Flora and Vegetation Survey of the Wanneroo Shooting Complex

Prepared for Sporting Shooters Association of Australia

July 2023

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FLORA AND VEGETATION SURVEY: WANNEROO SHOOTING COMPLEX

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Chain of authorship and review			
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EXECUTIVE SUMMARY

The Sporting Shooters Association of Australia (WA) Inc (SSAA WA) lease the Wanneroo Shooting Complex located at Lot 5607 Neaves Road Pinjar (the survey area). The survey area is located within Crown Land on title LR3121/481 which is managed by Department of Biodiversity Conservation and Attractions (DBCA) and leased to SSAA WA. SSAA WA are planning to upgrade the current facilities to include a new public shooting range which will involve clearing approximately 6ha of remnant vegetation. Coterra engaged Anders Environmental Consulting (Anders) to assess the flora and vegetation values of the survey area, which included a desktop assessment, reconnaissance survey undertaken in April 2022 and detailed spring flora and vegetation survey undertaken in October 2022.

The survey area is located within the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) region. The vegetation complex (Heddle et al. 1980) occurring within the survey area is the Bassendean Complex which consists of low open forest and low woodland to areas of sedgelands on wetter sites.

The desktop assessment gathered contextual information on the survey area, which was verified during the field survey, this included:

- 11 Ecological Communities of Conservation Significance within 10 kms of the survey area. 10 of these were listed as Threatened Ecological Communities (TECs) under the Commonwealth and one of these was State Listed as a Priority Ecological Community (PEC). Five of the TECs were also State listed as PECs.

- Five TECs were found to have a high likelihood of occurrence in the survey area:
    - Banksia Woodlands of the Swan Coastal Plain ecological community. This community is found *within* the survey area.
    - Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community
    - SCP21c – *Banksia attenuata - Melaleuca preissiana* low-lying woodlands or shrublands, occurs on the Bassendean system
    - SCP22 – *Banksia ilicifolia – Banksia attenuata* woodlands, *Melaleuca preissiana* woodlands and scrubs are also recorded, central Swan Coastal Plain
    - SCP23b – *Banksia attenuata – Banksia menziesii* woodlands, Swan Coastal Plain.

- 74 conservation significant flora species within 20 km of the survey area. Two species were considered to have a high likelihood of occurrence within the survey area:
    - *Pithocarpa corymbulosa* – Priority 3
    - *Stylidium longitubum* – Priority 4.

The Survey area is located within an Environmentally Sensitive Area (ESA) with other ESA's within 10km of the survey area. Two National Parks occur within a 15km radius of the survey area:

- Yanchep National Park
- Nearabup National Park.

Five Nature Reserves occur within a 15km radius of the survey area:

- Yeal Nature Reserve
- Lake Joondalup Nature Reserve
- Jandabup Nature Reserve
- Neaves Road Nature Reserve
- Nearabup Nature Reserve.

The reconnaissance survey (April 2022) and detailed spring flora and vegetation survey was completed in October 2022. A summary of the flora and vegetation values within the proposed clearing area include:

- One TEC present - Banksia Woodlands of the Swan Coastal Plain (Endangered) representing 4.901 ha
- One PEC SCP23b Swan Coastal Plain Northern Banksia attenuata - Banksia menziesii woodlands (Priority 3) also representing 4.901 ha
- One multiple use wetland – Lake Pinjar intersects the clearing area with 0.496 ha present
- No Threatened or Priority flora species were recorded
- No Weeds of National Significance or Declared Pests were recorded
- Three vegetation types – two Banksia woodlands and one Melaleuca woodland
- Vegetation condition was mostly Very Good.

Within the wider survey area, the following flora and vegetation values include:

- One PEC occurs outside the clearing area: SCP21c Low lying Banksia attenuata woodlands or shrublands (Priority 3)
- Two unnamed conservation category wetlands
- Potential dieback adjacent to tracks in the north and east of the survey area
- Three vegetation types – two Banksia woodlands and one Melaleuca woodland
- Vegetation condition ranged from Excellent to Completely Degraded
- No Threatened or Priority flora species were recorded
- No Weeds of National Significance or Declared Pests were recorded
- 102 species recorded (86% native and 14% introduced species) across the survey area.

The clearing area has a high level of biodiversity and mostly Very Good condition. The following recommendations from the outcome of the assessment are made for the clearing area:

- Avoid clearing vegetation type VT1 which represents Banksia Woodlands of the Swan Coastal Plain TEC and SCP23b Swan Coastal Plain Northern Banksia attenuata - Banksia menziesii woodlands PEC
- Minimise clearing Very Good condition vegetation where possible.

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DEFINITIONS

Acronym	Definition
Anders	Anders Environmental Consulting
BAM Act	*Biosecurity and Agricultural Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016*
BOM	Bureau of Meteorology
CR	Critically Endangered
Cwth	Commonwealth
DBCA	Department of Biodiversity Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPIRD	Department of Primary Industries and Regional Development
EN	Endangered
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
FCT	Floristic Community Type
ha	Hectare
IBRA	Interim Biogeographic Regionalisation of Australia
km	Kilometre
m	Metre
mm	Millimetre
MNES	Matter of National Environmental Significance
NVIS	National Vegetation Information System
PEC	Priority Ecological Community
TEC	Threatened Ecological Community
VU	Vulnerable
WA	Western Australia
WONS	Weed of National Significance

1.0 INTRODUCTION

1.1 BACKGROUND

The Sporting Shooters Association of Australia (WA) Inc (SSAA WA) currently lease the Wanneroo Shooting Complex located at Lot 5607 Neaves Road Pinjar (the survey area). SSAA WA are planning to upgrade the current facilities to include a new public shooting range (6 ha).

The survey area is comprised of two areas:

- Proposed clearing area of 100m x 600m for a new gun range, apron, parking area, and amenities representing approximately 6.019 ha
- The entire lease area of approximately 392 ha.

As part of state and federal environmental approval requirements, an assessment of the environmental values is required to support the proposal. Coterra engaged Anders Environmental Consulting (Anders) to undertake a reconnaissance and detailed flora and vegetation survey in Autumn and Spring 2022. The results of the assessment are provided in this report.

1.2 LOCATION OF SURVEY AREA

The survey area is in Pinjar, a rural locality in the City of Wanneroo, located approximately 47km north-east of Perth (Figure 1).

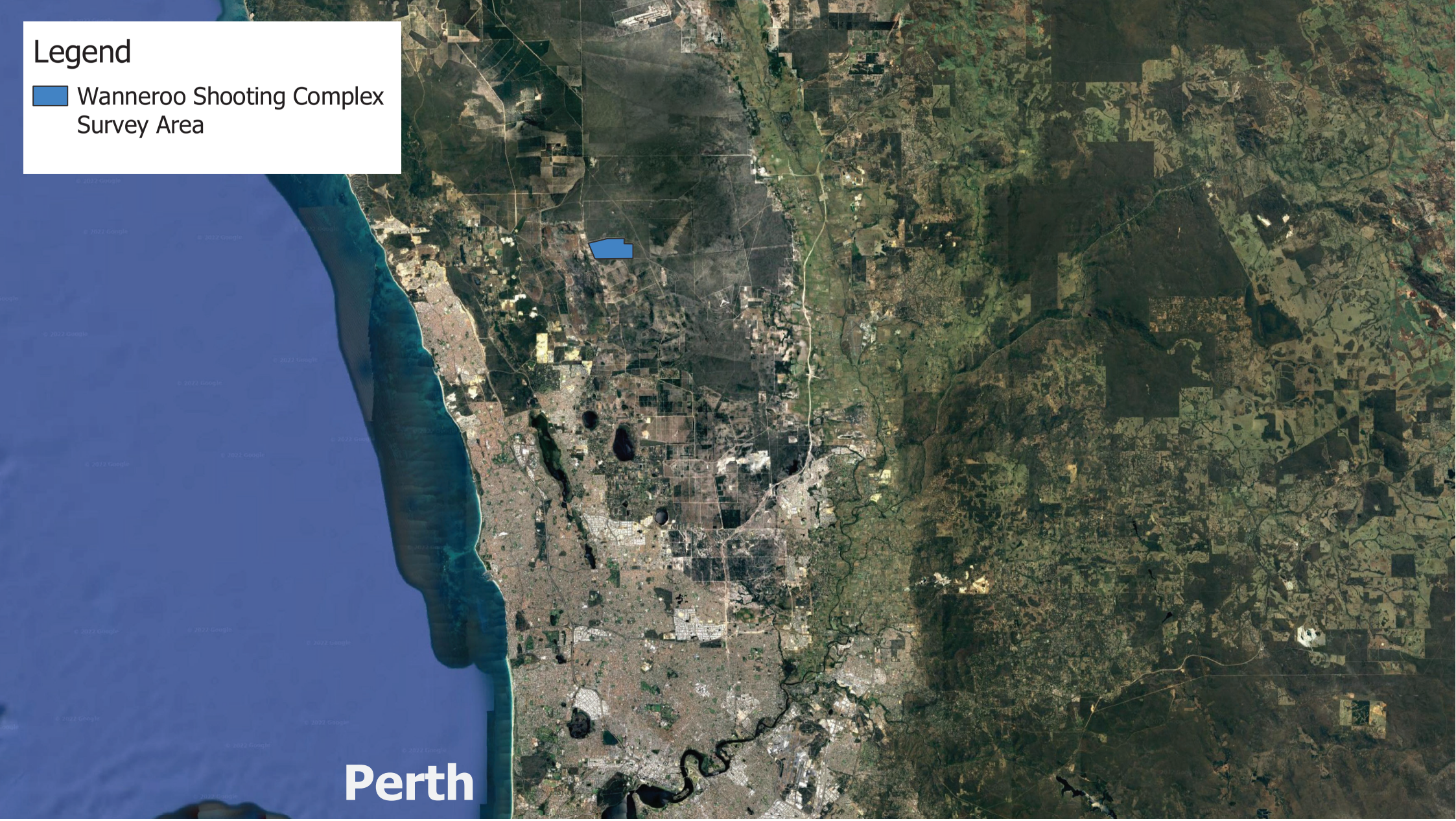
The clearing area is approximately 6 ha and the entire lease area (survey area) is approximately 392 ha and consists of mainly native vegetation with some cleared areas for the current extent of the shooting range, as well as tracks.

1.3 OBJECTIVE AND SCOPE

The purpose of the survey was to identify the flora and vegetation values of the survey area with a focus on the clearing area.

The scope of works included:

- mapping the vegetation types present
- mapping the vegetation condition
- determine the presence of any Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs)
- identification of Threatened and Priority flora populations.



Wanneroo Shooting Complex, Pinjar

Figure 1 Survey Location

Date: 8/11/2022
Author: Z Webber
Projection: UTM MGA Zone 50

0 10 20 km

1:350,000

Anders Environmental Consulting

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 Lists 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 or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. Categories and definitions of Priority Flora and Fauna 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.

