Appendix C Beharra Springs Operations Camp Targeted Flora Survey – Anders Environmental 2023

Beharra Springs Operations Camp Targeted Flora Survey

Beach Energy Limited

April 2023

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TARGETED FLORA SURVEY: BEHARRA SPRINGS OPERATIONS CAMP

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Date: April 2023

Client: Beach Energy Limited

Version: 2.0

Chain of authorship and review			
Name	**Task**	**Version**	**Date**
C. Krens	Draft report for client	1.1	January 2023
C. Krens	Final report for client	2.0	April 2023

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EXECUTIVE SUMMARY

Beach Energy Limited are proposing to construct an operations camp at the Beharra Springs Gas Plant facility (survey area) located approximately 32 km south-east of Dongara. There have previously been a number of conservation significant species recorded near the survey area, and a targeted survey was required to confirm the presence of any populations within the survey area.

The survey area is located on the Geraldton Sandplains Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion, specifically within the Lesueur Sandplain Subregion (GES02). The broad vegetation association occurring within the survey area is Eridoon 378, which consists of mixed heath with scattered tall shrubs of Acacia, Proteaceae and Myrtaceae species.

The desktop assessment identified 57 conservation significant flora species potentially occurring within the survey area, eleven of which were considered to have a high likelihood of occurrence within the survey area:

- *Banksia elegans* (Priority 4)
- *Calytrix chrysantha* (Priority 4)
- *Hemiandra* sp. Eneabba (H. Demarz 3687) (Priority 3)
- *Hypocalymma gardneri* (Priority 3)
- *Lasiopetalum ogilvieanum* (Priority 1)
- *Paracaleana dixonii* (Endangered (Cwth), Vulnerable (WA))
- *Persoonia rudis* (Priority 3)
- *Schoenus griffinianus* (Priority 4)
- *Schoenus* sp. Eneabba (F. Obbens & C. Godden I154) (Priority 2)
- *Stawellia dimorphantha* (Priority 4)
- *Stylidium carnosum* subsp. Narrow leaves (J.A. Wege 490) (Priority 1).

The targeted survey was undertaken in October 2022. Three conservation significant species were recorded:

- *Banksia elegans* – 84 plants
- *Hemiandra* sp. Eneabba (H. Demarz 3687) – 2 plants
- *Schoenus griffinianus* – 44 plants.

Populations occurred mainly in the north of the survey area. In the Allocasuarina shrublands, located in the south of the survey area, no populations were recorded.

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DEFINITIONS

Acronym	Definition
Anders	Anders Environmental Consulting
BC Act	*Biodiversity Conservation Act 2016*
BOM	Bureau of Meteorology
Cwth	Commonwealth
DBCA	Department of Biodiversity Conservation and Attractions
DMIRS	Department of Mines, Industry Regulation and Safety
DCCEEW	Department of Climate Change, Energy the Environment and Water
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
ha	Hectare
IBRA	Interim Biogeographic Regionalisation of Australia
IBSA	Index of Biodiversity Surveys for Assessments
km	Kilometre
m	Metre
mm	Millimetre
MNES	Matter of National Environmental Significance

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

Beach Energy Limited (Beach Energy) proposes to construct an operations camp near the Beharra Springs Gas Plant (survey area). Native vegetation will require clearing as part of the construction process.

Conservation significant flora species have previously been recorded near the survey area. Confirmation of any conservation significant flora species within the survey area is required to support project approvals. Beach Energy commissioned Anders Environmental Consulting to conduct a targeted survey of the survey area.

1.2 PROJECT LOCATION

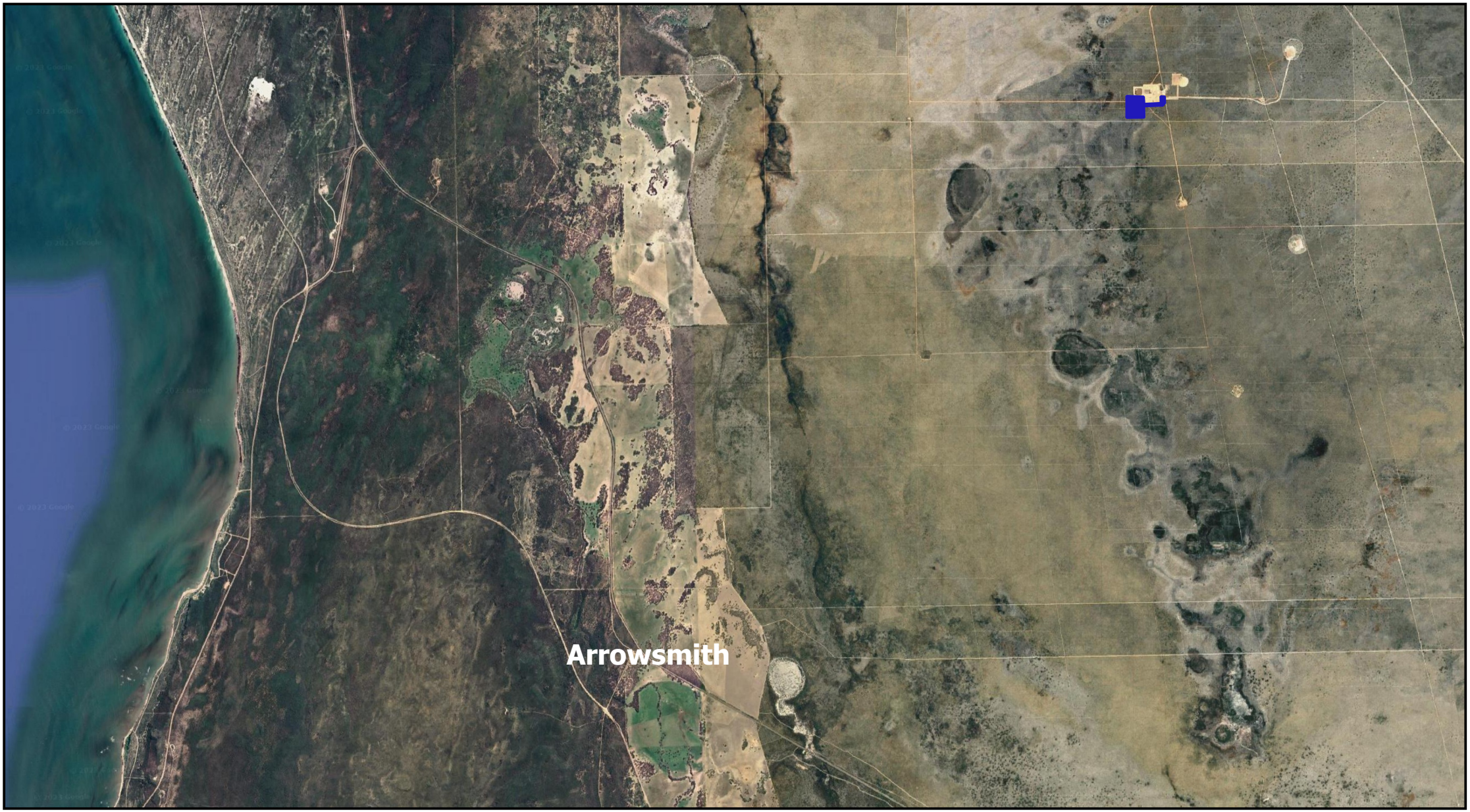
The survey area is adjacent to the existing Beharra Springs facility located approximately 32 km south-east of Dongara and 280 km north of Perth (Figure 1) within the Shire of Irwin.

The survey area is approximately 10 ha.

1.3 SCOPE OF WORKS

The objective of the assessment was to identify populations of conservation significant flora within the survey area. The scope of works involved:

- Desktop assessment.
- A targeted flora survey searching for conservation significant flora species.
- Technical report and spatial data.



Beharra Springs Operations Camp

Figure 1 Survey location

Date: 15/01/2023
Author: C Krens
Projection: UTM MGA Zone 50

0 1 2 km

1:75,000

Legend

Survey Area

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2.0 LEGISLATIVE CONTEXT

2.1 COMMONWEALTH LEGISLATION

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the main piece of Commonwealth legislation protecting biodiversity in Australia. All matters of national environmental significance (MNES) are listed under the EPBC Act. These include:

- listed threatened species and ecological communities
- migratory species protected under international agreements
- Ramsar wetlands of international importance
- the Commonwealth marine environment
- world Heritage properties
- national Heritage places
- Great Barrier Reef Marine Park
- water resources in relation to coal seam gas disturbance and large coal mining disturbance
- nuclear actions.

