpublished report to Invertebrate Solutions, 3p.
- GHD (2011). Short Range Endemic Invertebrate baseline survey for Southdown Project. Unpublished report to Grange Resources Ltd, 38 pages.
- GHD (2012). Short Range Endemic Invertebrate baseline survey Phase 1 and 2 for Southdown Project. Unpublished report to Grange Resources Ltd, 64 pages.
- GHD (2014). Ravensthorpe Heavy Haulage Route Terrestrial Short Range Endemic Invertebrate Survey. Unpublished report to Main Roads Western Australia, 32p.
- Harms, D. (2014). The evolution of mesic biomes: insights from an ancient lineage of arachnids. Unpublished Ph.D. Thesis, The University of Western Australia, School of Animal Biology, 382p.

- Harms, D. (2018). The origins of diversity in ancient landscapes: deep phylogeographic structuring in a pseudoscorpion (Pseudotyranochthoniidae: *Pseudotyranochthonius*) reflects Plio-Pleistocene climate fluctuations. *Zoologischer Anzeiger - A Journal of Comparative Zoology* 112-123.
- Harvey, M.S. (2002). Short-range endemism in the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics*. 16: 555–570.
- Harvey M.S., Hillyer, M.J., Main, B.J., Moulds, T.A., Raven, R.J., Rix, M.G., Vink, C.J. and Huey J.A. Phylogenetic relationships of the Australasian open-holed trapdoor spiders (Araneae: Mygalomorphae: Nemesiidae: Anaminae): multi-locus molecular analyses resolve the generic classification of a highly diverse fauna. *Zoological Journal of the Linnean Society*, 2018, 1–46.
- Invertebrate Solutions. (2019). Conservation Significant and Short Range Endemic invertebrate desktop habitat assessment Thornlie-Cockburn Link Proposal, Perth, Western Australia. Technical memorandum to the Public Transport Authority, June 2019.
- Javidkar, M., Cooper, S.J.B., King, R.A., Humphreys, W.F. and Austin A. (2015). Molecular phylogenetic analyses reveal a new southern hemisphere oniscidean family (Crustacea : Isopoda) with a unique water transport system. *Invertebrate Systematics* 29(6): 554.
- Javidkar, M., King, R., Cooper, S.J.B., Humphreys, W.F. and Austin A. (2017). Taxonomy of *Paraplatyarthrus* Javidkar and King (Isopoda: Oniscidea: Paraplatyarthridae) with description of five new species from Western Australia, and comments on Australian *Trichorhina* Budde-Lunde, 1908 (Platyarthridae). *Zootaxa* 4243(3): 401-431. <https://doi.org/10.11646/zootaxa.4243.3.1>
- Judd, S. (2019). Report on the isopods of the Munglinup Graphite Project, Munglinup, Western Australia. Unpublished report to Invertebrate Solutions.
- Reid, A. 2002. Western Australian Onychophora (Peripatopsidae): a new genus, *Kumbadjena*, for a southern species-complex. *Records of the Western Australian Museum* 21, 129-155.
- Rix, M.G., Edwards D.L., Byrne M., Harvey M.S., Joseph L. and Roberts J.D. (2015). Biogeography and speciation of terrestrial fauna in the south-western Australian biodiversity hotspot. *Biological Reviews* 90: 762–793. <https://doi.org/10.1111/brv.12132>
- Rix, M.G., Raven, R., Main, B.J., Harrison, S.E., Austin, A.D., Cooper S.J.B. and Harvey M.S. (2017). The Australasian spiny trapdoor spiders of the family Idiopidae (Mygalomorphae : Arbanitinae): a relimitation and revision at the generic level. *Invertebrate Systematics*, 2017, 31, 566–634. <http://dx.doi.org/10.1071/IS16065>
- Rix, M.G., Raven, R., Austin, A.D., Cooper S.J.B., and Harvey M.S. (2018a). Systematics of the spiny trapdoor spider genus *Bungulla* (Mygalomorphae: Idiopidae): revealing a remarkable radiation of mygalomorph spiders from the Western Australian arid zone. *Journal of Arachnology* 46:249–344
- Rix, M.G., Main, B.Y., Raven, R., and Harvey M.S. (2018b). Systematics of the spiny trapdoor spiders of the genus *Eucanippe* (Mygalomorphae: Idiopidae: Aganippini) from south-western Australia: documenting a poorly-known lineage from Australia's biodiversity hotspot. *Journal of Arachnology*, 46(1):133-154.
- Rix, M.G., Huey J.A., Cooper S.J.B., Austin A.D., Harvey M.S. (2018c). Systematics of the giant spiny trapdoor spiders of the genus *Gaius* Rainbow (Mygalomorphae: Idiopidae: Aganippini):

documenting an iconic lineage of the Western Australian inland arid zone. *Journal of Arachnology*, 46(3):438-472.

Schwentner, M and Giribet, G. (2018). Phylogeography, species delimitation and population structure of a Western Australian short-range endemic mite harvestman (Arachnida: Opiliones: Pettalidae: *Karripurcellia*) *Evolutionary Systematics*, 81–87.
<https://DOI.org/10.3897/evolsyst.2.25274>

Western Australian Museum (WAM). (2019a). Arachnida and Myriapoda database search October 2019.

Western Australian Museum (WAM). (2019b). Crustacea database search October 2019.

Western Australian Museum (WAM). (2019c). Mollusc database search October 2019.

