# APPENDIX 9F

## SRE ASSESSMENT (2024)

PHOENIX
ENVIRONMENTAL SCIENCES

# Short-range endemic desktop review for the Keysbrook Mineral Sands Project (Western Extension)

Prepared for Doral Mineral Sands Pty Ltd

April 2024

Final

Short-range endemic desktop review for the Keysbrook Mineral Sands Project (Western Extension)
Prepared for Doral Mineral Sands Pty Ltd

**Version history**

| Author/s | Reviewer/s | Version | Version number | Date submitted | Submitted to |
|---|---|---|---|---|---|
| E. Broom | A. Jacks | Draft for client comments | 0.1 | 03-Apr-24 | C. Bovell |
| E. Broom | A. Jacks | Final, client comments addressed | 1.0 | 04-Apr-24 | C. Bovell |



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# 1 INTRODUCTION

Doral Mineral Sands Pty Ltd (Doral) operates the Keysbrook Mineral Sands Project (the Project), located in Keysbrook, Western Australia (WA; Figure 1-1). Doral are planning to extend their current Keysbrook mining operations across the landholding. This survey area is referred to as the Keysbrook Western Extension.

In March 2024, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Doral to undertake a short-range endemic desktop review for the Project. The purpose of the review was to determine the likelihood of occurrence of short-range endemic (SRE) invertebrate taxa and potential SRE habitat from within the study area.

The study area is located in the Shire of Serpentine-Jarrahdale and the South-West Climatic Region as defined by EPA (2020).

## 1.1 SCOPE OF WORK

The scope of work for the short-range endemic desktop review was to gather contextual information of the potential SRE habitats and species of the study area.

## 1.2 STUDY AREA

The study area is the Project Development Envelope and is 1,221.71 ha in area. Of the 881.7 ha of the study area that has been vegetation mapped, 95.9 ha is native vegetation (10.9% of the mapped area) and 785.8 ha has been cleared or cleared and replanted (EcoEdge 2021, 2022, 2023) (Figure 1-1).

## 1.3 SHORT-RANGE ENDEMIC INVERTEBRATES

Short-range endemic (SRE) fauna are defined as animals that display restricted geographic distributions, nominally less than 10,000 km$^2$, that may also be disjunct and highly localised (Harvey 2002). EPA (2016) identifies species with restricted distributions as being significant fauna in the context of environmental impact assessments (EIA). SRE fauna need to be considered in EIA as localised, small populations of species that are generally at greater risk of changes in conservation status due to environmental change than other, more widely distributed taxa.

Short-range endemism in terrestrial invertebrates is believed to have evolved through 2 primary processes (Harvey 2002):

- relictual – where the drying climate reduced the area of suitable habitat available to a species, forcing a range contraction. Such habitats typically maintain historic mesic conditions (e.g. south-facing rock faces or slopes of mountains or gullies).
- habitat speciality – where species settled in particular isolated habitat types (e.g. rocky outcrops) by means of dispersal and evolved in isolation into distinct species.

SRE invertebrates have however also been reported in more widespread habitats such as spinifex plains or woodlands, mainly in groups with low dispersal capabilities, for example mygalomorph spiders and millipedes (see for example Car & Harvey 2014; Rix *et al.* 2018).

There can be uncertainty in categorising a specimen as an SRE due to several factors including poor regional survey density, lack of taxonomic research and problems of identification, i.e. specimens that may represent SREs cannot be identified to species level based on the life stage. For example, in contrast to mature males, juvenile and female millipedes, mygalomorph spiders and scorpions cannot be identified to species level. Molecular techniques such as 'barcoding' (Hebert *et al.* 2003a; Hebert *et al.* 2003b) are routinely employed to overcome taxonomic or identification problems.



Doral Mineral Sands Pty Ltd
Keysbrook Mineral Sands Project

| | |
|---|---|
| Project No | 1655 |
| Date | 27/03/2024 |
| Drawn by | JL |
| Map author | EB |

1:661,600 (at A4) GDA 1994 MGA Zone 50



- Study area
- 40km desktop search buffer
- DBCA managed land
- Lakes
- Environmentally Sensitive Areas
- Roads

**Figure 1-1**

**Project location and study area**

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# 2 METHODS

## 2.1 DESKTOP SEARCHES

A search of the WA Museum Arachnid, Myriapod, Crustacean and Mollusc databases (WAM 2024) was undertaken as the most contemporary and accurate SRE data source for the study area. The desktop search area radius was 40 km in size and based on the centre point of the study area (Figure 1-1). Analysis of the resulting WAM dataset was spatially constrained to within the Perth (SWA02) subregion of the Swan Coast Plain IBRA bioregion to better reflect the SRE taxa that may occur within the study area.