If an action is likely to have a significant impact on a MNES this action must be referred to the Commonwealth Minister for the Environment for a decision on whether assessment and approval is required under the EPBC Act.

Species at risk of extinction are recognised at a Commonwealth level and are categorised in one of six categories as outlined in Table 1.

Table 1 Categories of species listed under the Commonwealth EPBC Act

Conservation	Code Category
Ex	Extinct Taxa
ExW	Extinct in the Wild
CE	Critically Endangered
E	Endangered
V	Vulnerable
CD	Conservation Dependent
OS	Other specially protected fauna

2.2 WESTERN AUSTRALIAN LEGISLATION

Threatened flora are plants which have been assessed as being at risk of extinction. Under the *Biodiversity Conservation Act 2016* (BC Act), the Western Australian Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Species that are considered Threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the BC Act. These categories are defined in Table 2.

Table 2 Conservation codes for species listed under the Western Australian BC Act

Code	Category
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."
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".
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".
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).
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).
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).
CD	Species of species conservation interest 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).
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).

Species that have not yet been adequately surveyed to warrant being listed under the BC Act, or are otherwise data deficient, are added to a Priority List under Priorities 1, 2 or 3 by the Western Australian Minister for the Environment. 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

list, are placed in Priority 4. Categories and definitions of Priority Flora species are provided in Table 3.

Table 3 Conservation categories for species listed by DBCA and endorsed by the Minister for the Environment

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

3.0 METHODOLOGY

3.1 DESKTOP ASSESSMENT

Targeted surveys are used to gather comprehensive information on significant flora. A targeted survey aims to determine the size and extent of all significant flora populations in the survey area and to place any impacts into context (EPA 2016a).

A combination of datasets and reports were analysed to identify potential conservation significant flora species. A likelihood of occurrence within the survey area of each conservation significant species was determined based on the criteria outlined in Table 4.

Table 4 Criteria for likelihood of occurrence of conservation significant flora

Likelihood of occurrence	Conservation significant flora
High likelihood to be present	Known populations occur within or adjacent^ to the survey area and suitable habitat is likely to be present to support the species
Medium likelihood to be present	Known populations occur within the vicinity^^ of the survey area and suitable habitat is likely to be present to support the species
Low likelihood to be present	Known populations do not occur in the vicinity^^ of the survey area, or known populations occur within the vicinity^^ of the survey area, however suitable habitat is unlikely to be present to support the species

^ Adjacent – population occurs within 5 km of the survey area
^^ Vicinity – population occurs within 20 kms of the survey area

3.2 TARGETED FLORA SURVEY

The targeted survey followed the methods outlined in the Environmental Protection Authority (EPA) Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).

A two-day targeted survey was undertaken from 20th to 21st October 2022. The survey involved two Botanists searching transects to locate and map populations of conservation significant species within the survey area. The survey team comprised Lead Botanist Catherine Krens (Flora collection licence number FB62000188) and Graduate Botanist Zoe Webber (Flora Collection Licence Number FB62000441).

A field booklet was provided to all team members which contained information on each conservation significant species. Information included images (from Florabase records and the Western Australian herbarium collections), description of the plant, flowering period, and known habitat. Prior to commencing the survey, known conservation significant flora populations were visited to record photographs of plants in situ and familiarise the team with the species characteristics.

Transects were walked in parallel lines at 10m to 30m spacing and tracks were recorded on Garmin GPS units to show the survey effort. Populations of individual plants or small groups of plants were recorded up to an area of 5m x 5m, with the central point of each population recorded on the GPS. For each population the following information was recorded:

- GPS location
- Photograph (not all populations were photographed)
- Number of individual plants within the population.

3.3 LIMITATIONS

Limitations are common in flora surveys which may result in reduced data quality and survey effort and deviations from the EPA guidelines. An assessment of the limitations of the survey as outlined in the EPA guidelines (2016a) are addressed in Table 5.

Table 5 Limitations of the flora and vegetation survey

Limitation	Determination	Justification
Availability of contextual information at a regional and local scale	**Not a constraint**	All contextual information including earlier reports and spatial data was available at the time of survey.
Competency/experience of the team conducting the survey, including experience in the bioregion	**Not a constraint**	The survey was led by Catherine Krens who is a Senior Botanist with over 15 years' experience undertaking flora surveys including targeted searches within Western Australia and the Geraldton Sandplains bioregion. The field team members have experience undertaking targeted surveys. Prior to beginning the survey, known populations were visited and photographs taken to familiarise the field team with the target species.
Proportion of flora recorded and collected and any identification issues	**Minor constraint**	The vegetation was dense throughout the survey area and transects were walked at a slow pace to enable detection of individual plants and populations. There is a possibility that some smaller species (i.e., *Schoenus griffinianus*) may have been missed under dense vegetation.
Effort and extent - was the survey area fully surveyed	**Not a constraint**	Transects at 10m to 30m spacing were walked across the entire survey area.
Access restrictions within the survey area	**Not a constraint**	No access issues were encountered.
Survey timing, rainfall, season of survey	**Not a constraint**	The survey was undertaken within spring during the main flowering period for the Geraldton Sandplains bioregion.
Disturbance that may have affected the results of survey such as fire, flood or clearing	**Not a constraint**	Some minor disturbances were observed including tracks and old seismic lines. Minor clearing and rubbish were present along tracks near the gas plant facility.

4.0 EXISTING ENVIRONMENT

4.1 CLIMATE

The climate of the Geraldton Sandplains bioregion has a warm semi-arid to Mediterranean climate with predominantly winter rainfall. The closest Bureau of Meteorology (BOM) weather station with a temperature and rainfall dataset is Carnamah (weather station 8025).

Carnamah recorded a long-term mean maximum temperature ranging between 18.1˚C (July) to 36.1˚C (January) (1887 to 2022) Figure 2). The rainfall in the 12 months prior to the survey (October 2021 to September 2022), was 362.4 mm which was slightly below the long-term average of 376.6 mm. In the three months prior to the survey (July 2022 to September 2022), 184.6 mm of rainfall was recorded, which is 38.3 mm above the long-term average of 146.3 mm for the same time period (Figure 2). August had a large rainfall spike with 97.7 mm of rainfall recorded (Bureau of Meteorology 2022).

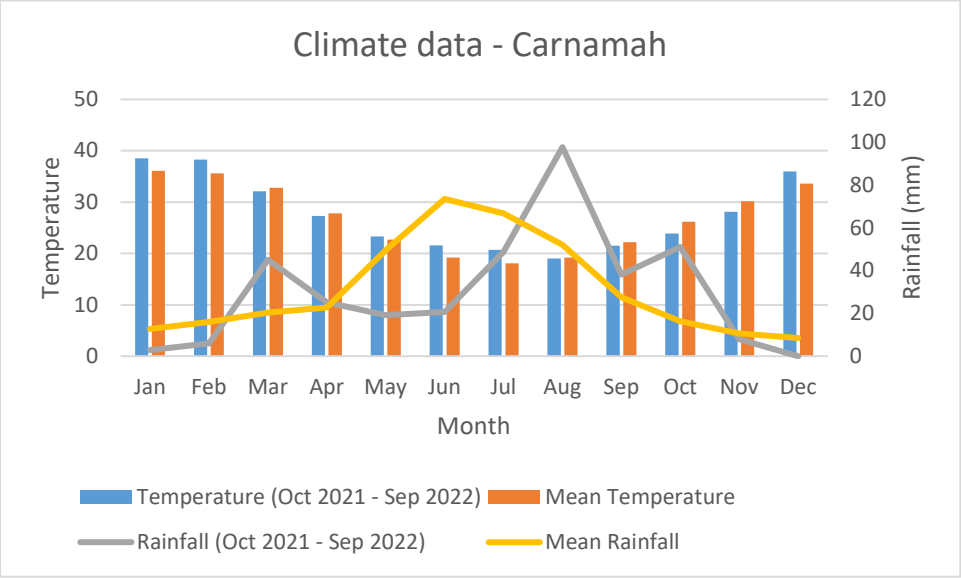

Figure 2 Climate data recorded at Carnamah weather station (Rainfall and maximum temperature 12 months prior to survey and long-term average) (Bureau of Meteorology 2022).

4.2 IBRA BIOREGION

The survey area occurs within the Geraldton Sandplains Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion (Figure 3) and specifically the Lesueur Sandplain Subregion (GES02). The Geraldton Sandplains bioregion is composed mainly of proteaceous scrub-heaths, rich in endemics, on the sandy earths of an extensive, undulating, lateritic sandplain mantling Permian to Cretaceous strata. Extensive York Gum and Jam woodlands occur on outwash plains associated drainage (Desmond and Chant, 2001).