Appendix 1

Conservation Codes from Department of Biodiversity, Conservation and Attractions



CONSERVATION CODES

For Western Australian Flora and Fauna

Threatened, Extinct and Specially Protected fauna or flora¹ are species² which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T **Threatened species**

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.

Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.

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

CR **Critically endangered species**

Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN **Endangered species**

Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.

VU **Vulnerable species**

Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

EX Extinct species

Species where “*there is no reasonable doubt that the last member of the species has died*”, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW Extinct in the wild species

Species that “*is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*”, and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).

Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI Migratory species

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).

Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

CD Species of special conservation interest (conservation dependent fauna)

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS Other specially protected species

Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

P **Priority species**

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

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

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

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.

¹ The definition of flora includes algae, fungi and lichens

² Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Appendix 2

Protected Matters Search Tool Results



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: 17/09/19 16:41:57

[Summary](#)

[Details](#)

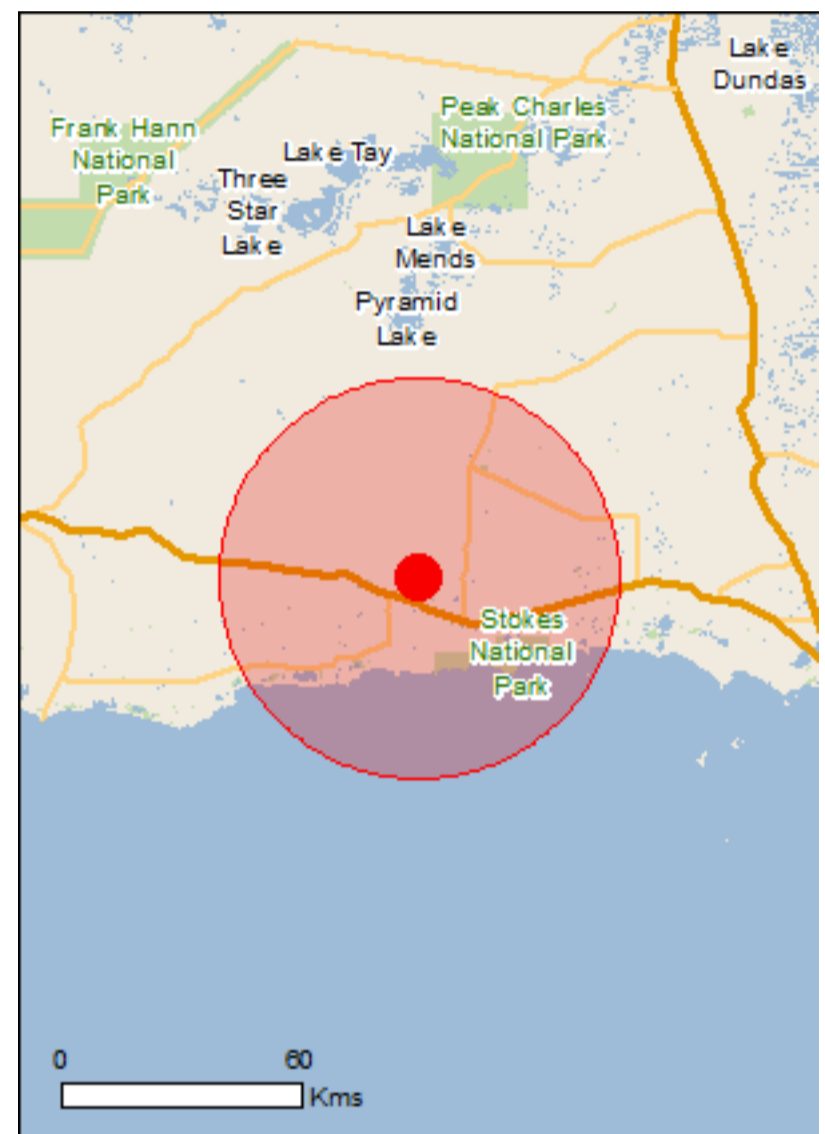
[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

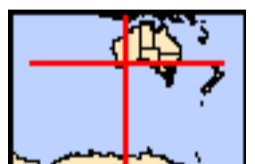
[Acknowledgements](#)



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

[Coordinates](#)

Buffer: 50.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	53
Listed Migratory Species:	47

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	73
Whales and Other Cetaceans:	15
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	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:	24
Regional Forest Agreements:	None
Invasive Species:	13
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)

[\[Resource Information \]](#)

Name	Proximity
Lake gore	Within 10km of Ramsar

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
Eucalypt Woodlands of the Western Australian Wheatbelt	Critically Endangered	Community may occur within area
Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia	Endangered	Community likely to occur within area

Listed Threatened Species

[\[Resource Information \]](#)