Threatened Ecological Communities (TECs) are naturally occurring biological assemblages that occur in a particular type of habitat and that may be subject to processes that threaten to destroy or significantly modify the assemblage across its range. TECs are listed by both state and commonwealth legislation. Vegetation communities in Western Australia are described as TECs if they have been endorsed by the Western Australian Minister for Environment following recommendations made by the TEC Scientific Committee. Categories of TECs are defined in Table 4.

Table 4 Conservation categories of Western Australian TECs

Conservation Code	Category
PD	Presumed Totally Destroyed An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future
CR	Critically Endangered An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
EN	Endangered An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
VU	Vulnerable An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Department of Biodiversity Conservation and Attractions (DBCA) maintain a database of state listed TECs which is available for online searches via their website. Possible TECs that do not meet survey criteria or are not adequately defined are listed as Priority Ecological Communities (PECs) under Priorities 1, 2 and 3. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. Conservation dependent communities are classified as Priority 5. PECs are endorsed by the Minister for Environment; their categories are described in Table 5.

Table 5 Conservation categories of PECs

Conservation Code	Category
P1	Priority One: Poorly known ecological communities. Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g., within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2	Priority Two: Poorly known ecological communities. Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3	Priority Three: Poorly known ecological communities. This includes communities that are: i) known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation, or: ii) known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; iii) made up of large, and/or widespread occurrences, which may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4	Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring, and classified as: i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These communities are usually represented on conservation lands. ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category. iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5	Priority Five: Conservation Dependent ecological communities Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

3.0 METHODOLOGY

3.1 DESKTOP ASSESSMENT

A desktop assessment of available databases and spatial data was undertaken to identify potential conservation significant flora species, Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) within 20 km of the survey area.

The relevant sources of data reviewed during the desktop assessment are listed in Table 6.

Table 6 Information reviewed during the desktop assessment

Source	Databases and reports
Department of Biodiversity Conservation and Attractions (DBCA)	- Threatened and Priority Flora Database and Flora List (DBCA 2022a) - Western Australian Herbarium Specimen Database (DBCA 2022b) - Threatened and Priority Ecological Communities Database (DBCA 2022c)
Department of Climate Change, Energy, the Environment and Water (DCCEEW)	- EPBC Act Protected Matters Search Tool (DCCEEW 2022)

For the TECs, PECs, and conservation significant flora identified during the desktop assessment, their likelihood of occurrence within the survey area was determined based on the criteria outlined in Table 7.

Table 7 Criteria for likelihood of occurrence of conservation significant flora and ecological communities

Likelihood of occurrence	Conservation significant species	Threatened or Priority Ecological Communities
High likelihood to be present	Known populations occur within or adjacent^ to the survey area	TEC/PEC occurs within or adjacent^ to the survey area
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	TEC/PEC occurs within the vicinity^^ of the survey area and similar vegetation may be present within or adjacent to the survey area
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	TEC/PEC does not occur within the vicinity^^ of the survey area and similar vegetation is not present within or adjacent^ to the survey area

^ Adjacent – population or TEC/PEC occurs within 2 km of the survey area
^^ Vicinity – population or TEC/PEC occurs within 10 kms of the survey area

3.2 FLORA AND VEGETATION SURVEY

The flora and vegetation survey involved a detailed spring survey (October 2022) and reconnaissance survey (April 2022) which was undertaken in accordance with Technical Guide – *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a) and Environmental Factor Guideline – Flora and Vegetation (EPA 2016b).

The objective of the survey was to verify the desktop assessment results, characterise the flora and delineate the vegetation present. The survey involved:

- mapping the vegetation types
- mapping the vegetation condition
- compiling an inventory of flora species including weed species
- undertaking a targeted survey for conservation significant flora identified in the desktop assessment.

Data was collected from ten 10 m x 10 m quadrats, 18 relevés, mapping notes, vegetation condition notes, opportunistic flora collections, and observations across the survey area. Quadrats were established within mature intact vegetation and away from disturbed areas with a minimum of three quadrats established within each vegetation type. For each quadrat, the following information was collected:

- Site number
- GPS coordinate from the north-west corner
- Photograph from the north-west corner
- Landform
- Soil description
- Fire history
- Vegetation condition and description of disturbances
- Vegetation structure
- Species present: estimated height and estimated foliage cover.

The survey was conducted by qualified Botanist Catherine Krens (Flora Collection Licence Number FB62000188) and Graduate Botanist Zoe Webber (Flora Collection Licence Number FB62000441) who are experienced with undertaking surveys of similar scope within the Perth metropolitan area and the Swan Coastal Plain. The reconnaissance survey was undertaken between 21st to 22nd April 2022 (Anders 2022) and the detailed survey was undertaken between 3rd and 4th October 2022 (spring). The optimal survey time for the South-West and Interzone Botanical Province is during spring when species flowering is abundant.

Flora unable to be identified in the field were collected for verification and identification with the Western Australian Herbarium specimens. Department of Biodiversity Conservation and Attractions (DBCA) taxonomists were consulted for identification of conservation significant species.

The vegetation types were described using the National Vegetation Information System (NVIS) standard to sub-association level (Commonwealth of Australia 2003). Floristic composition vegetation classification, as recommended in the Environmental Protection Authority (EPA 2016a) guidelines for detailed surveys, was used to analyse species composition within each quadrat.

Multivariate comparative (cluster) analysis was performed to measure the similarity between quadrats.

Vegetation condition was mapped across the survey area and the condition rating used was based on the Keighery (1994) scale which is suitable for the South-West and Interzone Botanical Province in which the survey area occurs. The vegetation condition ratings relate to vegetation structure, the level of disturbance at each structural layer and the ability of the vegetation unit to regenerate (EPA 2016a). The vegetation condition scale is provided in Table 8.

Table 8 Vegetation condition ratings (Keighery 1994)

Vegetation Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered and obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging, and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback, and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback, and grazing.
Completely Degraded	The structure of the vegetation is no longer intact, and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

A targeted survey was conducted for the conservation significant flora species identified in the desktop assessment. The focus of the targeted survey was to search the extent of the clearing area, meandering transects were walked and potential conservation significant species were recorded, and samples collected for verification at the Western Australia Herbarium. Suitable habitat within the wider survey area were also searched.

3.2.1 VEGETATION MAPPING

The vegetation types were described using the National Vegetation Information System (NVIS) standard to level V (Commonwealth of Australia 2003), which describes the three traditional strata (upper, mid, and ground). Vegetation mapping was completed by using QGIS 3.8 software with aerial

imagery and quadrat data used to define vegetation units. Floristic composition vegetation classification, as recommended in the EPA guidelines (2016a) for detailed surveys, was used to analyse species composition within each quadrat.

Statistical analysis of floristic data using statistical package PC-Ord v7.0 was undertaken. Bray-Curtis nearest neighbour hierarchical cluster analysis was run for each quadrat against the comprehensive Keighery (2012) dataset.

To determine the presence of TECs and PECs the Bray-Curtis dissimilarity index was used to identify the most similar Keighery quadrats, and their associated Floristic Community Type (FCT). The Bray–Curtis dissimilarity measure is bounded between 0 and 1, where 0 means the two sites have the same composition (that is they share all the species), and 1 means the two sites do not share any species. The lower the dissimilarity index the more similar sites are. The inverse of the dissimilarity index was used to calculate the percentage similarity of each quadrat to the Keighery sites.

3.2.2 LIMITATIONS

Limitations are common in flora and vegetation 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 9.

Table 9 Limitations of the flora and vegetation survey

Limitation	Determination	Justification
Availability of contextual information at a regional and local scale	**Not a limitation**	All contextual information was available at the time of survey. Database search results and desktop assessment was completed prior to commencing the survey.
Competency/experience of the team conducting the survey, including experience in the bioregion	**Not a limitation**	The surveyor Catherine Krens is a Senior Botanist with over 12 years' experience undertaking flora and vegetation surveys within the Perth metropolitan area and Swan Coastal Plain.
Proportion of flora recorded and collected and any identification issues	**Not a limitation**	A specimen of all flora species recorded was collected for confirmation at the Western Australian Herbarium. All species observed were recorded including opportunistic records outside quadrats.
Effort and extent - was the survey area fully surveyed	**Not a limitation**	The survey area was traversed on foot and vehicle and a detailed flora survey was undertaken across the survey area. All vegetation types were surveyed with a minimum of three quadrats established.
Access restrictions within the survey area	**Not a limitation**	No access issues were encountered.
Survey timing, rainfall, season of survey	**Not a limitation**	The survey was undertaken within spring (October 2022). Several large rainfall events occurred within three months prior to the survey, however, rainfall for the Pinjar area was below the mean rainfall records.
Disturbance that may have affected the results of survey such as fire, flood or clearing	**Minor limitation**	Historically, land on site has been cleared in areas for recreational purposes. The area has a fire history evident by old fire scarring on some trees. No disturbance apart from existing tracks and historically cleared areas were observed. Which is observable but does not impact the results of this flora survey.

4.0 EXISTING ENVIRONMENT

4.1 CLIMATE

The closest long-term Bureau of Meteorology (BOM) weather station with a complete dataset is Gingin Aero Weather Station (Station 009178), located approximately 17.6 km north-east of the survey area. The long-term mean minimum temperature for Gingin Aero Weather Station ranges from 6.5˚C (July) to 17.1˚C (February) (1961 to 2022) and the long-term mean maximum temperature ranges from 18.4˚C (July) to 33.2˚C (January) (1961 to 2022) (Figure 2) (Bureau of Meteorology 2022).

The Gingin Aero Weather Station recorded rainfall in the 12 months prior to the survey (October 2021 to September 2022), which was 74.5 mm above the long-term average of 637.3 mm (Bureau of Meteorology 2022). In the three months prior to the survey (July to September 2022), 361.7 mm of rainfall was recorded, which is 47.2 mm above the long-term average of 314.4 mm for the same period (1961 to 2021) (Bureau of Meteorology 2022). Several large rainfall events occurred within the two months prior to the survey; 4th August 2022 (33.0 mm), 9th August 2022 (32.2 mm), and 16th August 2022 (28.0 mm).