The Department of Biodiversity, Conservation and Attractions (DBCA) Threatened and Priority Fauna database was also reviewed to gather information regarding Threatened and Priority invertebrates within 40 km of the study area. Searches of the Index of Biodiversity Surveys for Assessments (IBSA) and literature were also conducted, though no published reports concerning SREs were found from vicinity of the study area.

## 2.2 HABITAT MAPPING AND ASSESSMENT

Three flora and vegetation reports written for the Project were reviewed to assess the local and regional importance and condition of vegetation within the study area:

- detailed and Targeted Flora and Vegetation Survey Keysbrook, Western Australia (EcoEdge 2021)
- detailed, Reconnaissance and Targeted Flora and Vegetation Survey Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road Keysbrook, Western Australia (EcoEdge 2022)
- reconnaissance and Targeted Flora and Vegetation Survey Part of Lots 20, 62, 63 and 211 Keysbrook, Western Australia (EcoEdge 2023).

The 8 vegetation units in these reports were categorised into 5 SRE habitat types.

Notably, these reports did not analyse or map vegetation in the entirety of the study area. 881.7 ha of the 1221.3 ha study area has been mapped (72.2%) (Figure 3-2). For the purposes of an the SRE assessment, this habitat has been inferred as 'cleared' aside from a large pocket of remnant vegetation in the south-east corner of the study area, which is slated in the Keysbrook Conservation and Environmental Management Plan as 'Lot202 Conservation Area' (Doral 2023). Based on nearby habitat, this area is inferred to consist of Marri, and Jarrah-Sheoak open forest or woodland in the analysis of habitat types in the study area.

## 2.3 SRE POTENTIAL HABITAT RATING

Vegetation mapping undertaken by EcoEdge (2021, 2022, 2023) was re-interpreted into SRE habitat based on broad vegetation types and landform. The habitat mapping was assessed for its potential to support endemic SRE species and communities. Potential SRE habitat was rated as follows:

- high – defined/known areas of habitat that contain elements that often give rise to specialisation or dependency in invertebrate fauna, such as aspect (e.g. south-facing slopes, geological features (e.g. granite), soil types that retain water (e.g. clay, loam)). These habitats may also include habitat isolates which have the capacity to restrict dispersal.
- low – areas of largely intact native vegetation that occur broadly across the landscape, are less incised and typically link more restricted habitats. This may include land that was cleared but has since been rehabilitated or is in the process of being rehabilitated.
- none – land that has been previously cleared for other uses that no longer contains native vegetation.

## 2.4 SRE STATUS RATING

Currently, there is no accepted system to determine the likelihood that a species is an SRE. The WA Museum applies 4 categories: Confirmed, Likely, Potential, and Widespread. Confirmed SREs are taxa for which the distribution is known to be less than 10,000 km$^2$, the taxonomy is well known, and the group is well represented in collections and/or via comprehensive sampling (WAM 2013). Potential SREs include those taxa for which there is incomplete knowledge of taxonomy or geographic distribution, and the group is not well represented in collections. Phoenix has applied 4 categories based on the WA Museum criteria (Table 2-1).

**Table 2-1 SRE categories**

| SRE category | Criteria |
|---|---|
| Confirmed | Distribution <10,000 km$^2$.<br>Taxonomy of the group is well known (but not necessarily published); group is well represented in collections, in particular from the region in question; high levels of endemism exist in documented species; inference is often possible from immature specimens. |
| Likely | Distribution < 10,000 km$^2$.<br>Taxonomically poorly resolved group but group is generally well represented in collections; unusual morphology for the group (e.g. some form of troglomorphism); often recorded as singletons in survey and few, if any, regional records. |
| Potential | Distribution <10,000 km$^2$.<br>Taxonomically poorly resolved group; patchy distribution, often common in certain micro-habitats, but no other regional records; congeners (= species in the same genus) both widespread and restricted in distribution. |
| Widespread | Distribution >10,000 km$^2$. |