Name	Status	Type of Presence
Birds		
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 likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Cereopsis novaehollandiae grisea Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	Breeding known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Status	Type of Presence
Diomedea dabbenena Tristan Albatross [66471]	Endangered	to occur within area 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 known 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 likely to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Phoebastria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
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	Foraging, feeding or related behaviour likely to 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 borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known 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 likely to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Breeding known to occur within area
Parantechinus apicalis Dibbler [313]	Endangered	Species or species habitat likely to occur within area
Phascogale calura Red-tailed Phascogale, Red-tailed Wambenger, Kenngoor [316]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Anigozanthos bicolor subsp. minor Little Kangaroo Paw, Two-coloured Kangaroo Paw, Small Two-colour Kangaroo Paw [21241]	Endangered	Species or species habitat known to occur within area
Conostylis lepidospermoides Sedge Conostylis [9254]	Endangered	Species or species habitat known to occur within area
Eremophila denticulata subsp. denticulata Fitzgerald Eremophila [64569]	Vulnerable	Species or species habitat known to occur within area
Eremophila lactea Milky Emu Bush [2416]	Endangered	Species or species habitat likely to occur within area
Eremophila subteretifolia Lake King Eremophila [56702]	Endangered	Species or species habitat may occur within area
Hypocalymma sp. Cascade (R. Bruhn 20896) [88311]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Kennedia glabrata Northcliffe Kennedia [16452]	Vulnerable	Species or species habitat likely to occur within area
Lambertia echinata subsp. echinata Prickly Honeysuckle [56729]	Endangered	Species or species habitat may occur within area
Rhizanthella gardneri Western Underground Orchid, Underground Orchid [20109]	Endangered	Species or species habitat known to occur within area
Ricinocarpos trichophorus Barrens Wedding Bush [19931]	Endangered	Species or species habitat likely to occur within area
Roycea pycnophylloides Saltmat [21161]	Endangered	Species or species habitat may occur within area

Reptiles

Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area

Sharks

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

Listed Migratory Species

[[Resource Information](#)]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Breeding known to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	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

Name	Threatened	Type of Presence
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Hydroprogne caspia Caspian Tern [808]		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]		Foraging, feeding or related behaviour likely to occur within area
Phoebastria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may 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*	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
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Breeding known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely 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 likely 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 likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species

Name	Threatened	Type of Presence
Pandion haliaetus Osprey [952]		habitat likely to occur within area Species or species habitat known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		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 -

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
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat 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 likely 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 likely to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Cereopsis novaehollandiae grisea Cape Barren Goose (south-western), Recherche Cape Barren Goose [25978]	Vulnerable	Breeding known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat may occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Pachyptila turtur Fairy Prion [1066]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Foraging, feeding or related behaviour likely to occur within area
Phoebastria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Breeding known to occur within area
Puffinus griseus Sooty Shearwater [1024]		Species or species habitat may occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		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 Tasmanian Shy Albatross [89224]	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
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur

Name	Threatened	Type of Presence within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		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
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		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
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within

Name	Threatened	Type of Presence 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
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Breeding known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to 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 borealis Sei Whale [34]	Vulnerable	Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within

Name	Status	Type of Presence area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to 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

Australian Marine Parks [Resource Information]

Name	Label
South-west Corner	National Park Zone (IUCN II)
South-west Corner	Special Purpose Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Cascade	WA
Cascade Nature Reserve	WA
Cheadanup	WA
East Naernup	WA
Fields	WA
Griffiths	WA
Lake Shaster	WA
Munglinup	WA
NTWA Bushland covenant (0015A)	WA
NTWA Bushland covenant (0015B)	WA
NTWA Bushland covenant (0019)	WA
NTWA Bushland covenant (0034)	WA
NTWA Bushland covenant (0035)	WA
NTWA Bushland covenant (0043)	WA
NTWA Bushland covenant (0047)	WA
NTWA Bushland covenant (0053)	WA
Recherche Archipelago	WA
Springdale	WA
Stokes	WA
Unnamed WA26885	WA
Unnamed WA27888	WA
Unnamed WA31745	WA
Unnamed WA32601	WA
Unnamed WA35659	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 Resources Audit, 2001.

Name	Status	Type of Presence
------	--------	------------------

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		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		
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
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-33.6883 120.96906

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.