4.3 GEOLOGY AND SOILS

The survey area lies within the Yarragadee Formation geological unit as mapped by the 1:500,000 State interpreted bedrock geology (DPIRD 2018) (Figure 4), which is described as:

- Fine- to coarse-grained sandstone, thin shale interbeds.

Soil landscapes and land system mapping of Western Australia describes broad soil and landscape characteristics from regional to local scales. According to the Best Available dataset for Soil Landscape Mapping (DPIRD, 2022a), two soil types occur across the survey area (Figure 5), these include:

- 221Be_3: Yellow deep sand
- 221Be_4: Yellow deep sand.

4.4 VEGETATION

Mapping of pre-European vegetation units within Western Australia is based on broad scale mapping by Beard (1976) at 1:3,000,000 which showed the distribution of 75 major categories of plants at the time of European settlement. Beards mapping was re-assessed by Shepherd et al. (2002) with some larger vegetation units divided into smaller units. Together, this pre-European database contains a total of 819 vegetation types recognised within Western Australia.

Some vegetation types have been extensively cleared since European settlement and have been constrained by development. The EPA has an objective to seek to retain at least 30% of the pre-clearing extent of each ecological community (DBCA 2019).

One broad vegetation association is mapped within the survey area (Figure 6) and is described below and their representation at a local, regional, and state level is shown in Table 6.

- Eridoon 378: Mixed heath with scattered tall shrubs of Acacia, Proteaceae and Myrtaceae species.

The current extent of Eridoon 378 vegetation association is above the 30% pre-clearing threshold at the state (65%), regional (65%) and local levels (79%).

Table 6 Broad vegetation types within the state, regional and local representation (DPIRD 2019b)

Vegetation association	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Current extent managed in DBCA lands (%)
Representation across Western Australia				
Eridoon 378	93,523	60,826	65	14
Representation across the Geraldton Sandplains Bioregion				
Eridoon 378	93,523	60,826	65	14
Representation across the Shire of Irwin				
Eridoon 378	51,858	41,479	79	9

Beharra Springs Operations Camp

Figure 3 IBRA Bioregion

Date: 06/04/2023
Author: C Krens
Projection: UTM MGA Zone 50

0 1 2 km

1:50,000

Legend

- Survey Area
- Geraldton Sandplains

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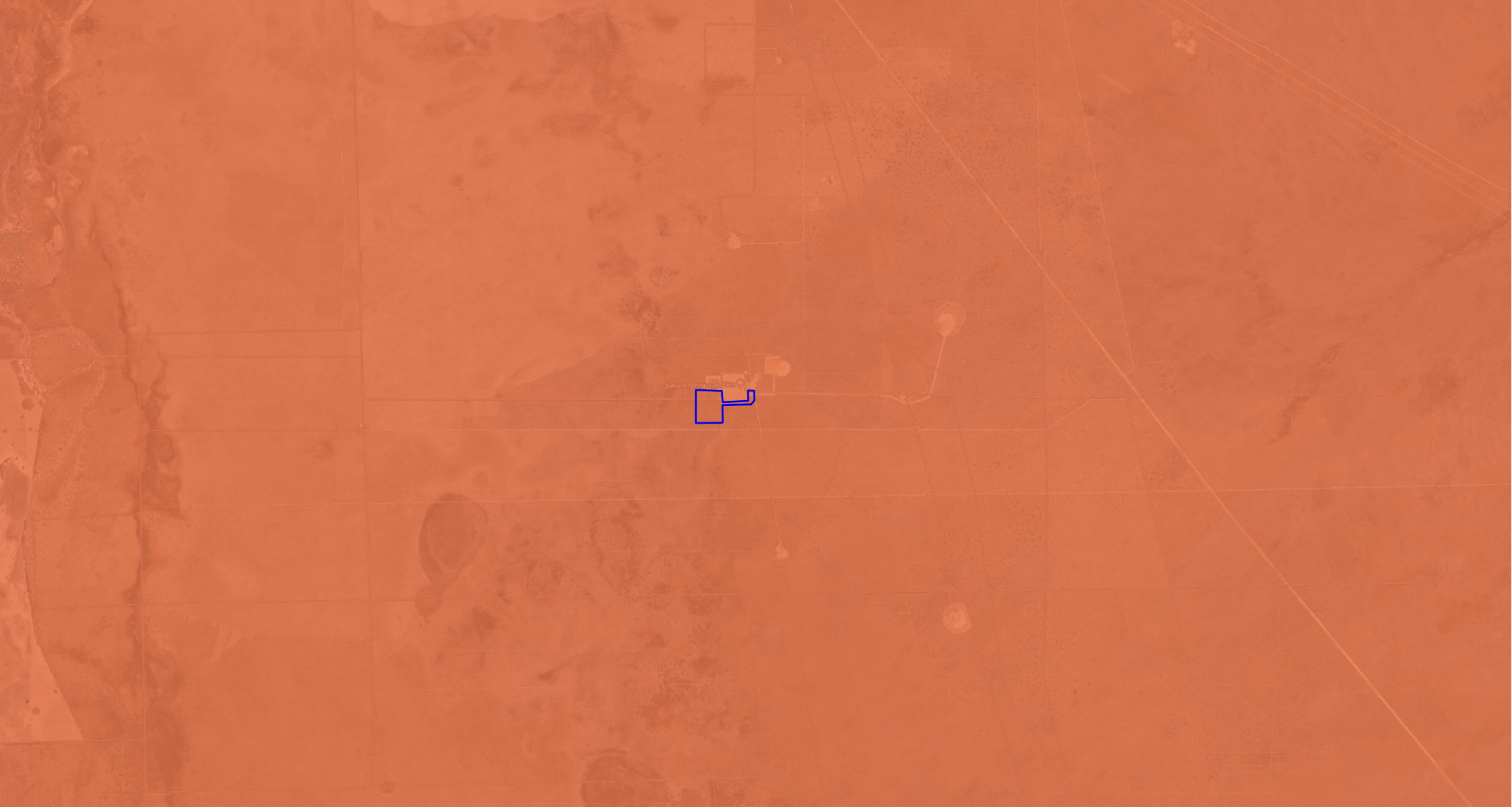

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Figure 4 Bedrock Geology

Date: 06/04/2023
Author: C Krens
Projection: UTM MGA Zone 50

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Legend

- Survey Area
- Yarragadee Formation

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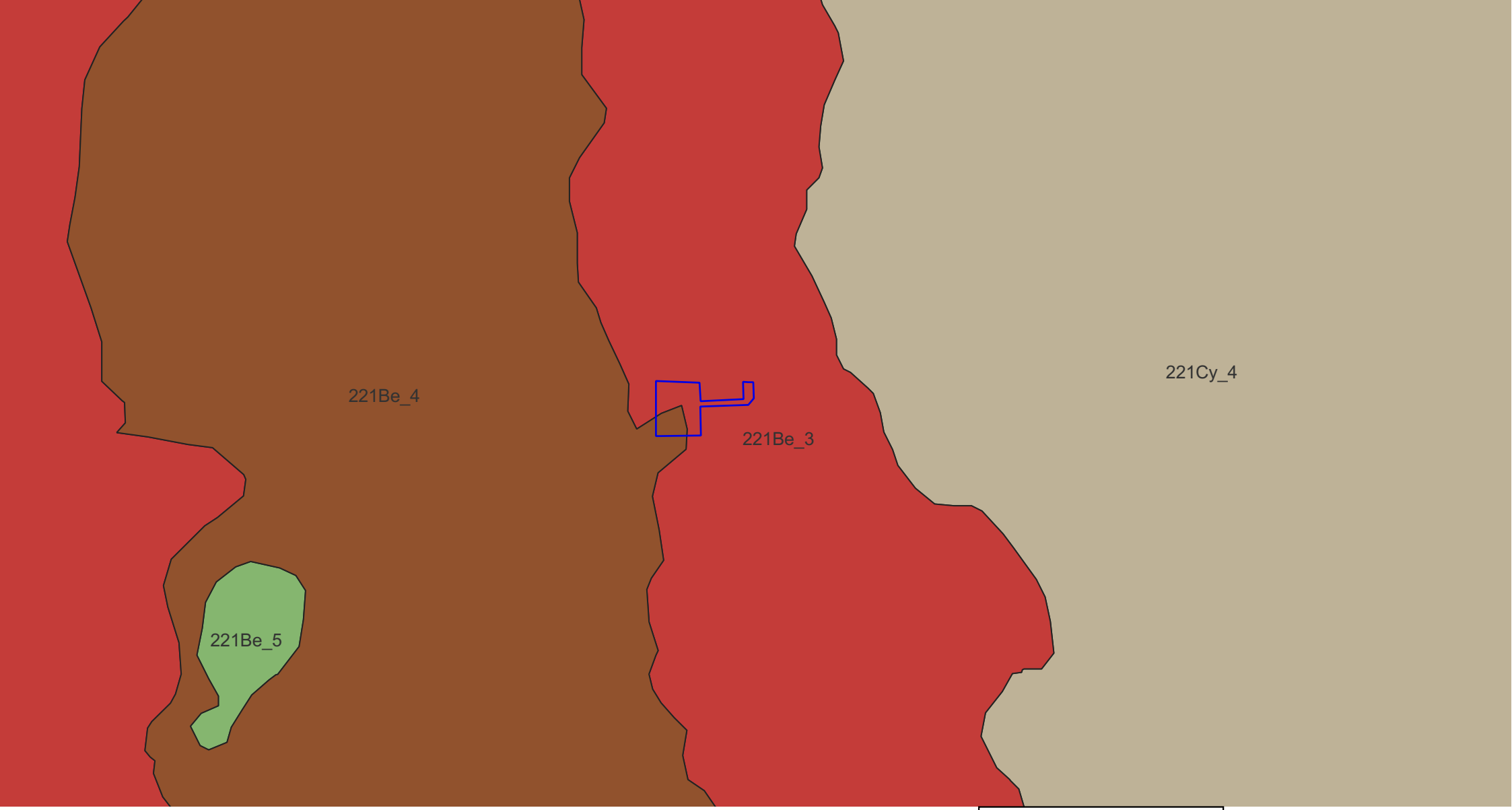