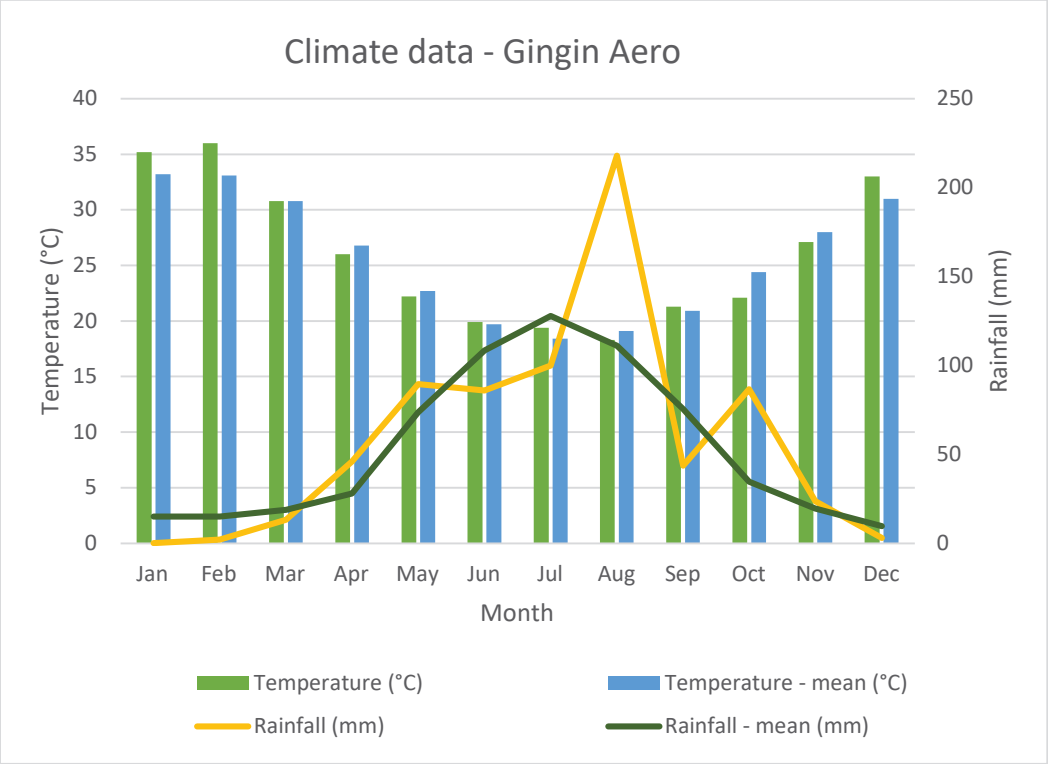


Figure 2 Climate data recorded at Gingin Aero Weather Station (Rainfall and maximum temperature 12 months prior to survey and long-term average) (Bureau of Meteorology 2022).

4.2 IBRA BIOREGION

The survey area occurs within the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion, specifically within the Perth Subregion (SWA02). The Swan Coastal Plain consists of a Warm Mediterranean climate and is low lying, covered mostly by woodlands (Mitchell, Williams, and Desmond, 2002). It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swamplands. To the east, the plain elevates to duricrusted Mesozoic sediments dominated by Jarrah woodland.

The Perth Subregion is comprised of colluvial and aeolian sands, alluvial river flats, and coastal limestone. The limestone deposits support heath and Tuart woodlands, whilst Banksia and Jarrah-Banksia woodlands are found on Quaternary marine dunes of various ages. Marri forests dominate over areas of colluvial and alluvial deposits. The eastern boundary of the Perth Subregion occurs approximately 18 km east of the survey area (Figure 3).

4.3 GEOLOGY AND SOILS

The Swan Coastal Plain is comprised of five major geomorphological elements that run from the west to east: Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain, and Ridge Hill Shelf. These systems are characterised by their geology, topography, vegetation, and soils. The survey area lies within the Bassendean Dune System. This system is of low relief, often with broad swales or relatively flat sand sheets between the low dunes. The soils are comprised of deep grey leached quartz sands. There is one geological unit occurring within the survey area as mapped by the 1:500,000 State interpreted bedrock geology (DPIRD 2022a) (Figure 4):

- Leederville formation: Interbedded sandstone and siltstone; minor conglomerate; scattered thin coal seams

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, 2021b), four soil types occur across the survey area (Figure 5), these include:

- 212Bs__G: Bassendean, Gavin phase (flat or gently undulating landscape)
- 212Bs__Ja: Bassendean, Jandakot phase (Jandakot low dunes)
- 212Bs__J: Bassendean, Joel phase (poorly drained depressions)
- 212Bs__DL: Bassendean drainage lines phase (broad shallow channels, peaty soils)

4.4 VEGETATION

4.4.1 PRE-EUROPEAN 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 particularly within the Perth Metropolitan Region. The EPA has an objective to seek to retain at least 30% of the pre-clearing extent of each ecological community and has a modified objective to seek to retain at least 10% of the pre-clearing extent of each ecological community for defined constrained areas (intensely developed) in the Perth Metropolitan Region (EPA, 2015).

One broad vegetation type is mapped within the survey area (Figure 6), which is above the EPA threshold of 30% pre-European clearing at a state, regional and local level. The vegetation type is described below and its representation at a local, regional, and state level is shown in Table 10.

- **Bassendean 949**: Low woodland; Banksia

Table 10 Broad vegetation types within the state, regional and local representation (DPIRD 2019b)

Vegetation type	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Current extent managed in DBCA lands (%)
Representation across Western Australia (1B)				
Bassendean 949	115,119	69,992	60.80	52.53
Representation across the Swan Coastal Plain Bioregion (2B)				
Bassendean 949	115,119	69,992	60.80	52.53
Representation across the City of Wanneroo (4B)				
Bassendean 949	22,158	10,009	45.17	74.30

4.4.2 VEGETATION COMPLEXES

Vegetation complexes are vegetation associations that are characteristic of various combinations of landform, soil, and rainfall. Vegetation complexes of the south-west of Western Australia have been mapped by Heddle et. al., (1980) at scales of 1:250,000 respectively (Figure 7).

Heddle et al. (1980) has mapped the vegetation within the survey area as:

- Bassendean Complex North: Vegetation ranges from low open forest and low woodland to areas of sedgelands on wetter sites.

4.5 CONSERVATION AREAS

Environmentally Sensitive Areas (ESAs) are declared to prevent degradation of important environmental values such as Threatened flora, TECs or significant wetlands. Exemptions contained in the Environmental Protection (Clearing of Native vegetation) Regulations 2004 for low impact land clearing do not apply in ESAs and a clearing permit is required.

The survey area is located within an ESA (ID: 19528), with additional ESA's located within 10km of the survey area (Figure 8).

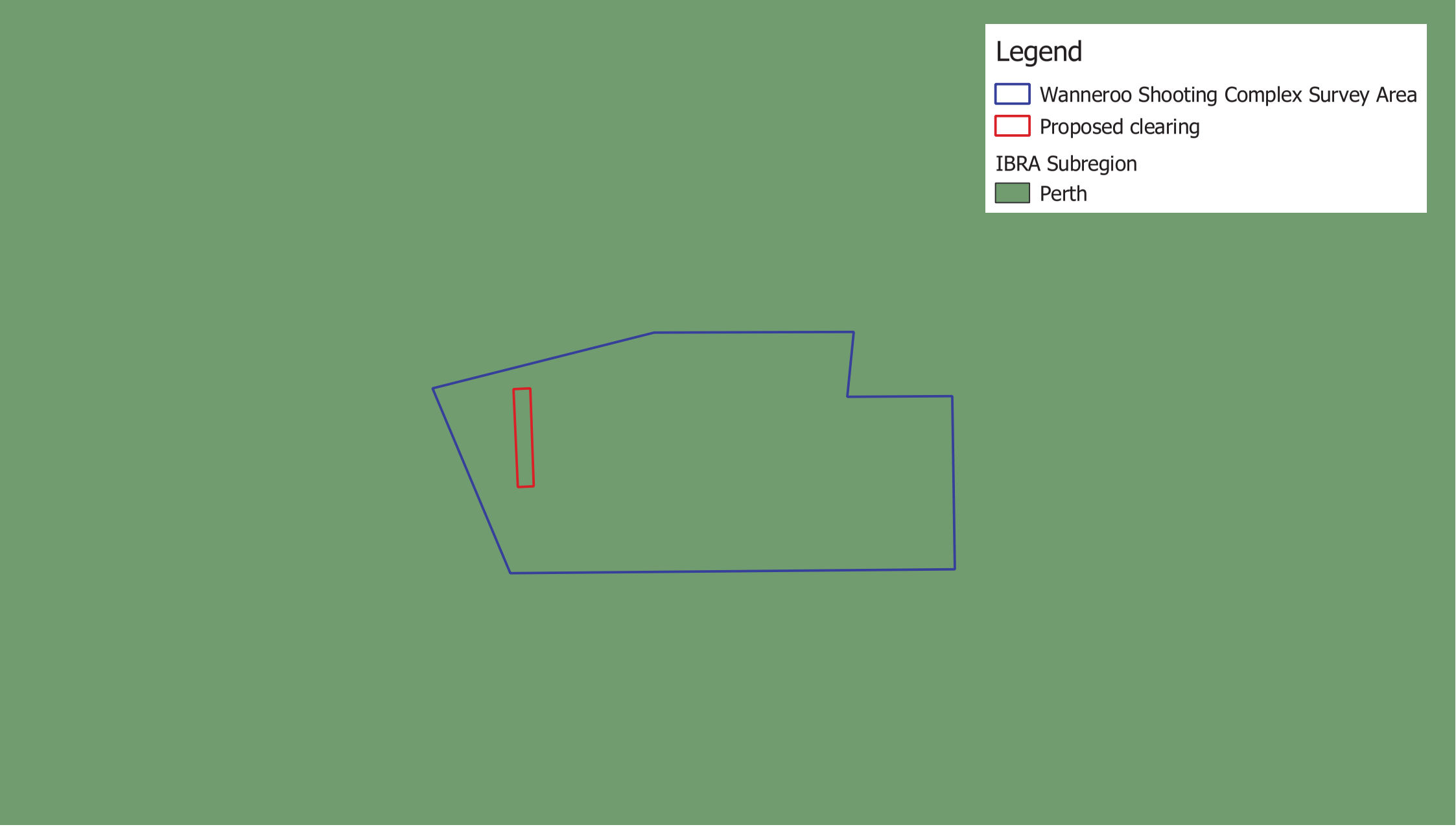
Two National Parks occur within a 15km radius of the survey area:

- Yanchep National Park (11.4km NW)
- Nearabup National Park (9km SW).

Five Nature Reserves occur within a 15km radius of the survey area:

- Yeal Nature Reserve (12.2km N)
- Lake Joondalup Nature Reserve (11.9km SSW)
- Jandabup Nature Reserve (12.3km S)
- Neaves Road Nature Reserve (10.1km SE)
- Nearabup Nature Reserve (8.2km SW).

There is a geomorphic wetland, that runs as part of Lake Pinjar to the West of the survey area. This is a low-lying basin that is subjected to seasonal inundation of the wetland during winter and seasonal drying over summer (Figure 9). This is of multiple use and is not managed under conservation. There are two other wetland areas to the East of the survey area, these are also on a low-lying basin and are categorised as damplands. These two damplands are under Conservation within DBCA (DBCA, 2022d).