Appendix 3

SRE Site locations and habitats

MUNSRE01

Mallee Shrubland

51 H 302227
6273985



MUNSRE02

Eucalyptus
Woodland

51 H 302075
6273322



MUNSRE03

Proteaceous
Kwongan shrubland

51 H 301548
6275134



MUNSRE04

Eucalyptus
Woodland

51 H 301954
6271327



MUNSRE05

Mallee Shrubland

51 H 302065
6271377



MUNSRE06

Major Drainage Line

51 H 301806
6271312



MUNSRE07

Low Mallee
Woodland

51 H 301784
6272368



MUNSRE08

Eucalyptus
Woodland

51 H 301569
6272946



MUNSRE09

Mallee Shrubland

51 H 301406
6273712



MUNSRE10

Mallee Shrubland

51 H 301633
6273712



MUNSRE11

Mallee Shrubland

51 H 301354
6273491



MUNSRE12

Proteaceous
Kwongan shrubland

51 H 301089
6274107



MUNSRE13

Proteaceous
Kwongan shrubland

51 H 302174
6275027



MUNSRE14

Proteaceous
Kwongan shrubland

51 H 302508
6274324



MUNSRE15

Eucalyptus
Woodland

51 H 302370
6273380



MUNSRE16

Low Mallee
Woodland

51 H 302407
6272735



MUNSRE17

Eucalyptus
Woodland

51 H 304932
6274963



MUNSRE18

Proteaceous
Kwongan shrubland

51 H 304934
6274644



MUNSRE19

Proteaceous
Kwongan shrubland

51 H 304797
6274205



MUNSRE20

Mallee Shrubland

51 H 304527
6273919



MUNSRE21

Eucalyptus
Woodland

51 H 303987
6273412



MUNSRE22

Eucalyptus
Woodland

51 H 304621
6273355



MUNSRE23

Major Drainage Line

51 H 301207
6274822



MUNSRE24

Eucalyptus
Woodland

51 H 300994
6274480



MUNSRE25

Eucalyptus
Woodland

51 H 300947
6272979



MUNSRE26

Mallee Shrubland

51 H 301614
6271765



MUNSRE27

Mallee Shrubland

51 H 301998
6271107



MUNSRE28

Mallee Shrubland

51 H 302763
6271077



MUNSRE29

Mallee Shrubland

51 H 302650
6271491



MUNSRE30

Eucalyptus
Woodland

51H 302257
6272157



Appendix 4

Specimen abundance and tracking codes

Phylum/ Subphylum	Class	Order	Family	Genus and sp	SRE Status	Abund ance	Site	Date	Collection Method	Tracking number	Identified by
Mollusca	Gastropoda	Systellomatomorpha	Charopidae	<i>Insullaoma predicta?</i>	Widespread	1	MJNSRE16	13/10/2019	Leaf litter extracted from tullgren funnel	ISTN1198	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Charopidae	<i>Insullaoma predicta?</i>	Widespread	1	MJNSRE26	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1202	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Charopidae	<i>Insullaoma predicta?</i>	Widespread	1	MJNSRE04	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1211	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Bothriembryontidae	<i>Bothriembryon balteolus</i>	Widespread	1	MJNSRE07	11/10/2019	Active searching and leaf litter sifting	ISTN1160	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Bothriembryontidae	<i>Bothriembryon balteolus</i>	Widespread	1	MJNSRE06	11/10/2019	Active searching and leaf litter sifting	ISTN1385	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Bothriembryontidae	<i>Bothriembryon balteolus</i>	Widespread	1	MJNSRE08	11/10/2019	Active searching and leaf litter sifting	ISTN1159	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Bothriembryontidae	<i>Bothriembryon balteolus</i>	Widespread	3	MJNSRE30	16/10/2019	Active searching and leaf litter sifting	ISTN1189	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Bothriembryontidae	<i>Bothriembryon dux</i>	Widespread	1	MJNSRE09	11/10/2019	Active searching and leaf litter sifting	ISTN1155	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Bothriembryontidae	<i>Bothriembryon dux</i>	Widespread	1	MJNSRE01	11/10/2019	Active searching and leaf litter sifting	ISTN1168	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Bothriembryontidae	<i>Bothriembryon dux</i>	Widespread	2	MJNSRE10	11/10/2019	Active searching and leaf litter sifting	ISTN1164	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Bothriembryontidae	<i>Bothriembryon dux</i>	Widespread	8	MJNSRE11	11/10/2019	Active searching and leaf litter sifting	ISTN1158	TimMoulds
Mollusca	Gastropoda	Systellomatomorpha	Bothriembryontidae	<i>Bothriembryon dux</i>	Widespread	2	MJNSRE09	11/10/2019	Active searching and leaf litter sifting	ISTN1156	TimMoulds
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Acanthodillo</i> sp. indet.	Likely	1	MJNSRE13	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1342	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	7	MJNSRE01	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1346	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	6	MJNSRE01	15/10/2019	Active searching and leaf litter sifting	ISTN1359	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	1	MJNSRE02	14/10/2019	Active searching and leaf litter sifting	ISTN1169	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	3	MJNSRE04	13/10/2019	Leaf litter extracted from tullgren funnel	ISTN1340	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	6	MJNSRE04	11/10/2019	Active searching and leaf litter sifting	ISTN1152	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	10	MJNSRE06	11/10/2019	Active searching and leaf litter sifting	ISTN1384	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	1	MJNSRE08	12/10/2019	Leaf litter extracted from tullgren funnel	ISTN1350	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	9	MJNSRE08	15/10/2019	Active searching and leaf litter sifting	ISTN1370	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	3	MJNSRE09	15/10/2019	Active searching and leaf litter sifting	ISTN1352	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	3	MJNSRE10	15/10/2019	Active searching and leaf litter sifting	ISTN1356	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	1	MJNSRE11	11/10/2019	Active searching and leaf litter sifting	ISTN1157	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	2	MJNSRE12	13/10/2019	Active searching and leaf litter sifting	ISTN1368	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	2	MJNSRE15	12/10/2019	Active searching and leaf litter sifting	ISTN1388	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	5	MJNSRE16	13/10/2019	Leaf litter extracted from tullgren funnel	ISTN1333	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	2	MJNSRE16	13/10/2019	Active searching and leaf litter sifting	ISTN1376	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	2	MJNSRE20	11/10/2019	Active searching and leaf litter sifting	ISTN1362	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	1	MJNSRE21	15/10/2019	Active searching and leaf litter sifting	ISTN1378	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	1	MJNSRE22	14/10/2019	Active searching and leaf litter sifting	ISTN1393	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	3	MJNSRE23	14/10/2019	Leaf litter extracted from tullgren funnel	ISTN1335	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	14	MJNSRE23	11/10/2019	Active searching and leaf litter sifting	ISTN1365	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	1	MJNSRE24	11/10/2019	Active searching and leaf litter sifting	ISTN1390	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	2	MJNSRE25	11/10/2019	Active searching and leaf litter sifting	ISTN1183	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	6	MJNSRE27	14/10/2019	Active searching and leaf litter sifting	ISTN1381	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	3	MJNSRE28	11/10/2019	Active searching and leaf litter sifting	ISTN1363	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Bubbelundia</i> sp. 'munglinupA'	Possible A	1	MJNSRE30	14/10/2019	Active searching and leaf litter sifting	ISTN1369	Simon Judd