Beharra Springs Operations Camp

Figure 5 Soil types

Date: 06/04/2023
Author: C Krens
Projection: UTM MGA Zone 50

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Legend

Survey Area

Soil Types

221Be_3

221Cy_4

221Be_4

221Be_5

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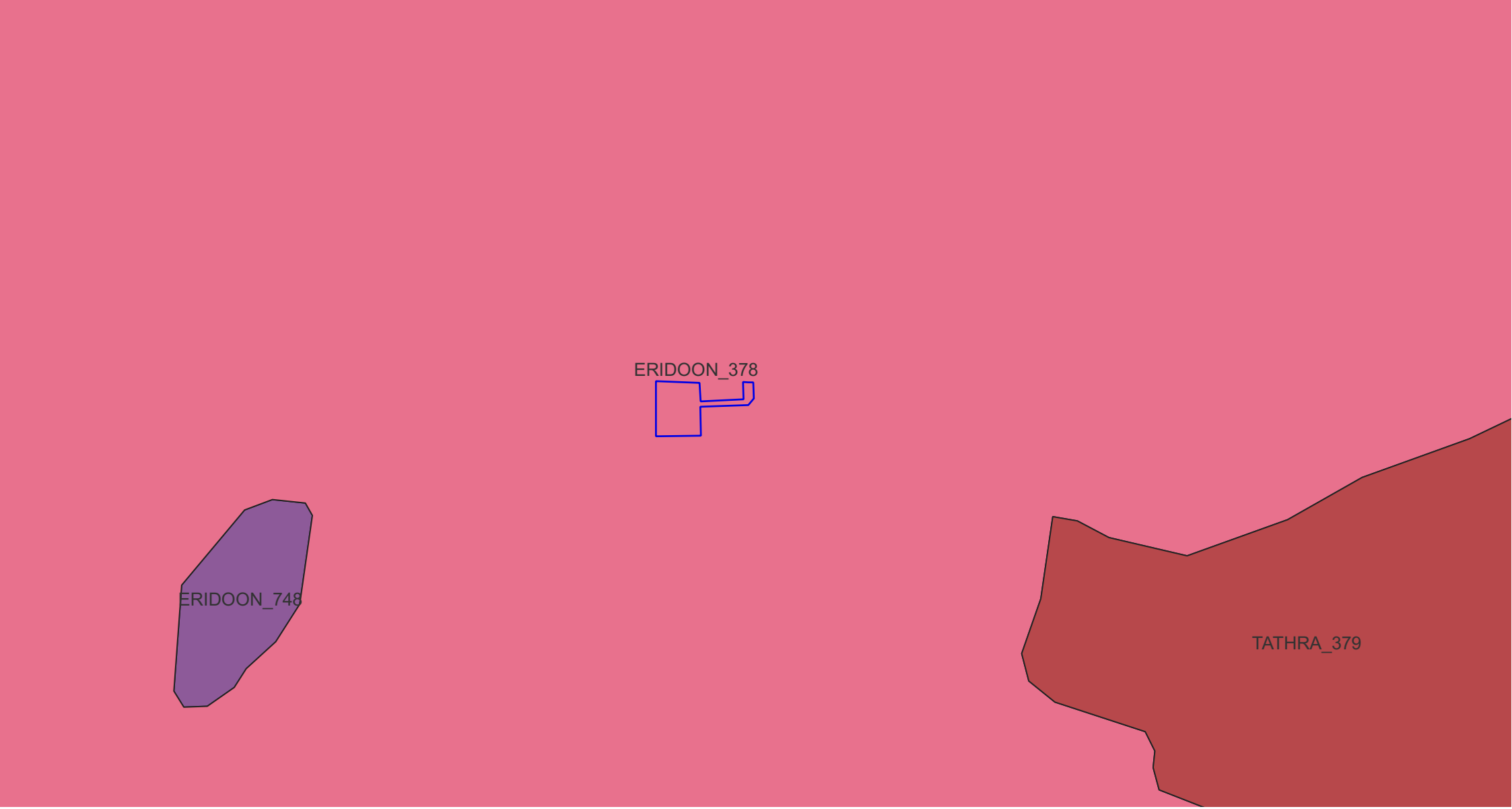

Beharra Springs Operations Camp

Figure 6 Pre-European Vegetation

Date: 06/04/2023
Author: C Krens
Projection: UTM MGA Zone 50

0 1 2 km

1:30,000

Legend

Survey Area

Pre_European_Vegetation

ERIDOON_748

ERIDOON_378

TATHRA_379

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5.0 RESULTS

5.1 DESKTOP ASSESSMENT

The desktop assessment identified 57 Commonwealth and State listed conservation significant flora species occurring within 40 km of the survey area. A break-down of the number of species within each conservation category is provided in Table 7.

Table 7 Number of species within each conservation category identified in the desktop assessment

Conservation status	Commonwealth listed species	State listed species
Critically Endangered		2^^
Endangered	10^	5^^
Vulnerable	1^	4^^
Priority 1		8
Priority 2		11
Priority 3		18
Priority 4		9

Note: ^some species are also State listed
^^ some species are also Commonwealth listed

The potential occurrence of the conservation significant species within the survey area was determined as either high, medium, or low likelihood to be present based on the criteria set out in Table 4. Eleven species were considered to have a high likelihood of occurrence within the survey area:

- *Banksia elegans* (Priority 4 (WA))
- *Calytrix chrysantha* (Priority 4 (WA))
- *Hemiandra* sp. Eneabba (H. Demarz 3687) (Priority 3 (WA))
- *Hypocalymma gardneri* (Priority 3 (WA))
- *Lasiopetalum ogilvieanum* (Priority 1 (WA))
- *Paracaleana dixonii* (Endangered (Cwth), Vulnerable (WA))
- *Persoonia rudis* (Priority 3 (WA))
- *Schoenus griffinianus* (Priority 4 (WA))
- *Schoenus* sp. Eneabba (F. Obbens & C. Godden I154) (Priority 2 (WA))
- *Stawellia dimorphantha* (Priority 4 (WA))
- *Stylidium carnosum* subsp. Narrow leaves (J.A. Wege 490) (Priority 1 (WA)).

The remaining 46 conservation significant species were considered to have a medium or low likelihood of occurrence in the survey area. A full description of all conservation significant species identified in the desktop assessment is provided in Appendix A.

5.2 TARGETED SURVEY

A targeted search was conducted to locate populations of conservation significant species across the entire survey area. A total of 8.65 km of transects were walked during the survey and Figure 7 shows the targeted search effort.

Habitat across the majority of the survey area consisted of Banksia woodlands over Proteaceous heath within light brown to grey sands with occasional lateritic gravels on undulating plains. The survey area's southwest corner was dominated by dense Allocasuarina tall shrublands that most likely represents a seasonal wetland. In particular, the survey area contained suitable habitats for seven of the eleven conservation significant species with a high likelihood of occurrence that were identified in the desktop search.