Wanneroo Shooting Complex, Pinjar

Figure 3 IBRA Bioregion

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

0 750 1500 m

1:30,000

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Wanneroo Shooting Complex, Pinjar

Figure 4 Geology

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

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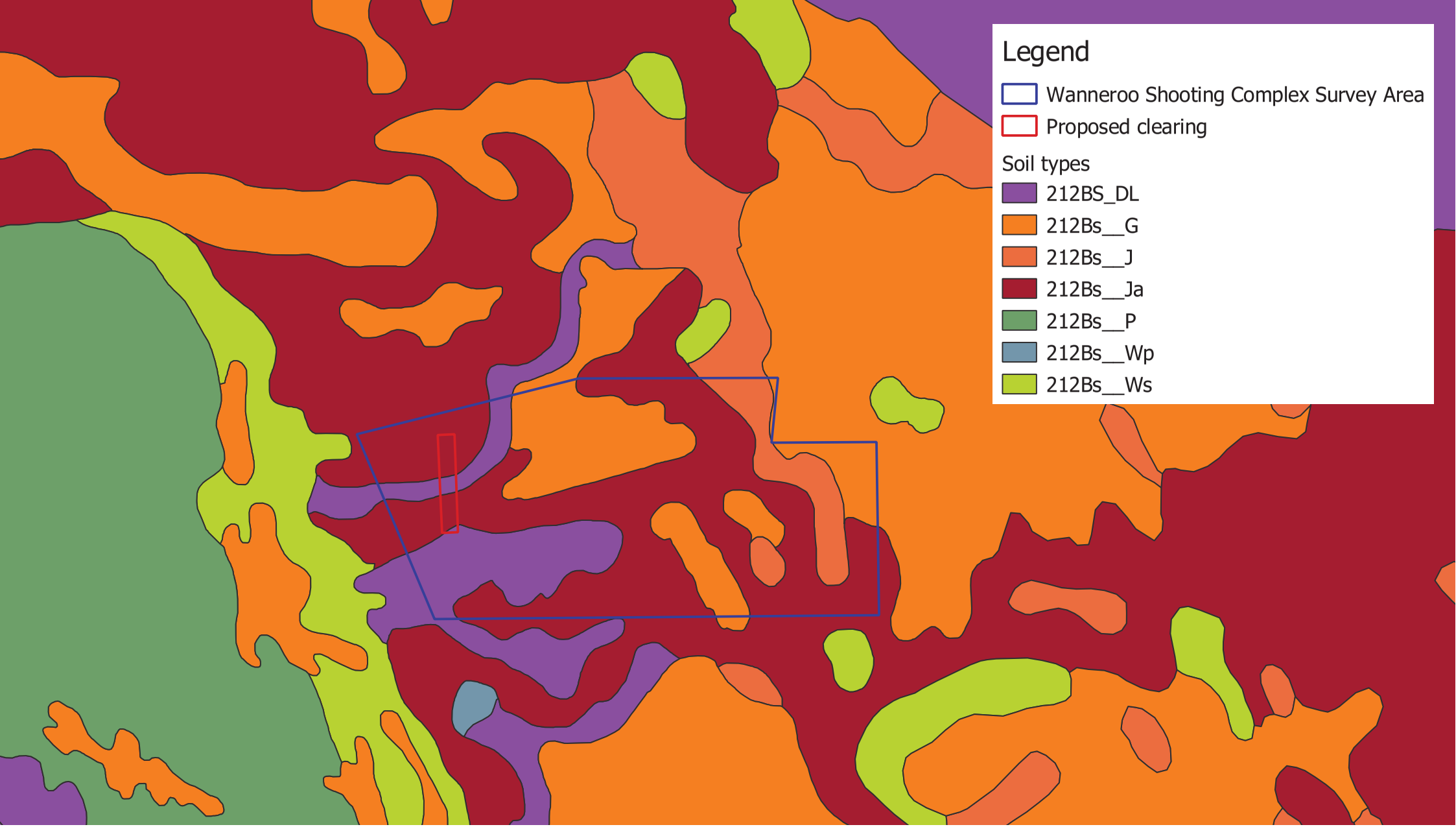

Wanneroo Shooting Complex, Pinjar

Figure 5 Soil types

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

0 750 1500 m

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Wanneroo Shooting Complex, Pinjar

Figure 6 Pre-European Vegetation

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

0 750 1500 m

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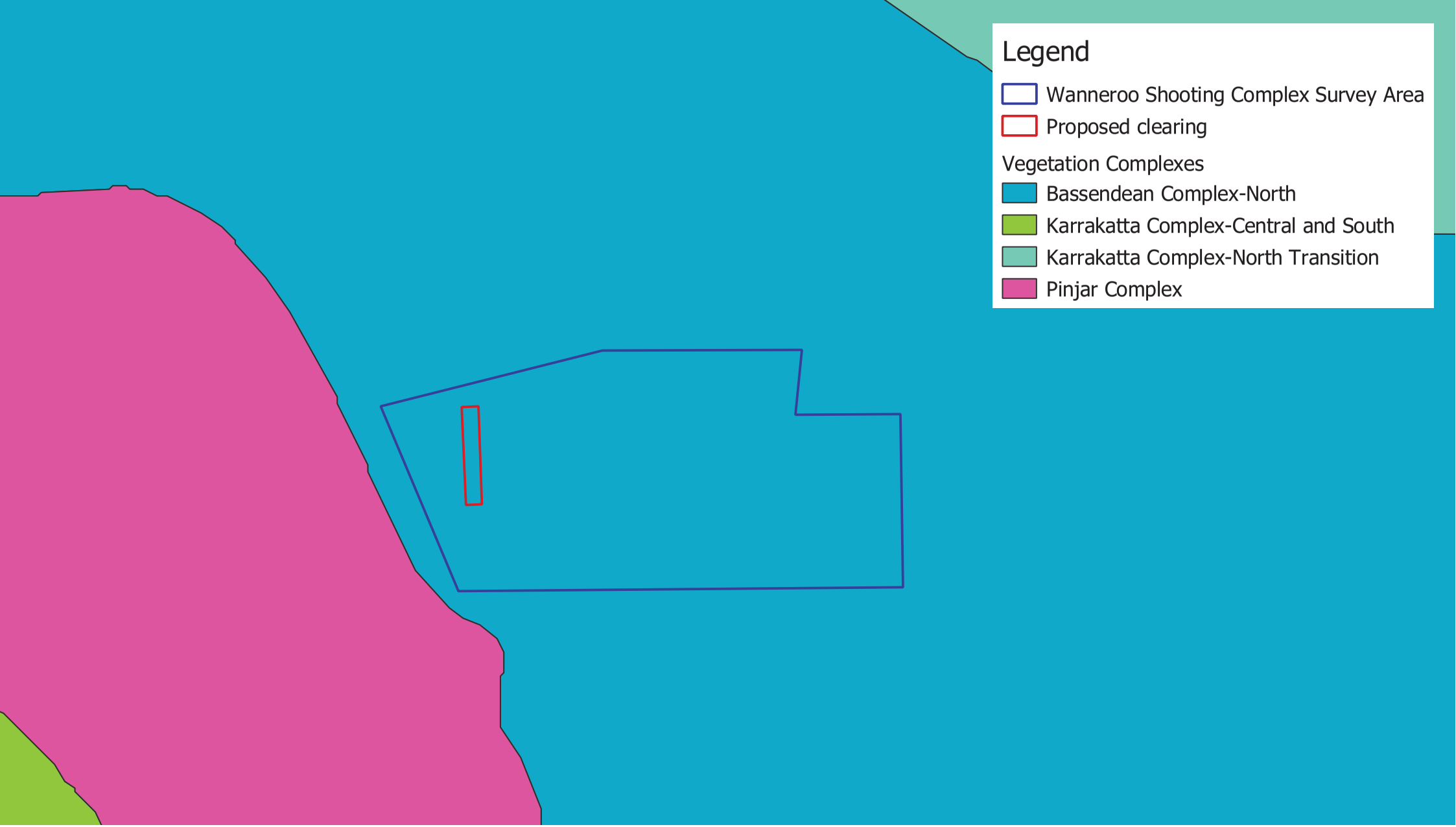

Wanneroo Shooting Complex, Pinjar

Figure 7 Vegetation Complexes of SCP

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

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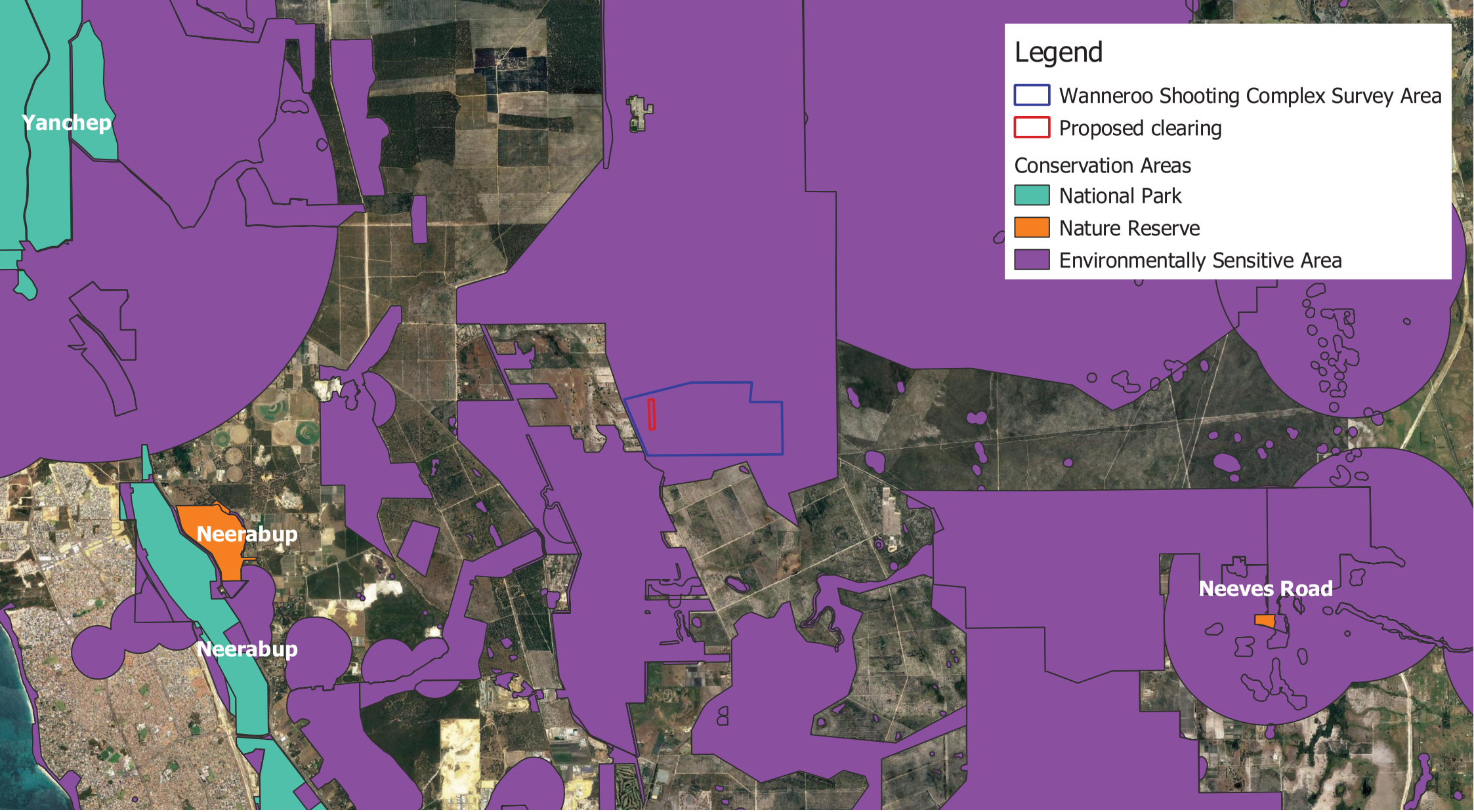