Phylum/ Subphylum	Class	Order	Family	Genus and sp	SRE Status	Abund ance	Site	Date	Collection Method	Tracking number	Identified by
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Budbelundia</i> sp. 'munglinupA'	Possible A	9	MJNSRE30	11/10/2019	Active searching and leaf litter sifting	ISTN1188	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Budbelundia</i> sp. 'munglinupB'	Possible A	2	MJNSRE19	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1213	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Budbelundia</i> sp. 'munglinupB'	Possible A	2	MJNSRE19	11/10/2019	Active searching and leaf litter sifting	ISTN1391	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Budbelundia</i> sp. 'munglinupB'	Possible A	1	MJNSRE20	16/10/2019	Active searching and leaf litter sifting	ISTN1362	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Budbelundia</i> sp. 'munglinupB'	Possible A	1	MJNSRE25	11/10/2019	Active searching and leaf litter sifting	ISTN1183	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Budbelundia</i> sp. 'munglinupB'	Possible A	4	MJNSRE27	16/10/2019	Active searching and leaf litter sifting	ISTN1381	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Pseudodiploexochus</i> sp. indet.	Likely	1	MJNSRE04	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1340	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Pseudodiploexochus</i> sp. indet.	Likely	1	MJNSRE16	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1333	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Pseudodiploexochus</i> sp. indet.	Likely	1	MJNSRE21	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1207	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Pseudodiploexochus</i> sp. indet.	Likely	1	MJNSRE27	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1348	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Pseudodiploexochus</i> sp. indet.	Likely	1	MJNSRE28	14/10/2019	Leaf litter extracted from tullgren funnel	ISTN1193	Simon Judd
Crustacea:	Malacostraca	Isopoda	Amadillidae	<i>Pseudodiploexochus</i> sp. indet.	Likely	1	MJNSRE30	16/10/2019	Leaf litter extracted from tullgren funnel	ISTN1191	Simon Judd
Crustacea:	Malacostraca	Isopoda	Paraplatyarthridae	<i>Paraplatyarthrus</i> sp. indet.	Likely	2	MJNSRE01	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1347	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	1	MJNSRE01	11/10/2019	Active searching and leaf litter sifting	ISTN1358	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	1	MJNSRE02	14/10/2019	Active searching and leaf litter sifting	ISTN1354	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	1	MJNSRE06	11/10/2019	Active searching and leaf litter sifting	ISTN1383	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	2	MJNSRE07	14/10/2019	Active searching and leaf litter sifting	ISTN1387	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	1	MJNSRE08	11/10/2019	Active searching and leaf litter sifting	ISTN1371	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	2	MJNSRE10	11/10/2019	Active searching and leaf litter sifting	ISTN1357	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	1	MJNSRE11	11/10/2019	Active searching and leaf litter sifting	ISTN1353	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	2	MJNSRE19	11/10/2019	Active searching and leaf litter sifting	ISTN1176	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	1	MJNSRE21	15/10/2019	Active searching and leaf litter sifting	ISTN1379	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	2	MJNSRE22	11/10/2019	Active searching and leaf litter sifting	ISTN1392	Simon Judd
Crustacea:	Malacostraca	Isopoda	Philosciidae	<i>Laevophiloscia</i> sp. indet.	Possible A	3	MJNSRE23	14/10/2019	Active searching and leaf litter sifting	ISTN1366	Simon Judd
Chelicerata	Arachnida	Mygalomorphae	Barychelidae	<i>Synothele rastelloides?</i>	Widespread	1	MJNSRE20	14/10/2019	Active searching and leaf litter sifting	ISTN1177	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Barychelidae	<i>Leg of ISTN1177</i>	Widespread	1	MJNSRE20	14/10/2019	Subsample	ISTN1360	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Anome</i> sp. 'munglinup-DNA'	Possible A	1	MJNSRE10	11/10/2019	Dug from burrow	ISTN1163	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Leg of ISTN1163</i>	Possible A	1	MJNSRE10	11/10/2019	Subsample	ISTN1223	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Anome</i> sp. 'munglinup-DNA'	Possible A	1	MJNSRE01	11/10/2019	Dug from burrow	ISTN1166	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Leg of ISTN1166</i>	Possible A	1	MJNSRE01	11/10/2019	Subsample	ISTN1221	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Anome</i> sp. 'munglinup-DNA'	Possible A	1	MJNSRE02	11/10/2019	Dug from burrow	ISTN1170	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Leg of ISTN1170</i>	Possible A	1	MJNSRE02	11/10/2019	Subsample	ISTN1224	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Proschemacha</i> sp. 'MG346'	Widespread	1	MJNSRE06	11/10/2019	Dug from burrow	ISTN1162	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Leg of ISTN1162</i>	Widespread	1	MJNSRE06	11/10/2019	Subsample	ISTN1225	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Proschemacha</i> sp. 'MG346'	Widespread	1	MJNSRE15	13/10/2019	Dug from burrow	ISTN1172	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Leg of ISTN1172</i>	Widespread	1	MJNSRE15	13/10/2019	Subsample	ISTN1226	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Proschemacha</i> sp. 'MG346'	Widespread	1	MJNSRE01	11/10/2019	Dug from burrow	ISTN1167	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Leg of ISTN1167</i>	Widespread	1	MJNSRE01	11/10/2019	Subsample	ISTN1222	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Teyl</i> sp. 'MG355 - DNA'	Possible A	1	Opportunistic	14/10/2019	Dug from burrow	ISTN1174	TMoulds
Chelicerata	Arachnida	Mygalomorphae	Nemesiidae	<i>Leg of ISTN1174</i>	Possible A	1	Opportunistic	14/10/2019	Subsample	ISTN1227	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Garypinidae	<i>Amblyopium</i> sp. 'WA1'	Possible A	1	MJNSRE17	14/10/2019	Leaf litter extracted from tullgren funnel	ISTN1195	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Geogarypidae	<i>Geogarypus taylori</i>	Widespread	2	MJNSRE06	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1196	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Geogarypidae	<i>Geogarypus taylori</i>	Widespread	1	MJNSRE15	13/10/2019	Leaf litter extracted from tullgren funnel	ISTN1210	TMoulds