# 3 RESULTS

## 3.1 SRE AND SIGNIFICANT INVERTEBRATE SPECIES

The WAM desktop review identified records of 12 Confirmed and 144 Potential SRE taxa from within the 40 km desktop search area (Table 3-1). When the 40 km search area was restricted to the Perth subregion of the Swan Coastal Plain (SWA02) as the most relevant spatial subset, a total of 53 taxa were returned, including 4 Confirmed SREs and 49 Potential SREs. Of the 53 Confirmed and Potential SRE taxa, 6 are formally described species. Twenty-six records comprise taxa identified with morphospecies codes applied by the WA Museum (i.e. 'MYG' or 'DIP') or are not identified to species level (i.e. "sp." or "cf."). Twenty-one records are unidentifiable ('sp. indet') or could not be identified to species or morphospecies and may represent new species or other species listed in the same genus where records exist.

The desktop review identified 10 Potential SRE taxa from within a 10 km radius around the study area. Of these, 3 were formally described, 3 were named using morphospecies codes and 4 were unidentifiable as a species or morphospecies ('sp. indet').

The desktop review found that no SRE taxa have previously been recorded within the study area. *Bothriembryon serpentinus* was the closest recorded SRE, with one record 4.9 km east of the study area (Figure 3-1).

One significant species (*Idiosoma sigillatum*; P3 DBCA List) was identified during the review of the DBCA Threatened and Priority Fauna database. *Idiosoma sigillatum* (P3; DBCA List) occurs in the SWA02 subregion, with the closest record occurring 9.9 km from the study area (Table 3-1).

**Table 3-1 SRE and threatened taxa identified in the 40 km desktop review**

| Higher taxon, species | SRE category/ Cons. status | Closest record to study area (km) | Habitat records |
|---|---|---|---|
| **Class: Arachnida, Order: Opiliones (Harvestmen spiders)** | | | |
| *Ballarra longipalpus* | Potential | 20.9 | Not recorded |
| *Ballarra* `sp. indet.` | Potential | 22.1 | Melaleuca/Banksia woodland |
| *Megalopsalis* `sp. indet.` | Potential | 22.1 | Melaleuca/Banksia woodland |
| Neopilionidae `sp. indet.` | Potential | 19.1 | Not recorded |
| *Nunciella* `sp. indet.` | Potential | 13.9 | Not recorded |
| Sclerosomatidae `sp. indet.` | Potential | 8.3 | Not recorded |
| **Class: Chilopoda (Millipedes)** | | | |
| *Antichiropus* `DIP078` | Confirmed | 20.9 | Not recorded |
| *Antichiropus* `DIP082` | Confirmed | 21.6 | Acacia/Xanthorrhoea shrubland, Tuart woodland, Melaleuca/Banksia woodland |
| *Antichiropus* ` DIP112, Norman Road 1` | Confirmed | 19.1 | Not recorded |
| *Antichiropus* `DIP126` | Confirmed | 15.9 | Acacia//Xanthorrhoea shrubland, Tuart woodland, Melaleuca/Banksia woodland |
| *Antichiropus* `sp. indet.` | Potential | 19.3 | Not recorded |
| **Class: Gastropoda, Superorder: Eupulmonata (land snail)** | | | |
| *Bothriembryon indutus* | Potential | 16.7 | Not recorded |
| *Bothriembryon* `sp. indet` | Potential | 7.5 | Not recorded |
| *Bothriembryon serpentinus* | Potential | 4.9 | Not recorded |