Wanneroo Shooting Complex, Pinjar

Figure 8 Conservation Areas

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

0 2.5 5 km

1:100,000

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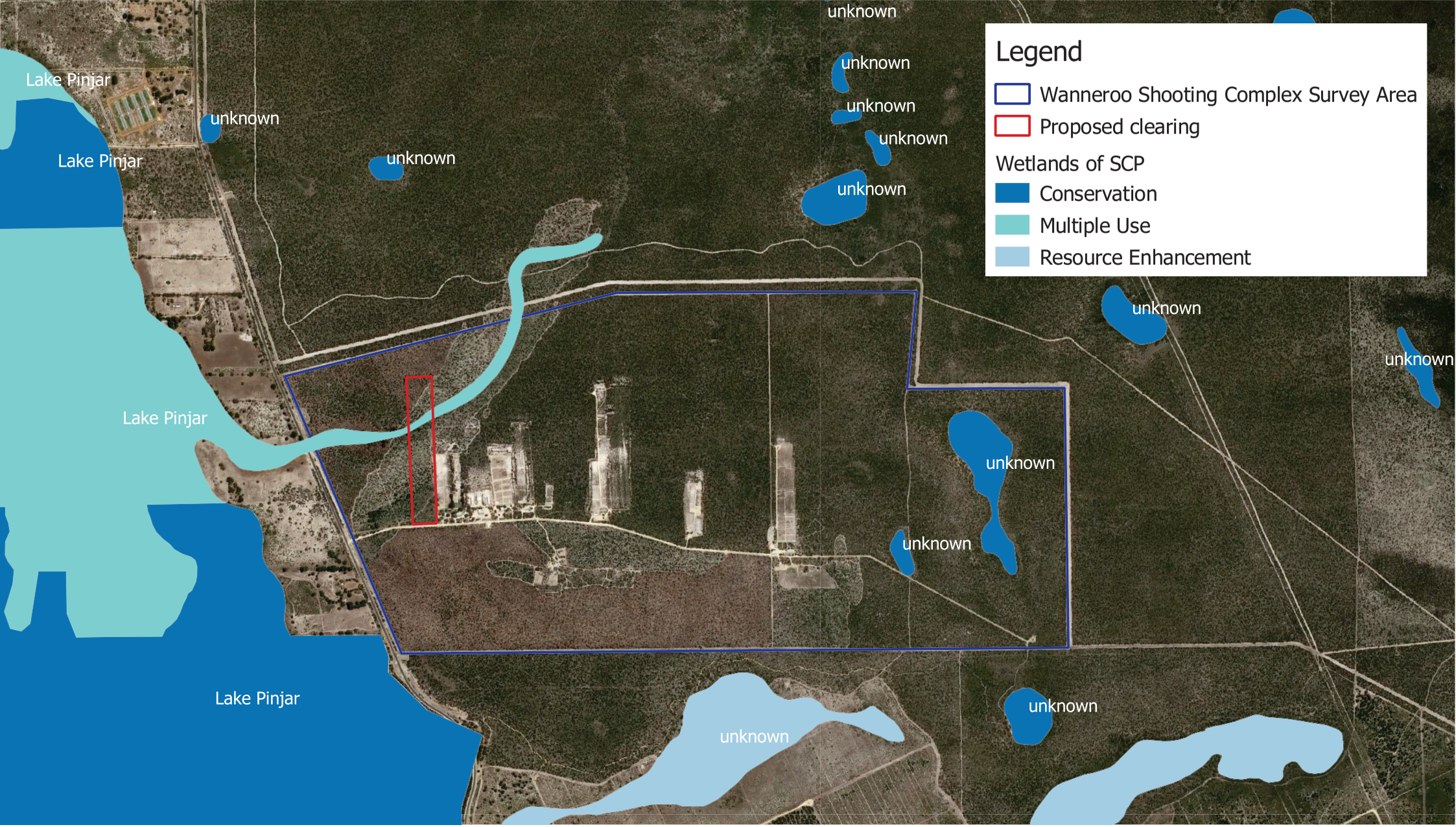

Wanneroo Shooting Complex, Pinjar

Figure 9 Wetlands

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

0 500 1000 m

1:20,000

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5.0 RESULTS

5.1 FLORA

5.1.1 DESKTOP ASSESSMENT

The desktop assessment identified 74 conservation significant flora species occurring within 20 km of the survey area. A break-down of the number of species within each conservation category is provided in Table 11.

Table 11 Number of species within each conservation category identified in the desktop assessment

Conservation status	Commonwealth listed species	State listed species
Critically Endangered	2^	6^^
Endangered	13^	8^^
Vulnerable	7^	8^^
Priority 1		3
Priority 2		10
Priority 3		26
Priority 4		13

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 7. Two species were considered to have a 'High' likelihood of occurrence within the survey area:

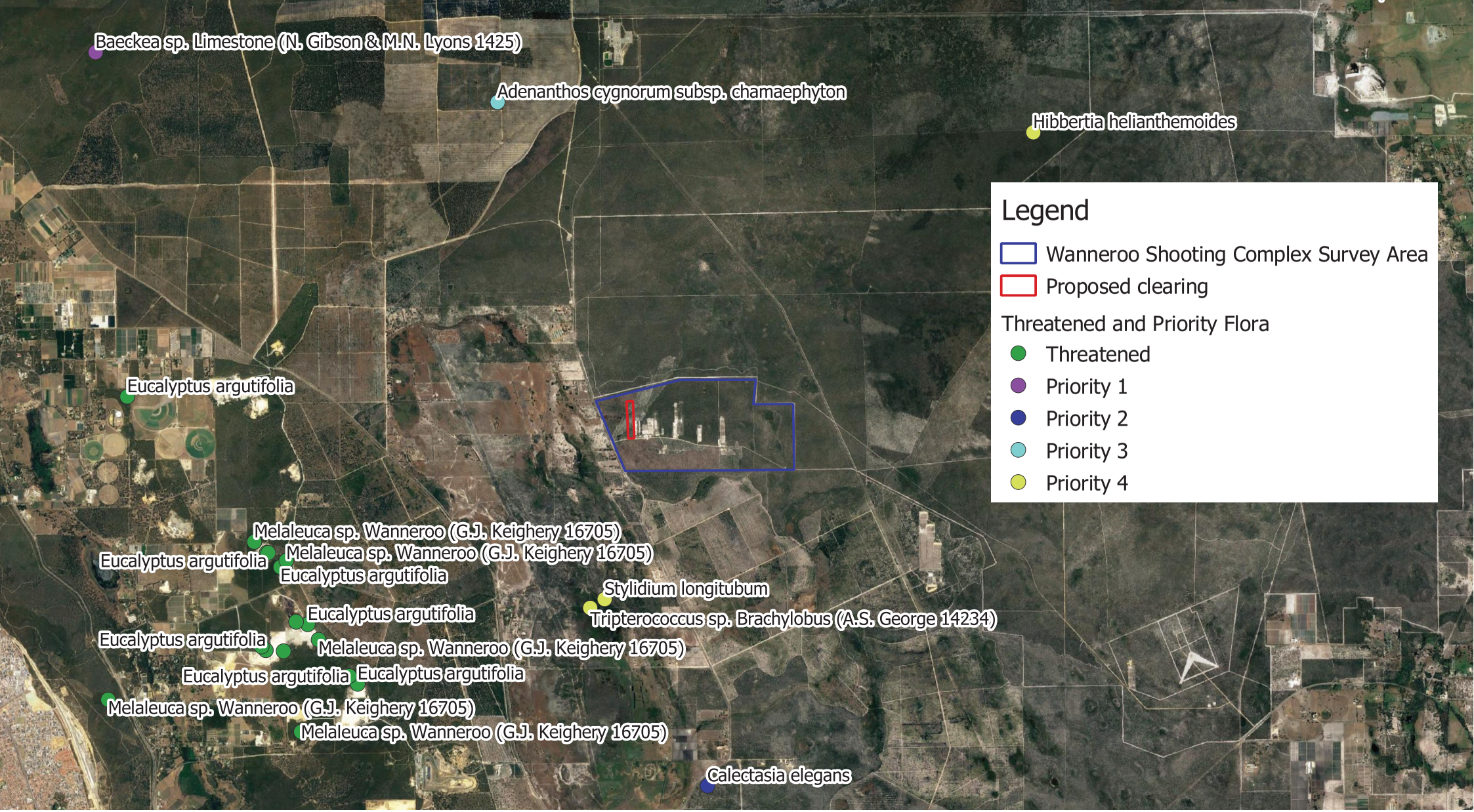
- *Pithocarpa corymbulosa* – Priority 3
- *Stylidium longitubum* – Priority 4

A total of 16 species were considered to have a 'Medium' likelihood of occurrence within the survey area:

- *Acacia benthamii* – Priority 2
- *Adenanthos cygnorum* subsp. *chamaephyton* – Priority 3
- *Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425) – Priority 1
- *Caladenia huegelii* – Endangered (Cwth), Critically Endangered (WA)
- *Calectasia elegans* – Priority 2
- *Eucalyptus argutifolia* – Vulnerable (Cwth and WA)
- *Jacksonia sericea* – Priority 4
- *Leucopogon squarrosus* subsp. *trigynus* – Priority 2
- *Melaleuca* sp. Wanneroo (G.J. Keighery 16705) – Endangered (Cwth and WA)
- *Pimelea calcicola* – Priority 3
- *Poranthera moorokatta* – Priority 2

- *Schoenus griffinianus* – Priority 4
- *Stenanthemum sublineare* – Priority 2
- *Stylidium maritimum* – Priority 3
- *Styphelia filifolia* – Priority 3
- *Tripterococcus* sp. Brachylobus (A.S. George 14234) – Priority 4.