During the targeted survey, three conservation significant species were recorded which are all Priority flora: *Banksia elegans*, *Hemiandra* sp. Eneabba, and Schoenus griffinianus (Table 8). The desktop survey highlighted that known populations of these three recorded Priority species also occur within 1km of the survey area. In total, 130 Priority plants were recorded from 99 locations. There is a breakdown of recorded species in Table 8, as well as a full list of records in Appendix B and their locations mapped in Figure 8.

Table 8 Summary of recorded conservation significant species

Species	Status	Number of locations	Number of individuals
Banksia elegans	Priority 4	65	84
Hemiandra sp. Eneabba (H. Demarz 3687)	Priority 3	1	2
Schoenus griffinianus	Priority 4	33	44

A flora description and associated habitat for each of the conservation listed species found in the survey area is included below (Western Australian Herbarium, 2023).

5.2.1 *BANKSIA ELEGANS*

Known as Elegant Banksia, *Banksia elegans* is a tall shrub or low tree which grows up to 4m tall. Its roots are fire-tolerant and often sucker. Between October and November, it displays attractive yellow-green large round flowers with distinctive blue-green saw tooth leaves (Plate 1). Banksia elegans occurs on sandplains and consolidated dunes.

5.2.2 *HEMIANDRA* SP. ENEABBA (H. DEMARZ 3687)

Hemiandra sp. Eneabba (H. Demarz 3687) is a straggly erect lime green shrub up to 0.9 m in height. The plant has pungent leaves and violet to blue flowers in February (Plate 2). During the survey, *H*. sp. Eneabba was flowering, indicating an extended flowering period. Typically, it occurs on sandy soils and disturbed areas.

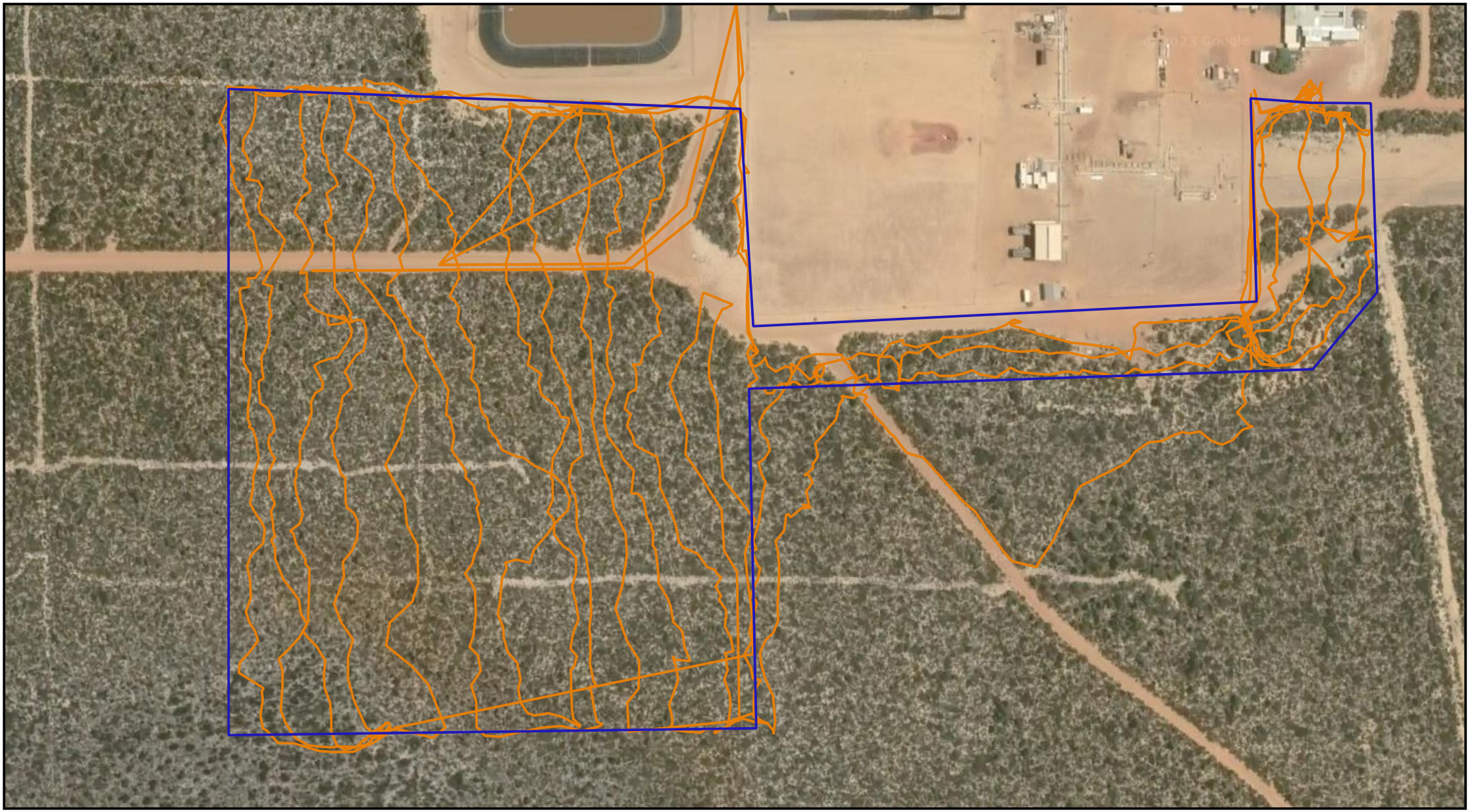
5.2.3 *SCHOENUS GRIFFINIANUS*

Schoenus griffinianus is a small, tufted perennial grass-like sedge that grows to 0.1 m high. It flowers from September to October and has distinctive bracts on grey-green stems (Plate 3). It is known to occur in white sand.

Plate 1 ***Banksia elegens*** **in situ**

Plate 2 ***Hemiandra*** **sp. Eneabba (H. Demarz 3687) in situ**

Plate 3 ***Schoenus griffinianus*** **in situ**



Beharra Springs Operations Camp

Figure 7 Survey effort

Date: 15/01/2023
Author: C Krens
Projection: UTM MGA Zone 50

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1:2,500

Legend

- Survey Area
- Survey effort

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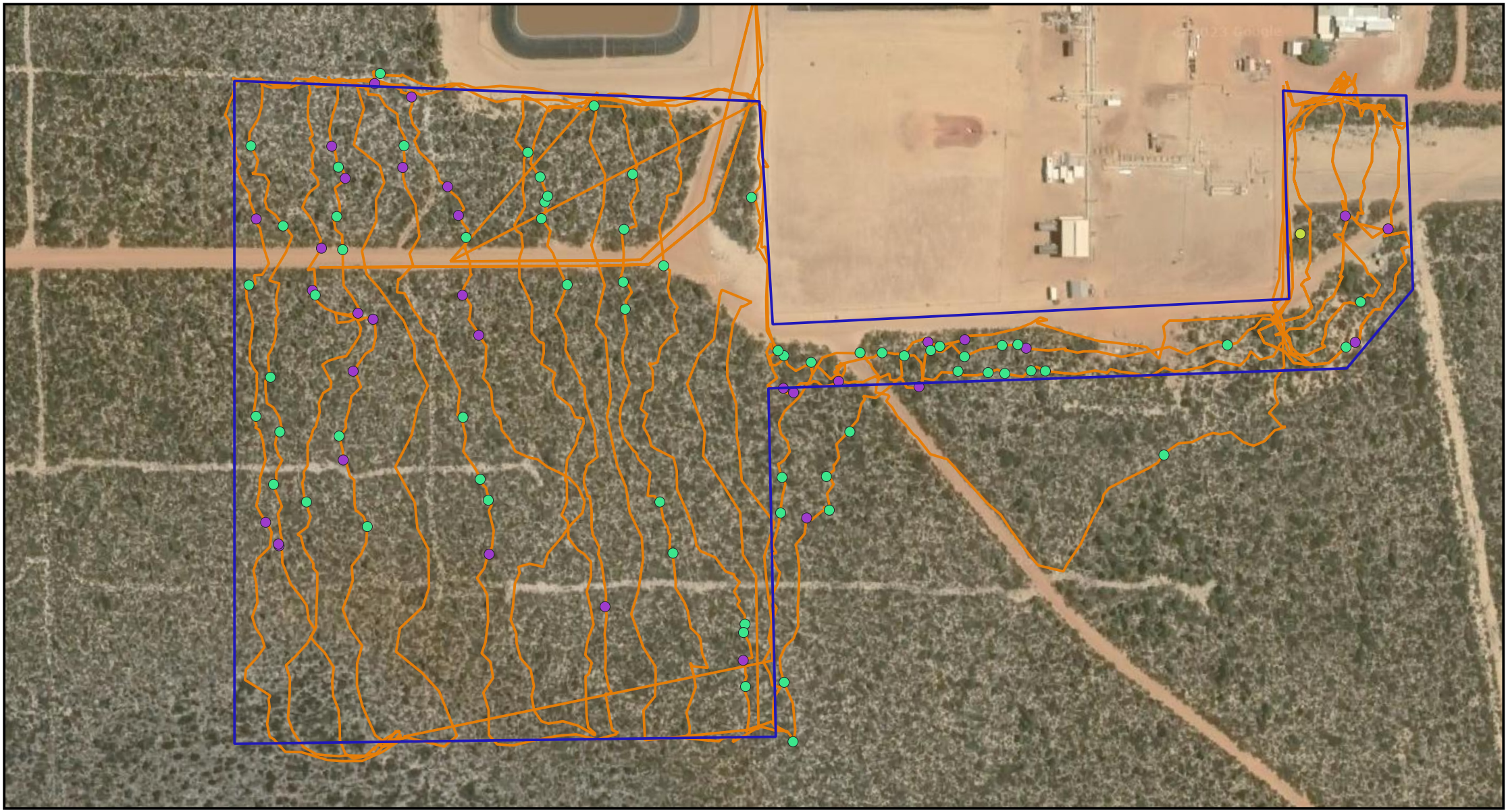