Phylum/ Subphylum	Class	Order	Family	Genus and sp	SRE Status	Abund ance	Site	Date	Collection Method	Tracking number	Identified by
Chelicerata	Arachnida	Pseudoscorpionida	Geogarypidae	<i>Geogarypus taylori</i>	Widespread	1	MUNRE23	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1336	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Geogarypidae	<i>Geogarypus taylori</i>	Widespread	1	MUNRE27	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1349	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Geogarypidae	<i>Geogarypus taylori</i>	Widespread	1J	MUNRE14	13/10/2019	Leaf litter extracted from tullgren funnel	ISTN1209	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Geogarypidae	<i>Geogarypus taylori</i>	Widespread	2	MUNRE07	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1220	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Chernetidae	<i>Nesidiochernes</i> sp. 'south coast'	Possible A	1	MUNRE23	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1337	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Olopiidae	<i>Indolpium</i> sp.	Possible A	2	MUNRE04	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1341	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Olopiidae	<i>Indolpium</i> sp.	Possible A	1	MUNRE28	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1334	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Olopiidae	<i>Indolpium</i> sp.	Possible A	1	MUNRE23	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1338	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Olopiidae	<i>Indolpium</i> sp.	Possible A	3	MUNRE01	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1347	TMoulds
Chelicerata	Arachnida	Pseudoscorpionida	Olopiidae	<i>Indolpium</i> sp.	Possible A	1	MUNRE12	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1219	TMoulds
Chelicerata	Arachnida	Scorpionida	Urodacidae	<i>Lychas</i> sp. 'austroroccidentalis'	Widespread	1	MUNRE16	13/10/2019	Active searching and leaf litter sifting	ISTN1375	TMoulds
Myriapoda	Chilopoda	Lithobiomorpha	Henicopidae	<i>Lomyctes africanus</i>	Widespread	1	MUNRE13	13/10/2019	Leaf litter extracted from tullgren funnel	ISTN1343	TMoulds
Myriapoda	Chilopoda	Lithobiomorpha	Henicopidae	<i>Lomyctes africanus</i>	Widespread	1	MUNRE09	11/10/2019	Active searching and leaf litter sifting	ISTN1154	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE01	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1344	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	2	MUNRE01	11/10/2019	Active searching and leaf litter sifting	ISTN1165	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE06	11/10/2019	Active searching and leaf litter sifting	ISTN1382	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE07	11/10/2019	Active searching and leaf litter sifting	ISTN1386	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE08	11/10/2019	Active searching and leaf litter sifting	ISTN1373	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	2	MUNRE09	11/10/2019	Active searching and leaf litter sifting	ISTN1351	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE10	11/10/2019	Active searching and leaf litter sifting	ISTN1355	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE12	11/10/2019	Active searching and leaf litter sifting	ISTN1367	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE13	13/10/2019	Leaf litter extracted from tullgren funnel	ISTN1215	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE15	13/10/2019	Active searching and leaf litter sifting	ISTN1171	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE16	13/10/2019	Active searching and leaf litter sifting	ISTN1374	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE20	14/10/2019	Active searching and leaf litter sifting	ISTN1361	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE21	14/10/2019	Active searching and leaf litter sifting	ISTN1377	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE24	15/10/2019	Active searching and leaf litter sifting	ISTN1389	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	2	MUNRE27	15/10/2019	Active searching and leaf litter sifting	ISTN1185	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE28	15/10/2019	Active searching and leaf litter sifting	ISTN1186	TMoulds
Myriapoda	Chilopoda	Geophilomorpha	Mecistocephalidae	<i>Mecistocephalus</i> sp. '47 legs'	Possible A	1	MUNRE29	16/10/2019	Active searching and leaf litter sifting	ISTN1380	TMoulds
Myriapoda	Chilopoda	Scolopendromorpha	Cryptopidae	<i>Cryptops</i> sp. 'south coast'	Possible A	1	MUNRE23	15/10/2019	Active searching and leaf litter sifting	ISTN1364	TMoulds
Myriapoda	Chilopoda	Scolopendromorpha	Scolopendridae	<i>Scolopendra laeta</i>	Widespread	1	MUNRE06	11/10/2019	Active searching and leaf litter sifting	ISTN1161	TMoulds
Myriapoda	Chilopoda	Scolopendromorpha	Scolopendridae	<i>Scolopendra laeta</i>	Widespread	1	MUNRE12	11/10/2019	Active searching and leaf litter sifting	ISTN1153	TMoulds
Myriapoda	Chilopoda	Scolopendromorpha	Scolopendridae	<i>Scolopendra laeta</i>	Widespread	1	MUNRE16	13/10/2019	Active searching and leaf litter sifting	ISTN1173	TMoulds
Myriapoda	Chilopoda	Scolopendromorpha	Scolopendridae	<i>Scolopendra laeta</i>	Widespread	1	MUNRE18	14/10/2019	Active searching and leaf litter sifting	ISTN1175	TMoulds
Myriapoda	Chilopoda	Scolopendromorpha	Scolopendridae	<i>Scolopendra laeta</i>	Widespread	1	MUNRE21	14/10/2019	Active searching and leaf litter sifting	ISTN1178	TMoulds
Myriapoda	Chilopoda	Scolopendromorpha	Scolopendridae	<i>Scolopendra laeta</i>	Widespread	1	MUNRE23	15/10/2019	Active searching and leaf litter sifting	ISTN1180	TMoulds
Myriapoda	Chilopoda	Scolopendromorpha	Scolopendridae	<i>Scolopendra laeta</i>	Widespread	1	MUNRE24	15/10/2019	Active searching and leaf litter sifting	ISTN1182	TMoulds
Myriapoda	Chilopoda	Scolopendromorpha	Scolopendridae	<i>Scolopendra laeta</i>	Widespread	1	MUNRE29	16/10/2019	Active searching and leaf litter sifting	ISTN1187	TMoulds
Myriapoda	Diplopoda	Polydesmida	Paradoxosomatidae	<i>Antichiropus rex?</i> (juvenile)	Likely	2	MUNRE24	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1194	TMoulds
Myriapoda	Diplopoda	Polydesmida	Paradoxosomatidae	<i>Antichiropus rex?</i> (dead)	Likely	1	MUNRE26	15/10/2019	Active searching and leaf litter sifting	ISTN1184	TMoulds
Myriapoda	Diplopoda	Polyxenida	Polyxenidae	<i>Unixenus mjobergi</i>	Widespread	1	MUNRE08	11/10/2019	Active searching and leaf litter sifting	ISTN1372	TMoulds
Myriapoda	Diplopoda	Polyxenida	Polyxenidae	<i>Unixenus mjobergi</i>	Widespread	1	MUNRE08	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1217	TMoulds