| | | | |
|---|---|---|---|
| *Epinicium restifer* | Potential | 7.5 | Not recorded |
| *Succinea* `sp. indet` | Potential | 16.1 | Not recorded |
| Succineidae `sp. indet` | Potential | 15.4 | Not recorded |
| **Class: Arachnida, Infraorder: Mygalomorphae (Trapdoor spiders)** | | | |
| *Aname* `mainae` | Potential | 8.3 | Not recorded |
| *Aname* `MYG405` | Potential | 21.9 | Not recorded |
| *Aname* `MYG496` | Potential | 16.3 | Not recorded |
| *Aname* `sp. indet.` | Potential | 5.8 | Not recorded |
| Anamidae `sp. indet.` | Potential | 19.3 | Tuart woodland |
| Barychelinae `sp. indet.` | Potential | 20.9 | Not recorded |
| *Chenistonia* `sp. indet.` | Potential | 20.4 | Not recorded |
| *Eucyrtops latior* | Potential | 9.1 | Not recorded |
| *Eucyrtops* `sp. indet.` | Potential | 21.0 | Tuart woodland |
| *Idiosoma `sp. indet.`* | Potential | 16.7 | Not recorded |
| *Idiosoma sigillatum* | Potential/P3 | 9.9 | Not recorded |
| *Kwonkan* `MYG060` | Potential | 20.9 | Not recorded |
| *Kwonkan* `sp. indet` | Potential | 19.0 | Not recorded |
| *Proshermacha* `sp. indet.` | Potential | 14.9 | Tuart woodland, melaleuca/banksia woodland |
| *Synothele* `sp. indet.` | Potential | 20.5 | Not recorded |
| *Teyl* `MYG249` | Potential | 19.3 | Not recorded |
| *Teyl* `waldockae` | Potential | 21.6 | Tuart woodland, melaleuca/banksia woodland |
| **Class: Arachnida, Order: Pseudoscorpiones (Pseudoscorpions)** | | | |
| *Austrochthonius* `sp. indet.` | Potential | 14.9 | Not recorded |
| Olpiidae `sp. indet.` | Potential | 18.9 | Not recorded |
| **Class: Arachnida, Order: Scorpiones (Scorpions)** | | | |
| Buthidae `sp. indet.` | Potential | 19.0 | Not recorded |
| *Isometroides* `jarrah` | Potential | 8.3 | Not recorded |
| *Lychas* `majeri` | Potential | 22.9 | Not recorded |
| *Lychas* `sp. indet.` | Potential | 21.9 | Not recorded |
| *Urodacus* `sp. indet.` | Potential | 8.3 | Not recorded |
| *Urodacus* `woodwardii` | Potential | 19.1 | Not recorded |
| **Class: Malacostraca, Order: Isopoda (Slaters)** | | | |
| *Acanthodillo flavus* | Potential | 20.4 | Not recorded |
| *Buddelundia* `sp. 1 (Judd 2002)` | Potential | 7.5 | Not recorded |
| *Buddelundia* `sp. 4 (Judd 2002)` | Potential | 22.7 | Not recorded |
| *Cubaris* `sp. 1 (Judd 2002)` | Potential | 19.0 | Not recorded |
| *Laevophiloscia* `sp. 1 (Judd 2002)` | Potential | 19.3 | Not recorded |
| *Laevophiloscia* `sp. 2 (Judd 2002)` | Potential | 19.2 | Not recorded |
| Philosciidae `sp. 1 (Judd 2002)` | Potential | 19.2 | Not recorded |
| *Spherillo* `sp. 2 (Judd 2002)` | Potential | 19.3 | Not recorded |
| *Spherillo* `sp. 3 (Judd 2002)` | Potential | 9.5 | Not recorded |
| *Styloniscus* `sp. 1 (Judd 2002)` | Potential | 22.7 | Not recorded |
| **Class: Arachnida, Order: Araneae, Family Selenopidae, (Flat spiders)** | | | |
| *Karaops* `sp. indet.` | Potential | 8.3 | Under stone |

## 3.2 HABITATS

EcoEdge (2021, 2022, 2023) recorded 16 distinct vegetation types within the study area (Figure 1-1), which are divided into 8 vegetation units (Table 3-2; Figure 3-2). These represent 5 broad SRE habitat types, including 3 native vegetation types and 2 types generated through disturbance (Table 3-3).

The study area has been largely cleared for agriculture and includes large areas mapped as cleared and planted vegetation. Cleared habitat represents 758.04 ha (85.0% of the vegetation mapped area) and planted habitat represents 27.37 ha of land (3.1% of the vegetation mapped area). The remaining remnant vegetation consists mainly of Marri and Jarrah-Sheoak open forest/woodland and Paperbark dampland, as well as an area of sedgeland. Almost all of this remnant vegetation is classed as Completely Degraded to Degraded (EcoEdge 2021, 2022, 2023). Only 5 small pockets of native vegetation totalling 1.91 ha (0.03% of the vegetation mapped area) are classed as Good.

Based on available aerial imagery, all areas of the study area that have not been vegetation mapped appear to fall into one of the vegetation units described in Table 3-2. Most of these areas are cleared or replanted, aside from a large pocket of remnant vegetation in the south-east corner of the study area, which is slated in the Keysbrook Conservation and Environmental Management Plan as 'Lot202 Conservation Area' (Doral 2023).

Including inferred vegetation types from unmapped areas (see Methods), cleared vegetation represents 1,070.4 ha (87.6%) of the study area, planted vegetation represents 27.4 ha (2.4%) and native vegetation represents 123.9 ha (9.3%).