Beharra Springs Operations Camp

Figure 8 Conservation significant flora

Date: 15/01/2023
Author: C Krens
Projection: UTM MGA Zone 50

0 50 100 m

1:2,500

Legend

- Survey Area

Conservation significant flora

- Banksia elegans
- Hemiandra sp. Eneabba
- Schoenus griffinianus

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6.0 DISCUSSION

A targeted survey of the proposed Beharra Springs Operations Camp was conducted in October 2022 by walking transects at spacings of 10m to 30m. Most transects were walked in straight lines, but some meandering occurred to enable visual inspection of dense areas. The survey effort was considered sufficient to record the majority of populations occurring within the survey area.

The mid-October targeted survey is appropriate for the Geraldton Sandplains Bioregion (EPA 2016a). Approximately half (29 species) of the conservation significant species identified in the desktop assessment either flower or fruit in October. All three recorded species were flowering at the time of the survey, including *Hemiandra* sp. Eneabba (H. Demarz 3687), which is known to flower much later in February.

The desktop assessment determined that eleven species had a high likelihood of occurrence within the survey area. It was based on known populations occurring within five kilometres of the survey area and predicted habitat. During the survey, eight of the eleven conservation-significant species were not recorded. These species are known to occur at least 2 km from the survey area. This survey enabled a better understanding of the habitat present, and a reassessment of the eight unrecorded species was undertaken. As a result, four species have a medium likelihood of occurrence based on the survey area containing suitable habitat. The remaining four species have a low likelihood of occurrence as suitable habitat was not present or is unknown. Table 9 summarises the post-survey likelihood assessment.

Table 9 Post survey likelihood assessment of conservation significant species initially considered to have a high likelihood of occurrence

Species	Flowering time	Correct survey timing	Distance	Habitat	Habitat present	Likelihood after survey
Banksia elegans	October to November	Yes	Within 1 km	White sand sandplains	Yes	High - occurs within the survey area
Hemiandra sp. Eneabba (H. Demarz 3687)	February	No – too early, however it was flowering	Within 1 km	Sand, disturbed sites	Yes	High - occurs within the survey area
Schoenus griffinianus	September to October	Yes	Within 1 km	White sand	Yes	High - occurs within the survey area
Calytrix chrysantha	December to February	No – too early	5 km	White-grey sand flats	Yes	Medium
Hypocalymma gardneri	August to September	No – too late	3 km	Grey-brown sand,	Yes	Medium

Species	Flowering time	Correct survey timing	Distance	Habitat	Habitat present	Likelihood after survey
				laterite, sandplains		
Lasiopetalum ogilvieanum	July to October	Yes	4 km	White-grey or yellow sand, stony loam. Undulating plains, lateritic rises	Yes	Medium
Stawellia dimorphantha	June to November	Yes	5 km	White, grey, yellow sand.	Yes	Medium
Paracaleana dixonii	October to January	Yes	3 km	Grey sand over granite	No	Low
Persoonia rudis	September to January	Yes	3 km	White, grey, or yellow sand, often over laterite	No	Low
Schoenus sp. Eneabba	Unknown	Unknown	2 km	Unknown	Unknown	Low
Stylidium carnosum subsp. Narrow leaves	Unknown	Unknown	2 km	Unknown	Unknown	Low

The majority of Priority flora populations can be found adjacent to access tracks and disturbed areas in the north of the survey area. There are scattered populations in the southern half of the survey area. No populations have been found in the southwest corner, where Banksia shrublands change to Allocasuarina shrublands. Based on aerial imagery, the Allocasuarina shrublands appear to extend south of the survey area.

A targeted survey was also conducted by Mattiske Consulting (2018). This was undertaken adjacent to the survey area and also only recorded the same three Priority flora species identified by our survey. Based on the results of the targeted survey and an understanding of the habitat present within the survey area, three conservation significant species occur within the survey area. 16 species have a medium likelihood of occurrence, and 38 species have a low likelihood of occurrence (see Appendix A).

7.0 CONCLUSION

The targeted survey was conducted in October 2022 across the entire survey area. Three conservation significant species were recorded within the survey area:

- *Banksia elegans* (Priority 4) – 84 plants
- *Hemiandra* sp. Eneabba (H. Demarz 3687) (Priority 3) – 2 plants
- *Schoenus griffinianus* (Priority 4) – 44 plants.

In summary:

- The populations of the conservation significant species occurred mainly in the northern section of the survey area. The species observed were Priority listed.
- No EPBC listed species were recorded.
- The survey was conducted within the appropriate flowering window during Spring in October 2022.
- No significant limitations hindered the survey that was undertaken.
- The survey effort comprised of 8.65 km transects.

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APPENDIX A DESKTOP ASSESSMENT

Results of the desktop assessment are presented below.

Table A1 Conservation significant flora species identified in the desktop assessment.

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
Acacia vittata		P2	Dense, rounded shrub, 1-4 m high. Flowers Yellow	August	Grey sand, sandy clay. Margins of seasonal lakes.	8 km southwest	Medium	Low
Austrostipa nunaginensis (formerly Austrostipa sp. Cairn Hill (M.E. Trudgen 21176))		P3				15 km northwest	Medium	Low
Baeckea sp. Walkaway (A.S. George 11249)		P3	Dense, multi-stemmed shrub, 0.5-2 m high. Flowers White	December or January	Yellow/brown or white sand. Undulating plains, hillslopes	14 km north	Medium	Medium
Banksia elegans		P4	Shrub (with fire-tolerant rootstock, often suckering), 1-4 m high. Flowers yellow/green-yellow	October to November	Yellow, white, or red sand. Sandplains, low consolidated dunes	Within 1 km	High	High – occurs in survey area
Banksia fraseri var. *crebra*	`	P3				6 km southeast	Medium	Low

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
Banksia scabrella	`	P4	Much-branched, lignotuberous shrub, 0.6-2 m high. Flowers yellow & cream & purple	September to December or January	White, grey, or yellow sand, sometimes with lateritic gravel. Sandplains, lateritic ridges.	8 km east	Medium	Medium
Beyeria gardneri	`	P3	Shrub, 0.25-0.5 m high. Flowers yellow	August to September	Yellow sand	7 km north	Medium	Low
Caladenia denticulata subsp. *albicans*	`	P1				13 km southwest	Medium	Low
Calectasia palustris	`	P2	Stilt-rooted herb (undershrub) stems to 0.7 m high. Flowers Blue	July to October	White or grey sand. Seasonally inundated swamplands	More than 90 km southwest	Low	Low
Calytrix chrysantha	`	P4	Shrub, 0.3-1.3 m high. Flowers yellow	December or January to February.	White, grey, or yellow/brown sand. Flats.	5 km northeast	High	Medium
Calytrix superba	`	P4	Shrub, 0.2-1 m high. Flowers pink-red	December or January to February	Sand over laterite. Flats.	17 south east	Medium	Low