Phylum/ Subphylum	Class	Order	Family	Genus and sp	SRE Status	Abund ance	Site	Date	Collection Method	Tracking number	Identified by
Myriapoda	Diplopoda	Polyxenida	Polyxenidae	<i>Uhixenus mjobergi</i>	Widespread	1	MUNSRE01	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1199	TMoulds
Myriapoda	Diplopoda	Polyxenida	Polyxenidae	<i>Uhixenus mjobergi</i>	Widespread	1	MUNSRE04	11/10/2019	Leaf litter extracted from tullgren funnel	ISTN1339	TMoulds
Myriapoda	Diplopoda	Polyxenida	Polyxenidae	<i>Uhixenus mjobergi</i>	Widespread	7	MUNSRE16	13/10/2019	Leaf litter extracted from tullgren funnel	ISTN1332	TMoulds
Myriapoda	Diplopoda	Polyxenida	Polyxenidae	<i>Uhixenus mjobergi</i>	Widespread	5	MUNSRE23	15/10/2019	Leaf litter extracted from tullgren funnel	ISTN1214	TMoulds
Hexapoda	Insecta	Orthoptera	Tettigonidae	<i>Pachysaga croceopteryx</i>	Widespread	1	MUNSRE24	15/10/2019	Active searching and leaf litter sifting	ISTN1181	TMoulds

Appendix 5

Genotyping Australia Molecular Sequencing report



Certificate of Analysis

Client:

Invertebrate Solutions

Sample Log in Detail:

Your Reference	Munglinup SRE
No of samples:	8
Date samples received:	29/10/2019
Date samples analysed:	29/10/2019

On the 29th of October 2019, 8 specimens were received for analysis. The summary of the specimens received by Genotyping Australia are as follows:

SAMPLE NUMBER	Description / Number	Collection Information	Successfully Sequenced	Accession Match	Percentage Match	Genus	Species
56154	ISTN1360	14/10/2019	x		<85%	No close match	
56155	ISTN1224	11/10/2019	Failed				
56156	ISTN1223	11/10/2019	x		<85%	No close match but the same species as 56158	
56157	ISTN1226	13/10/2019	x	MG800150	96.5%	<i>Chenistonia</i>	MYG346 (WAMT80952)
56158	ISTN1221	11/10/2019	x		<85%	No close match but the same species as 56156	
56159	ISTN1222	11/10/2019	x	MG800150	96.5%	<i>Chenistonia</i>	MYG346 (WAMT80952)
56160	ISTN1225	11/10/2019	x	MG800150	95.9%	<i>Chenistonia</i>	MYG346 (WAMT80952)
56161	ISTN1227	14/10/2019	x	KJ745274	91.4%	No close match; mostly likely from the genus Aname	