Two of the 16 vegetation types identified in the study area meet the criteria to be considered the Threatened Ecological Community (TEC) "SCP FCT3c" (EcoEdge 2023). This is described as "*Corymbia calophylla* – *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain ecological community"(EcoEdge 2023). This community has been listed as Endangered under the Commonwealth Environmental Protection and Biodiversity Conservation Act (EPBC Act) and Critically Endangered under the Western Australian Biodiversity Conservation Act (BC Act) (DCCEEW 2024).

Three small areas of paperbark woodland intersected with Environmentally Sensitive Areas (ESAs) (Figure 1-1). These ESAs are Conservation Category Wetlands UFI 14465 and UFI 14870 and ESA 17492. The ESAs are located on the northern edge, south-eastern corner and central-west side of the study area (Figure 1-1).

TECs and conservation significant areas are not automatically likely to support SREs, and the vegetation in these significant areas was not necessarily historically rare prior to widespread clearing. In this case, the remnant vegetation in the study area that was considered a TEC or ESA was considered Degraded or Completely Degraded (EcoEdge 2021, 2022, 2023), which substantially decreases the likelihood of this habitat supporting SREs.

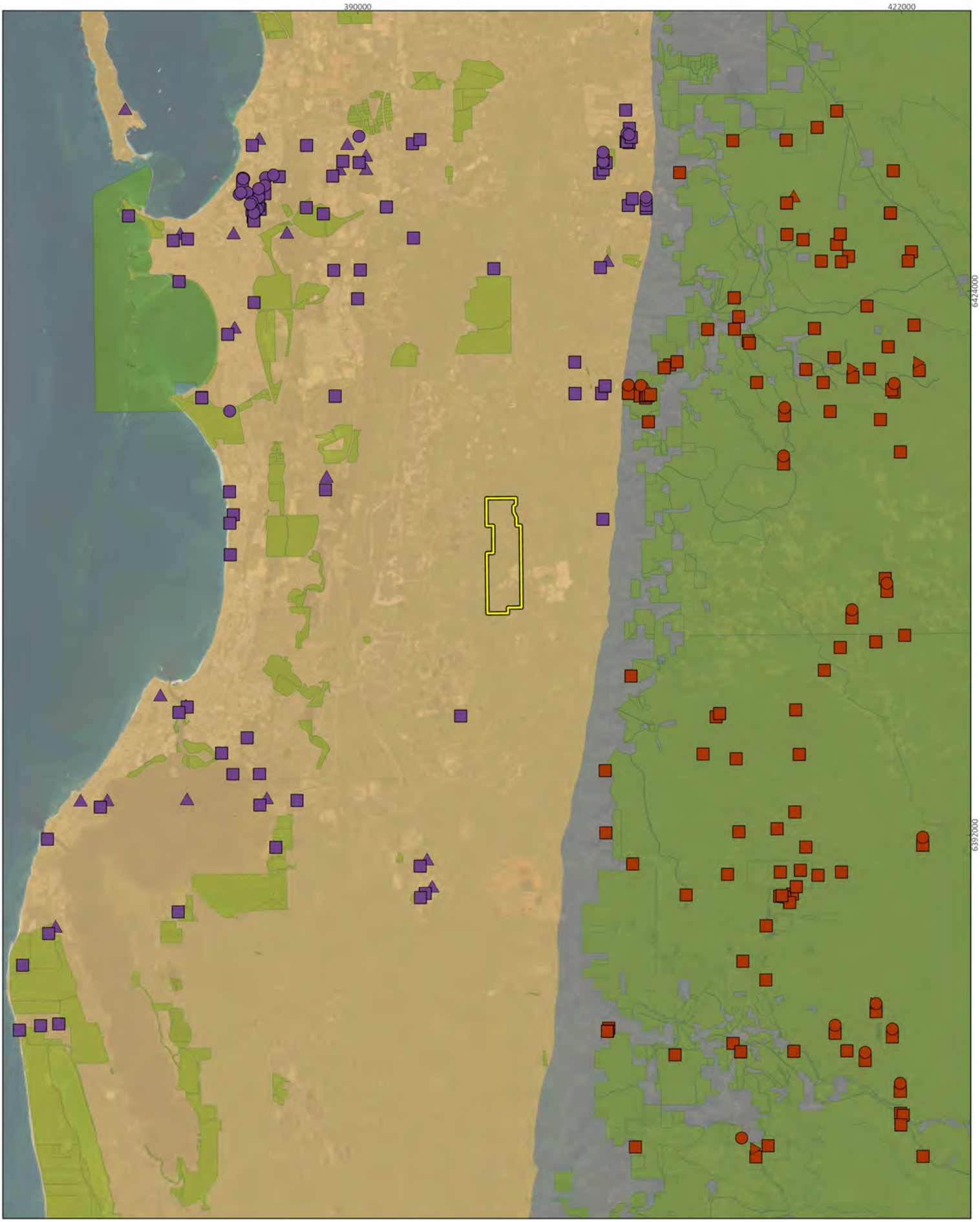
Almost the entirety of the vegetation in the study area is Degraded or Completely Degraded, and vegetation units falls into broad units that were likely relatively common in the surrounding area prior to historic land clearing. As such, the likelihood of all native vegetation types and vegetation units supporting SRE taxa (total 123.58 ha/ 10.13%) in the study area is low, and the likelihood of cleared and planted vegetation supporting SREs is none (Table 3-3; Figure 3-2). Although a TEC and multiple ESAs were identified within the study area, the likelihood of vegetation in these areas supporting SREs is also low as the habitat is degraded and appears to be composed of species that are found elsewhere in the study area and landscape.