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
Comesperma griffinii	`	P2	Annual or perennial, herb, to 0.15 m high. Flowers White	October	Yellow or grey sand. Plains	6 km west	Medium	Medium
Comesperma rhadinocarpum	`	P3	Perennial, herb. Flowers blue	October to November	Sandy soils	9 km northeast	Medium	Medium
Conostylis dielsii subsp. *teres*	Endangered	Vulnerable	Shortly rhizomatous, tufted perennial, grass-like or herb, 0.13-0.33 m high, leaves terete. Flowers cream-yellow	July to August	White, grey, or yellow sand, gravel. Low open woodland.	30 km north	Low	Low
Conostylis micrantha	Endangered	Vulnerable	Rhizomatous, tufted perennial, grass-like or herb, 0.13-0.24 m high. Flowers yellow-cream/red	July to August	White or grey sand. Sandplains.	29 km north	Low	Low
Daviesia speciosa	Endangered	Endangered	Many-stemmed shrub, 0.3-0.8 m high. Flowers red	April to May	Gravelly lateritic soils. Undulating plains, rises.	13 km northeast	Medium	Medium
Drosera pedicellaris		P1	Fibrous-rooted perennial, herb, to 0.15 m high. Flowers White	October to November	Deep beige sand	More than 60 km southeast	Low	Low
Eremaea acutifolia		P3	Spreading, dense shrub, 0.4-0.7(-1) m high. Flowers orange/pink	August to November	Grey or yellow sand. Sandplains.	21 km northwest	Low	Low

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
Eucalyptus ×balanites	Endangered	Critically Endangered	(Mallee), to 5 m high, bark rough, flaky. Flowers white	October to December or January to February	Sandy soils with lateritic gravel.	More than 100 km south	Low	Low
Eucalyptus crispata	Vulnerable	Endangered	(Mallee), 3-7 m high, bark rough on the trunk, in partly decorticated curls. Flowers yellow-cream	March to June	Sand, loam with lateritic gravel. Lateritic breakaways.	17 km east	Medium	Low
Eucalyptus foecunda subsp. *aeolica*	`	P2				17 km south	Medium	Low
Eucalyptus leprophloia	Endangered	Endangered	(Mallee), 2-5(-8) m high, bark rough loose & flaky to 1 m. Flowers cream-white	August to October	White or grey sand over laterite. Valley slopes.	19 km northeast	Medium	Low
Eucalyptus macrocarpa subsp. *elachantha*	`	P4	(Spreading or sprawling mallee), 0.8-4 m high, bark smooth, grey over salmon pink. Flowers red-pink	August to September or November to December	White or grey sand over laterite. Hillslopes, ridges, sandplains.	7 km north	Medium	Low
Eucalyptus macrocarpa × pyriformis	`	P3	Erect, open mallee tree, 1.2-6 m high. Flowers red	April or August to October	Sand, lateritic sandy soils. Hills, rocky ironstone ridges, sandplains.	11 km southeast	Medium	Medium

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
Eucalyptus zopherophloia	`	P4	(Spreading mallee), 2.5-4(-6) m high, bark rough, fibrous. Flowers cream-white	October to December or January	Grey/white sand with limestone rubble. Coastal areas.	6 km west	Medium	Low
Grevillea erinacea	`	P3	Spindly, prickly, sparingly branched shrub, (0.3-)0.6-1.8 m high. Flowers green-white-cream	July to December	White, grey, or yellow sand, often with lateritic gravel.	13 km southeast	Medium	Medium
Guichenotia alba	`	P3	Slender, lax, few-branched shrub, 0.1-0.45 m high. Flowers white	July to August	Sandy & gravelly soils. Low-lying flats, depressions.	7 km north	Medium	Low
Guichenotia quasicalva	`	P2	Erect, compact shrub, to 0.5 m high. Flowers blue-purple	September to October	Sandy clay over laterite. Drainage line.	16 km south	Medium	Low
Hemiandra gardneri	Endangered	Critically Endangered	Prostrate, pungent shrub, 0.1-0.2 m high, to 1 m wide. Flowers red/pink-red	August to October	Grey or yellow sand, clayey sand. Sandplains.	More than 60 km southeast	Low	Low
Hemiandra sp. Eneabba (H. Demarz 3687)	`	P3	Straggly, erect shrub, 0.5-0.9 m high, to 0.4 m wide. Flowers blue/violet	February	Sand. Disturbed sites.	Within 1 km	High	High – occurs in survey area
Hypocalymma gardneri	`	P3	Shrub, to 0.3 m high. Flowers yellow	August to September	Grey-brown sand, laterite.	3 km north	High	Medium

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
					Sandplains, upper slopes, heathland.			
Lasiopetalum ogilvieanum	`	P1	Shrub, 0.45-1.5 m high. Flowers pink-white	July to October	White/grey or yellow sand, stony loam. Undulating plains, lateritic rises	4km north	High	Medium
Mesomelaena stygia subsp. *deflexa*	`	P3	Tufted perennial, grass-like or herb (sedge), 0.1-0.5 m high. Flowers brown-black	March to October.	White, grey, or lateritic sand, clay, gravel.	12 km north	Medium	Medium
Micromyrtus rogeri	`	P1	Shrub, 0.2-0.4 m high. Flowers White	July to October	Yellow-brown sandy soils, gravel, laterite. Breakaways	14 km northeast	Medium	Low
Paracaleana dixonii	Endangered	Vulnerable	Tuberous, perennial, herb, 0.09-0.2 m high. Flowers yellow-brown	October to December or January	Grey sand over granite.	3 km east	High	Low
Persoonia chapmaniana	`	P3	Erect, spreading shrub, 1-2 m high. Flowers yellow	September to November	White sandy clay, yellow sand. Vicinity of salt lakes.	11 km southeast	Medium	Low
Persoonia filiformis	`	P3	Erect, spreading, lignotuberous shrub, 0.07-0.4 m high. Flowers yellow	November to December	Yellow or white sand over laterite.	7 km north	Medium	Low

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
Persoonia rudis	`	P3	Erect, often spreading shrub, 0.2-1 m high. Flowers yellow	September to December or January	White, grey, or yellow sand, often over laterite.	3 km east	High	Low
Poranthera asybosca	`	P1				25 km south	Low	Low
Schoenus badius	`	P2	Slender annual, grass-like or herb (sedge), 0.05-0.12 m high. Flowers brown-green	September to October	Grey sand. Moist areas.	13 km east	Medium	Low
Schoenus griffinianus	`	P4	Small, tufted perennial, grass-like or herb (sedge), to 0.1 m high	September to October	White sand	Within 1 km	High	High – occurs in survey area
Schoenus sp. Eneabba (F. Obbens & C. Godden I154)	`	P2				2 km north	High	Low
Scholtzia calcicola	`	P2				18 km south	Medium	Low
Stawellia dimorphantha	`	P4	Stilt-rooted perennial, herb, 0.05-0.2 m high. Flowers purple/cream	June to November	White, grey, yellow sand.	5 km north	High	Medium

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
Stylidium carnosum subsp. Narrow leaves (J.A. Wege 490)	`	P1				2km east	High	Low
Stylidium drummondianum	`	P3	Rosetted perennial, herb, 0.05-0.22 m high. Inflorescence paniculate. Flowers Pink	August to October	Sand or clayey sand over laterite. Upper hillslopes, breakaways. Low heath, mallee shrubland.	8 km north	Medium	Low
Stylidium pseudocaespitosum	`	P2	Rosetted perennial, herb, 0.1-0.3 m high. Inflorescence racemose. Flowers Yellow	September to November	White, grey, or yellow sand over laterite. Breakaways and hillslopes.	16 km south	Medium	Low
Stylidium sp. Three Springs (J.A. Wege & C. Wilkins JAW 600)	`	P2				20 km northwest	Low	Low
Stylidium torticarpum	`	P3	Caespitose perennial, herb, 0.12-0.27 m high. Inflorescence paniculate. Capsule twisted. Flowers Pink	September to November	Sandy clay and clay loam over laterite. Adjacent to creeklines, depressions, and beneath breakaways.	24 km east	Low	Low