The remaining 56 conservation significant species were considered to have a '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 and the locations of conservation significant populations are mapped in Figure 10.



Wanneroo Shooting Complex, Pinjar

Figure 10 Threatened and Priority Flora Populations

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

0 1 2 3 km

1:80,000

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5.1.2 FLORA SPECIES INVENTORY

A total of 102 vascular flora species from 34 families and 77 genera were recorded within the survey area. This included 88 (86%) locally native species and 14 (14%) introduced or naturalised species. 81 species were classified as perennial (79%) and 21 as annual (21%). Species richness within each quadrat ranged from 19 to 40 species.

The families with the highest species representation were Asteraceae (12 species), Fabaceae (12 species), Myrtaceae (12 species), Proteaceae (9 species), and Ericaceae (6 species). The full list of vascular flora species recorded is presented in Appendix B.

All 102 recorded species were collected for verification and identification at the Western Australian Herbarium. The majority of collected specimens were able to be identified to species level apart from four specimens due to insufficient flowering or fruiting material.

All species recorded within the survey area were endemic to the Swan Coastal Plain and no species occurred outside of their population range.

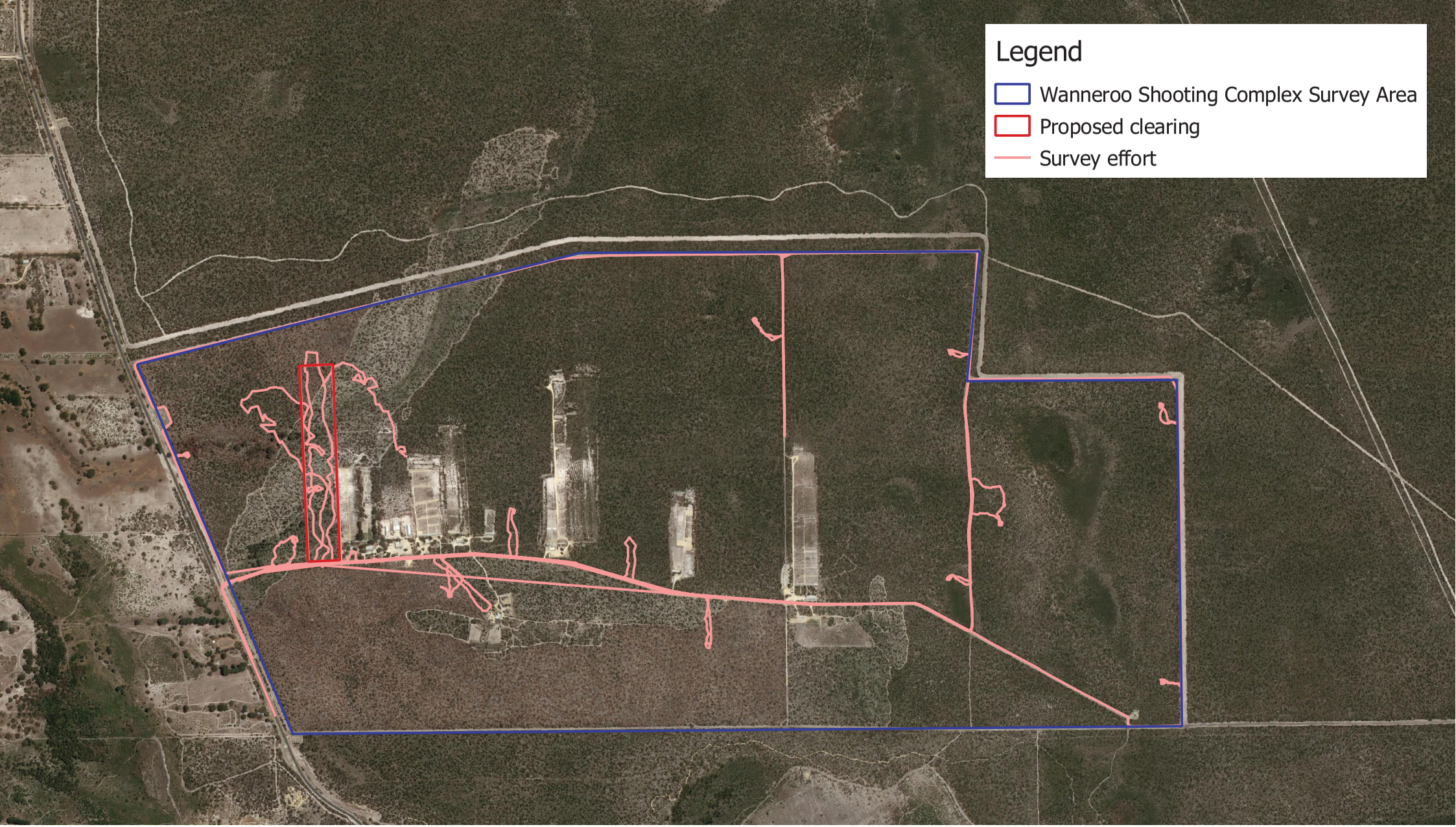
5.1.3 THREATENED AND PRIORITY FLORA

No species listed as Declared Rare Flora or Threatened (T or X) under the BC Act or as Threatened under the EPBC Act were recorded within the survey area. No Priority flora species were recorded within the survey area.

A targeted search was undertaken across the entire clearing area as well as within suitable habitat in the wider survey area for the 74 conservation significant species identified in the desktop assessment, with a focus on species considered to have a 'High' likelihood of occurrence within the survey area. Habitat searched included:

- Outcropping and rocky areas (*Pithocarpa corymbulosa*)
- Seasonally inundated wetter areas (*Stylidium longitubum*).

None of the species recorded within the survey area were of conservation significance. The survey effort is shown in Figure 11.



Wanneroo Shooting Complex, Pinjar

Figure 11 Survey Effort

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

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1:20,000

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5.1.4 WEEDS

A total of 14 introduced (weed) species were recorded within the survey area. None of the weeds are listed as a Declared Pest under the *Biosecurity and Agricultural Management Act 2007* (BAM Act) or Weed of National Significance (WONS).

Of the 14 introduced species Poaceae (grasses) and Asteraceae (daisies) were best represented with 5 species recorded for each family throughout the survey area. A summary of weed species is provided in Table 12.

Weed cover was highest adjacent to tracks, cleared areas and within the shooting ranges and associated infrastructure.

Table 12 Weed species recorded in the survey area

Family	Species	Common name	Status
Asteraceae	*Arctotis stoechadifolia*	White Arctotis	^Permitted
Poaceae	*Briza maxima*	Blowfly Grass	^Permitted
Poaceae	*Briza minor*	Shivery Grass	^Permitted
Poaceae	*Bromus diandrus*	Great Brome	^Permitted
Poaceae	*Bromus hordeaceus*	Soft Brome	^Permitted
Aizoaceae	*Carpobrotus edulis*	Hottentot Fig	^Permitted
Euphorbiaceae	*Euphorbia terracina*	Geraldton Carnation Weed	^Permitted
Iridaceae	*Gladiolus caryophyllaceus*	Wild Gladiolus	^Permitted
Asteraceae	*Hypochaeris glabra*	Smooth Cats-ear	^Permitted
Asteraceae	*Hypochaeris radicata*	Flat Weed	^Permitted
Primulaceae	*Lysimachia arvensis*	Pimpernel	^Permitted
Poaceae	*Pentameris airoides* subsp. *airoides*	False Hairgrass	^Permitted
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	^Permitted
Asteraceae	*Ursinia anthemoides*	Ursinia	^Permitted

^ Permitted under the BAM Act.

5.2 VEGETATION

5.2.1 DESKTOP ASSESSMENT

The desktop assessment identified eleven conservation significant ecological communities and associated buffers occurring within 20 km of the survey area. A break-down of the number of significant ecological communities within each conservation category is provided in Table 13.

Table 13 Number of ecological communities within each conservation category identified in the desktop assessment

Conservation status	Commonwealth	State
TEC – Critically Endangered	2^	2^^
TEC – Endangered	7^	3^^
TEC – Vulnerable	0	0
PEC		6^^

Note: ^some ecological communities are also State listed
^^ some ecological communities are also Commonwealth listed

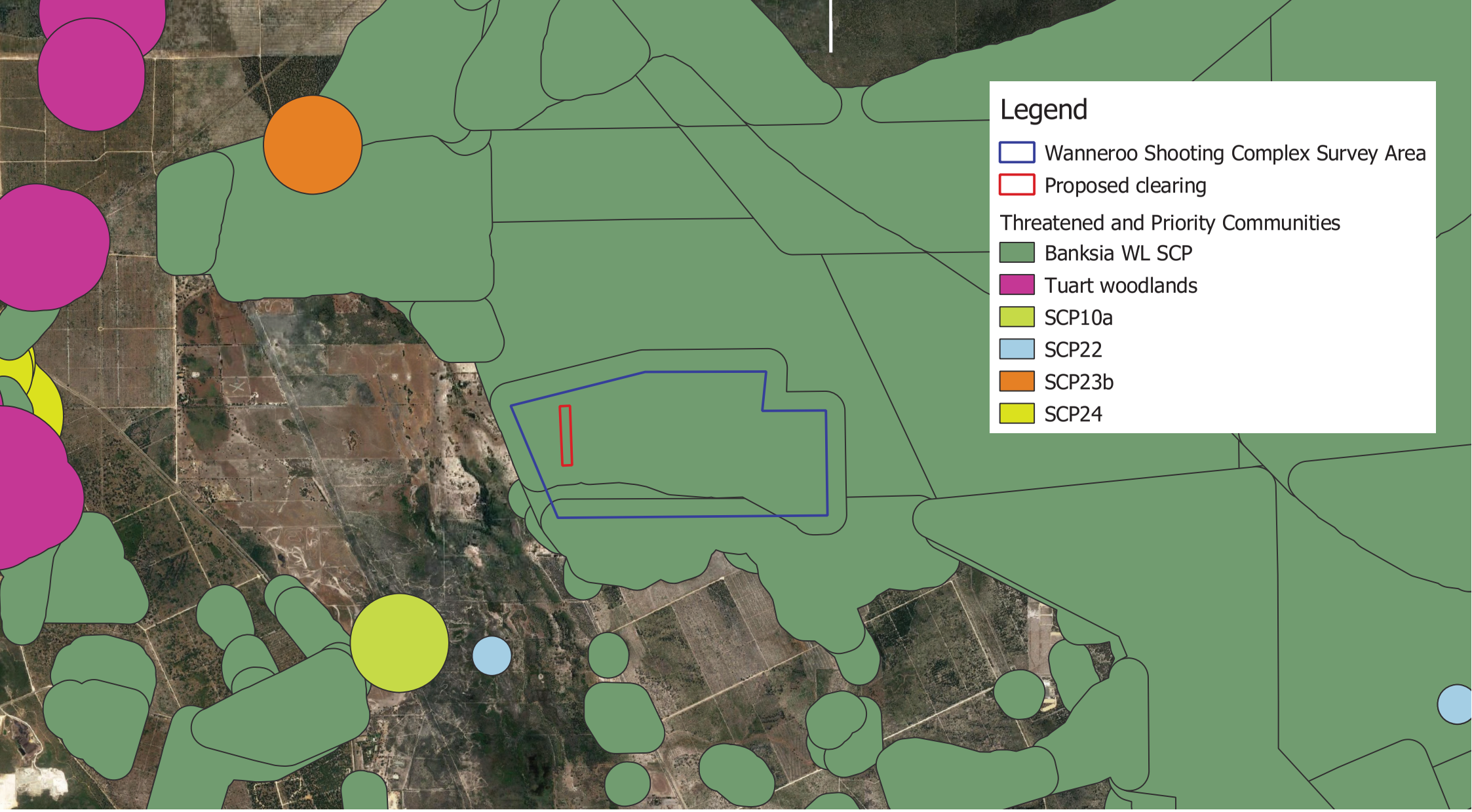
Five significant ecological communities were considered to have a 'High' likelihood of occurrence within the survey area:

- Banksia Woodlands of the Swan Coastal Plain ecological community – Endangered (Cwth), Priority 3 (WA). This community is found *within* the survey area.
- Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community – Critically endangered (Cwth), Priority 3 (WA).
- SCP21c – *Banksia attenuata - Melaleuca preissiana* low-lying woodlands or shrublands, occurs on the Bassendean system – Endangered (Cwth), Priority 3 (WA).
- SCP22 – *Banksia ilicifolia – Banksia attenuata* woodlands, *Melaleuca preissiana* woodlands and scrubs are also recorded, central Swan Coastal Plain – Endangered (Cwth), Priority 3 (WA).
- SCP23b – *Banksia attenuata - Banksia menziesii woodlands,* Swan Coastal Plain– Endangered (Cwth), Priority 3 (WA).

Four significant ecological communities were considered to have a 'Medium' likelihood of occurrence within the survey area:

- SCP10a – Shrublands on dry clay flats with thin skeletal soils – Critically Endangered (Cwth), Endangered (WA).
- SCP20a– *Banksia attenuata* woodlands over species rich dense shrublands, occurs on sands at the base of the Darling Scarp – Endangered (Cwth), Endangered (WA).
- SCP24 – *Banksia sessilis – Calothamnus quadrifidus* heathlands, occurring on deeper soils – Priority 3 (WA).
- SCP26a – *Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges – Endangered (WA).

A full description of all conservation significant ecological communities identified in the desktop assessment is provided in Appendix A and the locations and buffers are mapped in Figure 12.



Wanneroo Shooting Complex, Pinjar

Figure 12 Threatened and Priority Ecological Communities

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

0 1 2 3 km

1:80,000

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5.2.2 VEGETATION TYPES

Multivariate analysis of the ten quadrats was undertaken using the Bray-Curtis distance measure. Sorensen (Bray-Curtis) distance measure is the preferred distance measure for ecological data and is applied to presence-absence data. It retains sensitivity in more heterogeneous data sets and gives less weight to outliers.

The hierarchical cluster analysis dendrograms for the Sorenson distance measure method resulted in similarities between quadrats with two clear groups emerging, these represented the vegetation types (Table 14). The species occurring within each vegetation type is displayed in Appendix C. The hierarchical cluster dendrogram is provided in Appendix D.

Table 14 Distance measures and similarity percentage between quadrats and determined vegetation types

Quadrat	Closest sites	Distance measure	% Similarity	Determined vegetation type
NR01	NR10	0.3243	68%	VT1
	NR08	0.3429	66%	
	NR20	0.3429	66%	
NR06	NR08	0.2353	76%	VT1
	NR10	0.3056	69%	
	NR24	0.3333	67%	
NR08	NR10	0.2222	78%	VT1
	NR06	0.2353	76%	
	NR24	0.2754	72%	
NR10	NR24	0.2055	79%	VT1
	NR08	0.2222	78%	
	NR12	0.2958	70%	
NR12	NR10	0.2958	70%	VT1
	NR08	0.3134	69%	
	NR24	0.3529	65%	
NR19	NR29	0.5	50%	VT2
	NR10	0.5789	42%	
	NR26	0.5918	41%	
NR20	NR08	0.3235	68%	VT1
	NR10	0.3333	67%	
	NR01	0.3429	66%	
NR24	NR10	0.2055	79%	VT1
	NR08	0.2754	72%	
	NR06	0.3333	67%	
NR26	NR29	0.3617	64%	VT2
	NR10	0.5294	47%	
	NR06	0.5312	47%	
NR29	NR26	0.3617	64%	VT2
	NR19	0.5	50%	
	NR20	0.6471	35%	

Three vegetation types were present across the survey area. Vegetation type VT1 consisted of a mosaic of burnt (estimated to be greater than 5 years) and unburnt areas and have been mapped according to burn scars identified within the aerial imagery:

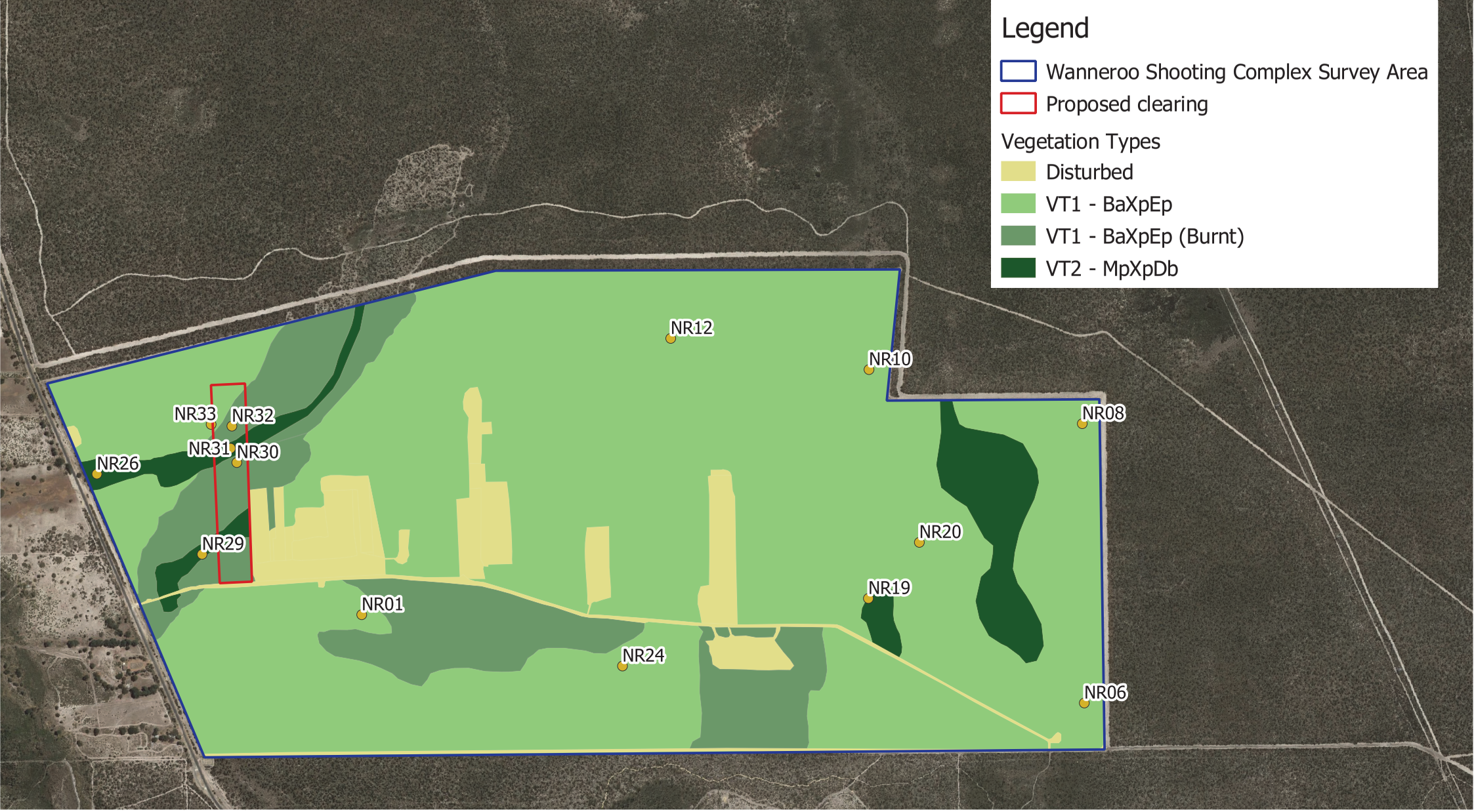
- VT1 – BaXpEp: *Banksia* open woodland (287.875 ha: 0.809 ha within clearing area, 287.066 ha outside clearing area)
- VT1 Burnt – BaXpEp: *Banksia* open woodland (51.54: 4.092 ha within clearing area, 47.448 ha outside clearing area)
- VT2 – MpXpDb: *Melaleuca* dampland (21.432 ha: 1.118 ha within clearing area, 20.314 outside clearing area).

Vegetation type VT1 BaXpEp – burnt was the most dominant vegetation type within the clearing area occupying over half (68%) of the clearing area. VT1 (unburnt) was the most dominant vegetation type outside the clearing area. A full description of the vegetation types is provided in Table 15 and mapped in Figure 13. Quadrat data is provided in Appendix E.