**Table 3-2 Summary of native vegetation units occurring within the study area (EcoEdge 2021, 2022, 2023) and potential to support SREs**

| Vegetation unit description (EcoEdge 2021, 2022, 2023) | SRE habitat type | Comments | Area (ha) | Area (%) | Potential Habitat rating |
|---|---|---|---|---|---|
| Jarrah-Banksia-Sheoak woodland | Jarrah/Marri dominated forest or woodland | Degraded/Completely Degraded condition. | 13.57 | 1.11 | Low |
| Marri, and Jarrah-Sheoak open forest or woodland | Jarrah/Marri dominated forest or woodland | Degraded/Completely Degraded condition. | 72.80 (27.69 inferred) | 5.96 (2.27 inferred) | Low |
| Flooded gum/Paperbark woodland | Paperbark dampland/woodland | Degraded/Completely Degraded condition. | 13.36 | 1.09 | Low |
| Jarrah-Marri open forest | Jarrah/Marri dominated forest or woodland | Good, Degraded and Completely Degraded condition. | 3.70 | 0.3 | Low |
| Paperbark dampland | Paperbark dampland/woodland | Degraded/Completely Degraded/Good condition. | 17.16 | 1.40 | Low |
| Sedgeland | Sedgeland | Degraded/Completely Degraded condition. | 3.40 | 0.27 | Low |
| Planted | Planted | Degraded/Completely Degraded/Good condition. | 27.76 | 2.27 | None |
| Cleared | Cleared | Degraded/Completely Degraded condition. | 1070.35 (312.31 inferred) | 87.61 (25.56 inferred) | None |
| **Total** | | | **1221.7** | **100 (27.83 inferred)** | |

**Table 3-3 Summary of SRE habitats within the study area**

| SRE habitat type | Area (ha) | Area (%) | Potential Habitat rating |
|---|---|---|---|
| Jarrah/Marri dominated forest or woodland | 90.07 | 7.37 | Low |
| Paperbark woodland/dampland | 30.51 | 2.49 | Low |
| Sedgeland | 3.0 | 0.27 | Low |
| Planted | 27.76 | 2.24 | None |
| Cleared | 1,070.35 | 87.61 | None |
| **Total** | **1221.7** | **100** | |





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Keysbrook Mineral Sands Project

| | |
|---|---|
| Project No | 1655 |
| Date | 27/03/2024 |
| Drawn by | JL |
| Map author | EB |