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
					Heath or mallee shrubland.			
Styphelia obtecta (formerly *Leucopogon obtectus*)	Endangered	Endangered				28 km south	Low	Low
Thelymitra stellata	Endangered	Endangered	Tuberous, perennial, herb, 0.15-0.25 m high. Flowers yellow & brown	October to November	Sand, gravel, lateritic loam.	14 km west	Medium	Medium
Thysanotus glaucus	`	P4	Caespitose, glaucus perennial, herb, 0.1-0.2 m high. Flowers purple	October to December or January to March	White, grey, or yellow sand, sandy gravel.	More than 60 km south	Low	Low
Verticordia argentea	`	P2	Erect, open shrub, 0.9-2 m high. Flowers pink & white	November to December or January to April	White, grey, or yellow sand. Sand ridges, undulating plains.	16 km south	Medium	Medium
Verticordia dasystylis subsp. *oestopoia*	`	P1	Spreading shrub, 0.1-0.4 m high. Flowers cream-yellow	October	Gritty soils over granite. Outcrops.	13 km southwest	Medium	Low
Verticordia luteola var. *luteola*	`	P3	Slender shrub, 0.5-1.4 m high. Flowers white-yellow	November to December	Grey sand over gravel. Flats.	8 km north	Medium	Medium

Species	Cwth	WA	Description	Flowering time	Habitat	Distance to survey area	Likelihood of occurrence	
							Pre-survey	Post-survey
Verticordia luteola var. *rosea*	`	P1	Slender shrub, 0.3-2 m high. Flowers pink/green-cream-brown	December or January	White sand. Flats.	11 km southwest	Medium	Medium
Wurmbea tubulosa	Endangered	Vulnerable	Cormous, perennial, herb, 0.01-0.03 m high, dioecious, or sometimes andromonoecious. Flowers white-pink	June to August	Clay, loam. Riverbanks, seasonally-wet places.	25 km north	Low	Low

APPENDIX B LOCATIONS OF PRIROTY FLORA POPULATIONS

SPECIES	ABUNDANCE	DATE	LATITUDE	LONGITUDE
Banksia elegans	2	20/10/22	-29.464502	115.14202
Banksia elegans	1	20/10/22	-29.464303	115.142097
Banksia elegans	1	21/10/22	-29.4645	115.1414
Banksia elegans	1	21/10/22	-29.4645	115.1404
Banksia elegans	1	21/10/22	-29.4645	115.1403
Banksia elegans	1	21/10/22	-29.4645	115.1401
Banksia elegans	1	21/10/22	-29.4645	115.1399
Banksia elegans	1	21/10/22	-29.4645	115.1398
Banksia elegans	1	21/10/22	-29.4645	115.1397
Banksia elegans	1	21/10/22	-29.4645	115.1393
Banksia elegans	3	21/10/22	-29.4645	115.1392
Banksia elegans	2	21/10/22	-29.4638	115.139
Banksia elegans	1	21/10/22	-29.4632	115.1372
Banksia elegans	1	21/10/22	-29.4642	115.1365
Banksia elegans	1	21/10/22	-29.4647	115.1365
Banksia elegans	1	21/10/22	-29.4652	115.1371
Banksia elegans	1	21/10/22	-29.4648	115.1369
Banksia elegans	1	21/10/22	-29.464	115.137
Banksia elegans	1	21/10/22	-29.4639	115.1369
Banksia elegans	1	21/10/22	-29.4636	115.1369
Banksia elegans	3	21/10/22	-29.4635	115.1373
Banksia elegans	2	21/10/22	-29.4648	115.1376
Banksia elegans	1	21/10/22	-29.465	115.1376
Banksia elegans	1	21/10/22	-29.4651	115.1377
Banksia elegans	2	21/10/22	-29.4642	115.1381
Banksia elegans	1	21/10/22	-29.4639	115.138
Banksia elegans	1	21/10/22	-29.4638	115.138
Banksia elegans	1	21/10/22	-29.4638	115.138
Banksia elegans	1	21/10/22	-29.4637	115.138
Banksia elegans	1	21/10/22	-29.4637	115.1384
Banksia elegans	2	21/10/22	-29.4639	115.1384
Banksia elegans	1	21/10/22	-29.4642	115.1384
Banksia elegans	1	21/10/22	-29.4643	115.1384
Banksia elegans	1	21/10/22	-29.4651	115.1385
Banksia elegans	1	21/10/22	-29.4654	115.1386
Banksia elegans	1	21/10/22	-29.4662	115.1392
Banksia elegans	2	21/10/22	-29.4659	115.1392
Banksia elegans	2	21/10/22	-29.4652	115.1394
Banksia elegans	1	21/10/22	-29.465	115.1394

SPECIES	ABUNDANCE	DATE	LATITUDE	LONGITUDE
Banksia elegans	1	21/10/22	-29.4648	115.1395
Banksia elegans	1	21/10/22	-29.464586	115.1405
Banksia elegans	1	21/10/22	-29.464584	115.140428
Banksia elegans	1	21/10/22	-29.46459	115.140401
Banksia elegans	1	21/10/22	-29.464594	115.140295
Banksia elegans	2	21/10/22	-29.464589	115.140211
Banksia elegans	3	21/10/22	-29.464581	115.140059
Banksia elegans	1	21/10/22	-29.463535	115.136507
Banksia elegans	2	21/10/22	-29.463891	115.136663
Banksia elegans	1	21/10/22	-29.464559	115.136587
Banksia elegans	1	21/10/22	-29.464801	115.13663
Banksia elegans	1	21/10/22	-29.465033	115.136594
Banksia elegans	1	21/10/22	-29.465113	115.136759
Banksia elegans	1	21/10/22	-29.464199	115.13682
Banksia elegans	1	21/10/22	-29.463583	115.137905
Banksia elegans	2	21/10/22	-29.463382	115.138243
Banksia elegans	1	21/10/22	-29.464094	115.138581
Banksia elegans	1	21/10/22	-29.465684	115.138963
Banksia elegans	1	21/10/22	-29.465721	115.138955
Banksia elegans	1	21/10/22	-29.46596	115.138961
Banksia elegans	1	21/10/22	-29.465195	115.139152
Banksia elegans	1	21/10/22	-29.465038	115.139162
Banksia elegans	1	21/10/22	-29.464492	115.139566
Banksia elegans	2	21/10/22	-29.464966	115.141092
Hemiandra sp. Eneabba (H. Demarz 3687)	2	20/10/22	-29.461798	115.141798
Schoenus griffinianus	1	20/10/22	-29.463982	115.142242
Schoenus griffinianus	1	20/10/22	-29.464481	115.142067
Schoenus griffinianus	1	20/10/22	-29.463922	115.142027
Schoenus griffinianus	1	21/10/22	-29.464484	115.140405
Schoenus griffinianus	1	21/10/22	-29.463268	115.137137
Schoenus griffinianus	1	21/10/22	-29.463858	115.136528
Schoenus griffinianus	3	21/10/22	-29.4652	115.136551
Schoenus griffinianus	1	21/10/22	-29.46493	115.136948
Schoenus griffinianus	1	21/10/22	-29.464538	115.137005
Schoenus griffinianus	1	21/10/22	-29.46431	115.13711
Schoenus griffinianus	3	21/10/22	-29.464282	115.137034
Schoenus griffinianus	1	21/10/22	-29.463685	115.136981
Schoenus griffinianus	2	21/10/22	-29.463542	115.136915
Schoenus griffinianus	2	21/10/22	-29.463641	115.137272
Schoenus griffinianus	1	21/10/22	-29.465357	115.137677
Schoenus griffinianus	1	21/10/22	-29.465597	115.138258
Schoenus griffinianus	1	21/10/22	-29.465219	115.139283

SPECIES	ABUNDANCE	DATE	LATITUDE	LONGITUDE
Schoenus griffinianus	1	21/10/22	-29.46445	115.13991
Schoenus griffinianus	1	21/10/22	-29.464442	115.140096
Schoenus griffinianus	1	21/10/22	-29.464647	115.139861
Schoenus griffinianus	1	21/10/22	-29.464617	115.139455
Schoenus griffinianus	5	21/10/22	-29.464664	115.139227
Schoenus griffinianus	1	21/10/22	-29.464644	115.139176
Schoenus griffinianus	1	21/10/22	-29.465297	115.136614
Schoenus griffinianus	2	21/10/22	-29.465305	115.136617
Schoenus griffinianus	1	21/10/22	-29.464178	115.136806
Schoenus griffinianus	1	21/10/22	-29.463992	115.136855
Schoenus griffinianus	1	21/10/22	-29.46333	115.137322
Schoenus griffinianus	1	21/10/22	-29.463729	115.137497
Schoenus griffinianus	1	21/10/22	-29.463857	115.137549
Schoenus griffinianus	1	21/10/22	-29.46421	115.137563
Schoenus griffinianus	1	21/10/22	-29.464388	115.137642
Schoenus griffinianus	1	21/10/22	-29.465844	115.138951