DNA Extraction

The first step in any molecular diagnostics procedure is to obtain high quality DNA and RNA. Rather than using a DNA and RNA extraction method that relies on silica-based membranes or phenol-chloroform, Genotyping Australia uses magnetic nano-bead based technology (Kingfisher; Thermofisher). The principal behind the magnetic bead separation technique is an iron-oxide core bead that is coated with silane. That surface is bound with molecules containing a free carboxylic acid, which in turn bound to DNA or RNA. Salt concentration determines the strength of the bonds between functional groups and nucleic acid, which allowed for controlled reversible binding. In correct salt concentrations the nucleic acids bind to the magnetic particles. Then a magnet is placed outside of the tube to create a strong external magnetic field. The magnetic particles bound with nucleic acid are attracted to the field and “stick” to the outer edges of the tube. The magnetic field is maintained while the unwanted solution is exchanged and contaminating proteins are washed away. After the washing steps, the DNA or RNA is released from the magnetic particles with an elution buffer, which results in a pure sample ready for analysis.

Polymerase Chain Reaction and Sequencing

Amplification of the targeted regions were performed using designated primers outlined in Table 2. Sample DNA is PCR amplified in parallel with appropriate positive and negative controls to ensure both that amplification is not an artefact, and that a failure to amplify is not a failed reaction. The reagents used to amplify were Taq Tii and associated components purchased from Fisher Biotech (Perth Western Australia). PCR conditions for each primer set varied and the details can be found in Tables 2 and 3. PCR amplicons were sent to AGRF Perth (NATA 14332) for DNA sequencing.



Table 2. Primers used in this project.

Code	Primer Forward	Sequence	Primer Reverse	Sequence	PCR Conditions
LCO - HCO	<i>LCO1490</i>	GGTCAACAAATCATAAAGA TATTGG	<i>HC02198</i>	CTAAACTTCAGGGTGACCAAAAAATCA	1

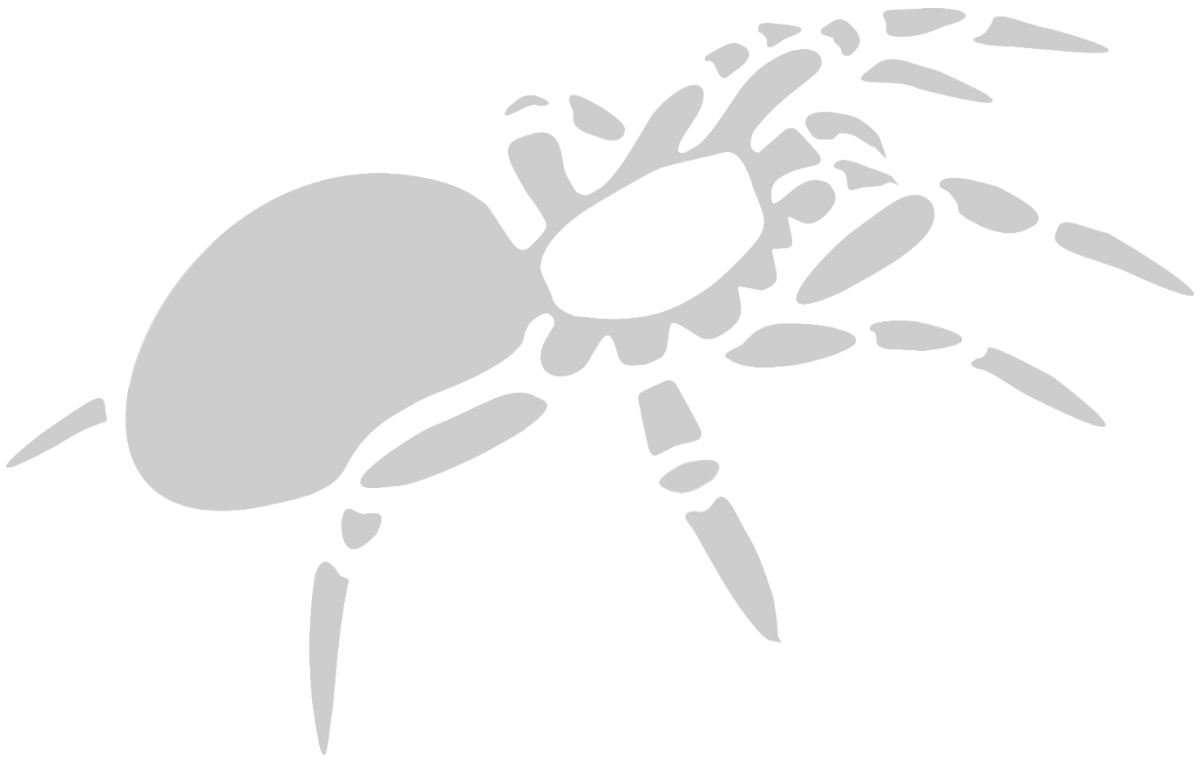
Table 3. PCR Conditions

Condition	Parameters
1	5 min at 95°C; 7 cycles (30 sec at 95°C, 30 sec at 40°C, 45 sec at 72°C), 35 cycles (30 sec at 95°C, 30 sec at 50°C, 45 sec at 72°C), Final extension for 10 min at 72°C.

Authorised by:

A handwritten signature in black ink, appearing to read 'M. Castalanelli', positioned above the name.

Mark Castalanelli – Director
on 1/11/2019



www.invertebratesolutions.com