0 5.5 11
Kilometers

1:287,591 (at A4) GDA 1994 MGA Zone 50



- Study area
- DBCA managed land

**Region, subregion**

- Jarrah Forest, Northern Jarrah Forest
- Swan Coastal Plain, Perth

**WAM Desktop SRE records from the Swan Coastal Plain Bioregion**

- Confirmed
- Potential
- Potential/P3

**WAM Desktop SRE records from outside the Swan Coastal Plain Bioregion**

- Confirmed
- Likely
- Potential
- Potential/P3

**Figure 3-1**

**Desktop records of SRE terrestrial invertebrates**

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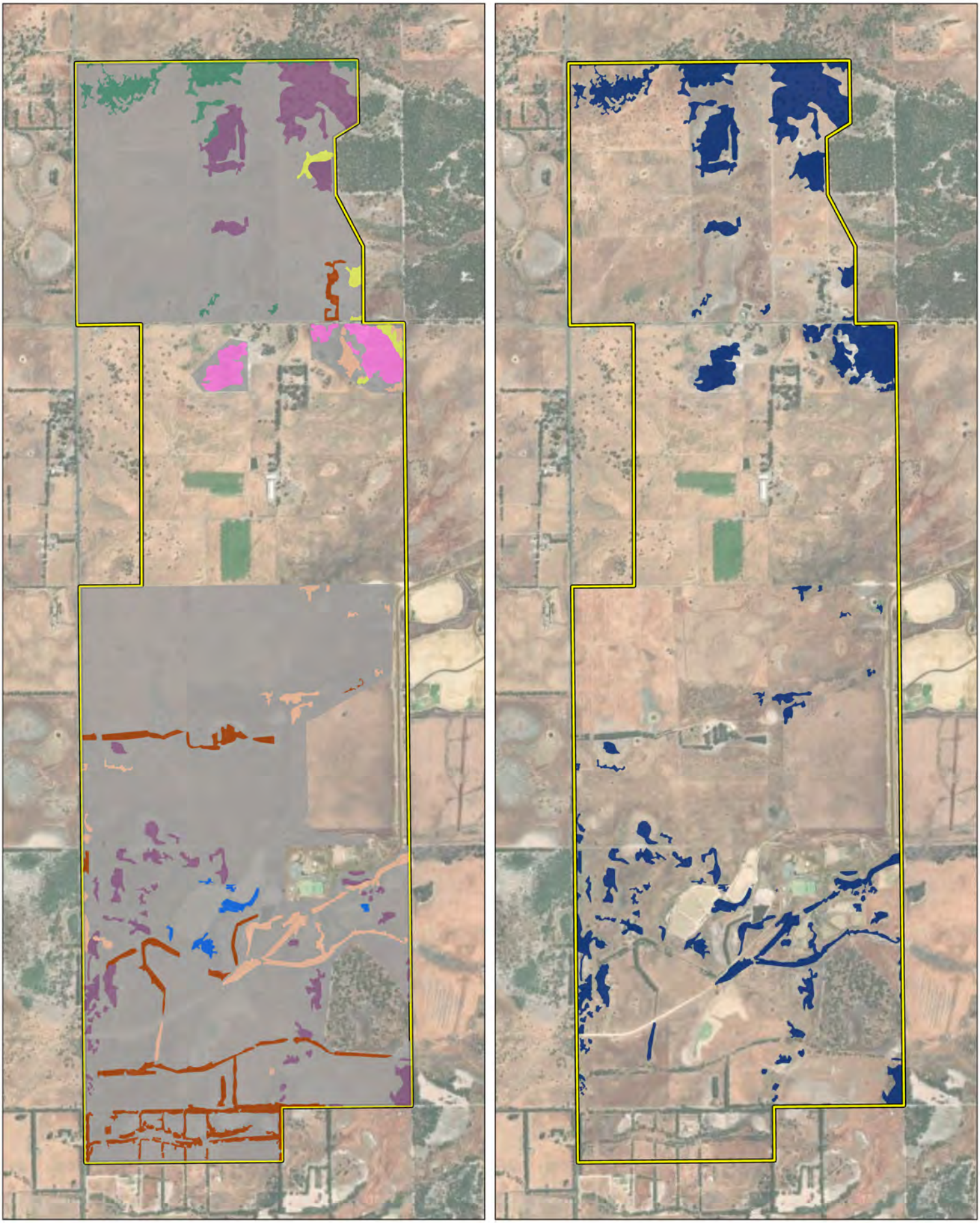


**Figure 3-2**

**Vegetation type and SRE habitat potential**

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# 4 DISCUSSION AND CONCLUSION

The WAM desktop invertebrate database (WAM 2024) returned 4 Confirmed SRE records and 49 Potential SRE records from the 40 km desktop search within SWA02 bioregion. None of these records were inside the study area (Table 3-1; Figure 3-1).

Of the 4 Confirmed SREs and significant invertebrates identified in the 40 km desktop search, records of only 2 Confirmed SREs (*Antichiropus* `DIP082` and *Antichiropus* `DIP126`) contained information regarding their habitat (Table 3-1). These species are recorded as inhabiting *Banksia* and *Melaleuca* woodland vegetation similar to that observed in the study area. However, over 99% of vegetation within the study area is Degraded or Completely Degraded (EcoEdge 2021, 2022, 2023) and as such *Antichiropus* `DIP082` and *Antichiropus* `DIP126` are considered unlikely to occur due to the study area. The remaining 2 Confirmed SREs (both also *Antichiropus* millipedes) are highly likely to be restricted to their known recorded locations and dependent on undisturbed habitats, thus also are unlikely to occur in the study area. In addition, no Potential SREs identified in desktop search extent are considered likely to occur within the study area based on unsuitable habitat (degradation and fragmentation). This includes the significant species *Idiosoma sigillatum* (P3; DBCA List).

EcoEdge (2021, 2022, 2023) report 8 vegetation units being present within the study area, which translates to 5 SRE habitat types, however only 3 of these support remnant vegetation and collectively represent of 123.58 ha (10.13%) of the study area. All remnants were in either Completely Degraded, Degraded or Good condition, which indicates obvious disturbances are present according to the Vegetation Condition scale used. As such, all native vegetation in the study area was given a Low Potential Habitat rating. Given the high degree of disturbance and degradation, it is unlikely that any SRE invertebrates occur in the study area. The remaining 89.87% of this habitat is Cleared or Planted and not considered SRE habitat.

Given the habitats in the study area are highly degraded and fragmented, SREs are unlikely to occur, therefore the risk is low. The Conservation and Rehabilitation Environmental Management Plan actions will help the Project to meet numerous EPA objectives with respect to fauna in the unlikely event that any SREs occur in the study area.

# REFERENCES

Car, C. A. & Harvey, M. S. 2014. The millipede genus *Antichiropus* (Diplopoda: Polydesmida: Paradoxosomatidae), part 2: species of the Great Western Woodlands region of Western Australia. *Records of the Western Australian Museum* **29**: 20–77.

DCCEEW. 2024. *Species Profile and Threats Database*. Department of Climate Change, Energy, Environment and Water, Canberra, ACT. Available at: https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Doral, M., Sands, Pty, Ltd. 2023. *Conservation and Environmental Management Plan, Keysbrook Mineral Sands Project*.

EcoEdge. 2021. *Detailed and Targeted Flora and Vegetation Survey Keysbrook, Western Australia*. EcoEdge.

EcoEdge. 2022. *Detailed, Reconnaisance and Targeted Flora and Vegetation Survey Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road Keysbrook, Western Australia*. EcoEdge.

EcoEdge. 2023. *Reconnaissance and Targeted Flora and Vegetation Survey Part of Lots 20, 62, 63 and 211 Keysbrook, Western Australia*. EcoEdge.

EPA. 2016. *Environmental Factor Guideline: Terrestrial fauna*. Environmental Protection Authority, Perth, WA. Available at: http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Terrestrial-Fauna-131216_3.pdf

EPA. 2020. *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment*. Environmental Protection Authority, Perth, WA. Available at: https://epa.wa.gov.au/sites/default/files/Policies_and_Guidance/EPA-Technical-Guidance-Vertebrate-Fauna-Surveys.pdf

Harvey, M. S. 2002. Short-range endemism among the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics* **16**: 555–570.

Hebert, P. D. N., A., C., Ball, S. L. & de Waard, J. R. 2003a. Biological identifications through DNA barcodes. *Proceedings of the Royal Society London B* **270**: 313–321.

Hebert, P. D. N., Ratnasingham, S. & de Waard, J. R. 2003b. Barcoding animal life: Cytochrome c oxidase subunit 1 divergences among closely related species. *Proceedings of the Royal Society London B, Supplement* **270**: 96–99.

Rix, M. G., Huey, J. A., Cooper, S. J. B., Austin, A. D. & Harvey, M. S. 2018. Conservation systematics of the shield-backed trapdoor spiders of the *nigrum*-group (Mygalomorphae, Idiopidae, *Idiosoma*): integrative taxonomy reveals a diverse and threatened fauna from south-western Australia. *Zookeys* **756**: 1–121 http://dx.doi.org/10.3897/zookeys.756.24397.

WAM. 2013. *WAM short-range endemic categories and sub-categories*. Western Australian Museum, Welshpool.

WAM. 2024. *WA Museum Arachnology/Myriapodology, Crustacea, Mollusca and Entomology database*, Welshpool, WA.