Table 15 Vegetation types recorded in the survey area

Code	Description	Details	Representative photograph
BaXpEp	*Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* low sparse shrubland.	Vegetation type: VT1 Distributed throughout most of the survey area. Mapped during the reconnaissance survey as VT3. Species richness: 33 to 40 Sites: NR06, NR08, NR10, NR12, NR20, NR24 Area: 287.875 ha, 73%: 0.809 ha within clearing area, 287.066 ha outside clearing area	
BaXpEp – Burnt	*Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* low sparse shrubland.	Vegetation type: VT1 - burnt Occurring in large patches throughout the survey area and across the majority of the clearing area representing old burn scars estimated to be more than 5 years. Floristic composition was the same as the unburnt areas. Mapped during the reconnaissance survey as VT1. Species richness: 33 to 40 Sites: NR01, NR30, NR32, NR33 Area: 51.5 ha, 13%: 4.09 ha within clearing area, 47.4 ha outside clearing area	

Code	Description	Details	Representative photograph
MpXpDb	*Melaleuca preissiana* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Dasypogon bromeliifolius* low sparse forbland	Vegetation type: VT2 Located in discreet areas in the Eastern and Western sections of the survey area. Corresponds to mapped wetlands (see Figure 9) including Lake Pinjar (Multiple Use) which occurs within the clearing area. Species richness: 19 to 28 Sites: NR19, NR26, NR29 Area: 21.4 ha, 5%: 1.1 ha within clearing area, 20.3 ha outside clearing area.	
Disturbed	Areas mostly cleared of native vegetation for the existing shooting range and access tracks in Completely Degraded condition	Tracks and historical clearing for the existing shooting range in the centre of the survey area. Area: 31.4 ha, 8%	
Total		**392 ha**	



Wanneroo Shooting Complex, Pinjar

Figure 13 Vegetation Types

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

0 250 500 m

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5.2.3 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

The Keighery (2012) dataset was used to determine if the quadrats aligned with any of the floristic community types (FCTs) and corresponding TECs and PECs. The Sorensen distance measure was used to compare the floristic data within each quadrat to the larger Keighery (2012) dataset with the 25 closest aligned Keighery sites selected to produce a dendrogram (Appendix D).

The analysis showed that the quadrats aligned with three Keighery FCTs (Table 16). Similarity between quadrats and closest aligned FCTs ranged between 32% to 59%. Two of the FCTs represent PECs; SCP21c and SCP23b.

Site	Keighery sites (2012) with closest affinity to survey areas sites	% Similarity (dissimilarity index)	Inferred FCT	TEC or PEC
NR01	ELE28	51% (0.492537)	SCP23b	PEC
NR06	ELE17	47% (0.534247)	SCP23b	PEC
NR08	ELE17	47% (0.534247)	SCP23b	PEC
NR10	ELE28	51% (0.492958)	SCP23b	PEC
NR12	MP08	49% (0.507246)	SCP23b	PEC
NR19	ELE07	40% (0.6)	SCP4	No
NR20	ELE25	42% (0.578947)	SCP21c	PEC
NR24	ELE28	46% (0.536232)	SCP23b	PEC
NR26	ELE07	45% (0.548387)	SCP4	No
NR29	ELE07	32% (0.68)	SCP4	No

Quadrats NR01, NR06, NR08, NR10, NR12 and NR24, which were determined to be VT1 - BaXpEp, aligned with PEC SCP23b. A total of 4.901 ha occurred within the clearing area.

One VT1 - BaXpEp quadrat, NR20, aligned with PEC SCP21c. This quadrat occured outside the clearing area.

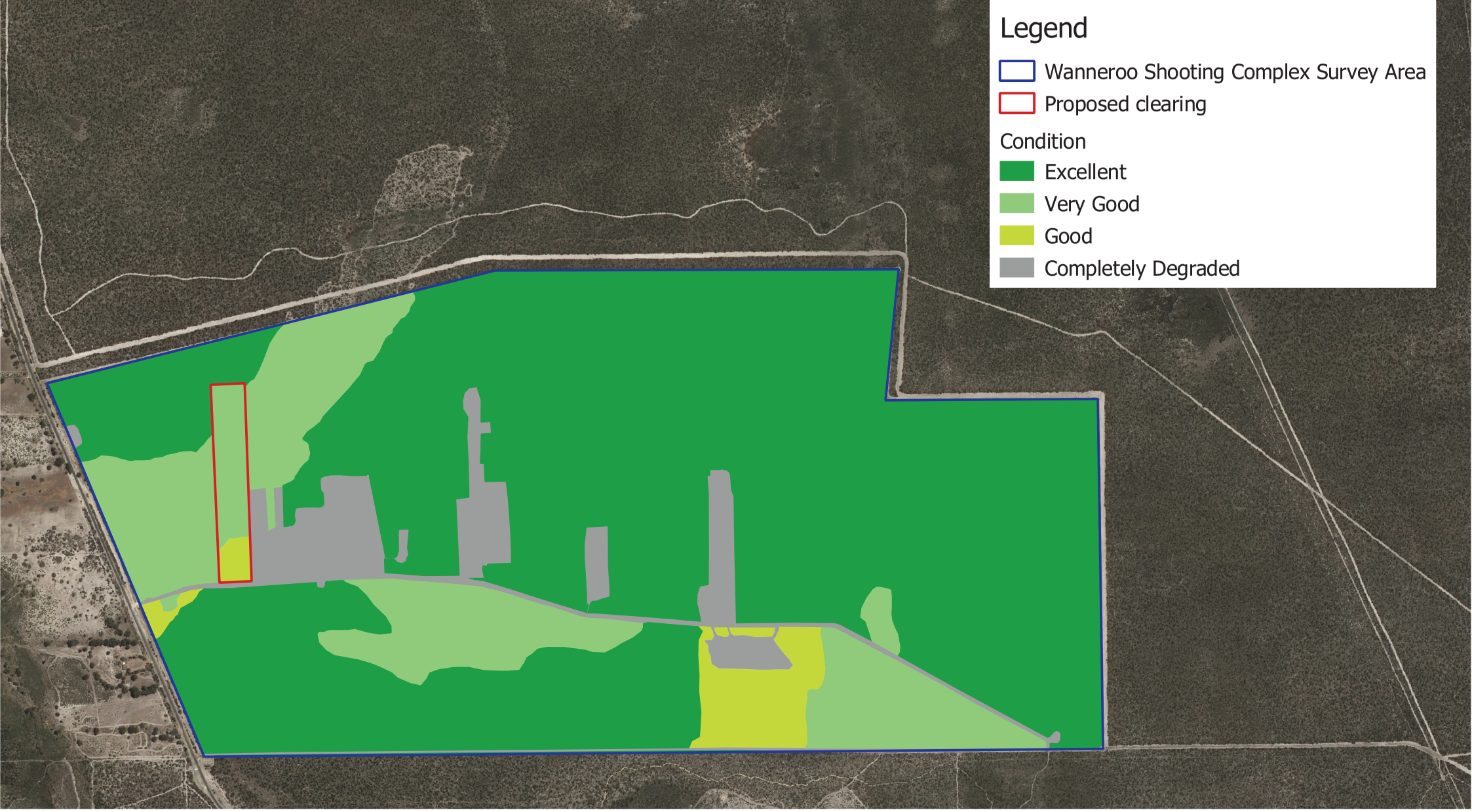
All VT2 - MpXpDb quadrats, NR19, NR26 and NR29, aligned with SCP4 which is not a TEC or PEC.

5.2.4 VEGETATION CONDITION

The vegetation condition of the survey area ranged from Completely Degraded to Excellent with most of the survey area mapped as Excellent, covering over 71% of the area. The clearing area was mostly in Very Good condition (79% of the clearing area). Disturbance was present along tracks and cleared areas for the existing shooting range. In these areas high weed cover was present. Condition in these areas was mapped as Completely Degraded. The vegetation condition within the survey area is outlined in Table 17 and mapped in Figure 14.

Table 17 Vegetation condition categories within the survey area

Condition scale	Clearing area (ha)	Outside clearing area (ha)	Total survey area (ha)
Excellent	0	280.482	280.482
Very Good	4.78	62.637	67.417
Good	1.239	11.708	12.947
Completely Degraded	0	31.416	31.416
Total	**6.019**	**386.243**	**392.262**



Wanneroo Shooting Complex, Pinjar

Figure 14 Vegetation Condition

Date: 17/12/2022
Author: C Krens
Projection: UTM MGA Zone 50

0 250 500 m

1:15,000

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6.0 DISCUSSION

6.1 FLORA

The detailed flora and vegetation survey was undertaken during spring in October 2022, which is the peak survey period for the Swan Coastal Plain. Most species were flowering or beginning to fruit which assisted in identification of species, apart from four species Asteraceae sp. (1, 2), Ericaceae sp. 1 and Orchidaceae sp. 1, which were sterile and could only be identified to genus level. All four undetermined species were confirmed to not represent any conservation significant species.

The detailed flora survey and targeted search did not find any conservation significant flora populations within the clearing area or wider survey area including *Pithocarpa corymbulosa* and *Stylidium longitubum* which were considered to have a high likelihood of occurrence. One species, *Stylidium schoenoides*, was considered initially to be *Stylidium maritimum* (Priority 3) which was considered to have a 'Medium' likelihood of occurrence. The two Stylidium species have a similar flower colour (white) and leaf form. Key differences in floristic characters are a distinctive wavy petal edge and several pink dots on the petal base, and membranous scales on leaves.

A higher-than-average rainfall leading up to the survey may have contributed to high annual representation of 21% (21 species). Most of the annual species were recorded along tracks and within disturbed areas such as the cleared areas around the shooting ranges. Species within quadrats were representative of Banksia woodlands and Melaleuca wetlands common within the Swan Coastal Plain and none of the species recorded were outside their known population range (Plate 1).

Plate 1 Floral diversity at Wanneroo Shooting Range a) *Banksia menziesii* b) *Eremaea pauciflora* and c) *Petrophile linearis*

6.2 VEGETATION

The vegetation of the survey area is representative of the Swan Coastal Plain, which is characterised by *Banksia* on sandy soils and *Melaleuca* in swamplands/damplands (Mitchell, Williams, and Desmond, 2002). VT1 (BaXpEp) is dominated by *Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* and *Eremaea pauciflora* low shrubland. This vegetation type occupied the greatest range of the survey area, at 287.875 hectares. Fires have occurred within the survey area which has resulted in a mosaic of burn scars within VT1 with the most recent fires estimated to have occurred within the last five years. The initial reconnaissance survey mapped the burnt areas as VT1 – Banksia Woodland and unburnt areas as VT3 – Banksia Woodland. The statistical analysis did not however separate the floristic composition of the burnt and unburnt areas of VT1. Condition within the burnt areas was lower (mainly Very Good) and understorey structure was altered with a greater number of weeds present. Aerial imagery clearly showed the extent of the fire scars and therefore it was considered important to separate VT1 into burnt and unburnt areas. A total of 0.809 ha of VT1 (unburnt) and 4.092 ha of VT1 – burnt occurs within the clearing area.

Several areas of potential *Phytophthora cinnamomi* were identified within this vegetation type, with characteristic evidence of *Banksia*'s dying back (Plate 2). This was noted in the northern and eastern areas of the survey area in proximity to existing cleared tracks for vehicle access. The microscopic plant pathogen lives in the soil and infested plant material and can be spread by any mechanism in which infested soil, plant material, or water is moved into uninfected areas. Whilst it can spread by root-to-root contact, human activities such as clearing with any mechanised equipment have the capacity to move it faster than any other means of spread (DBCA, 2020). Consequently, vehicles and equipment need to remain free from any infested plant material and soil to restrict the spread across the survey area.

Plate 2 Potential *Phytophthora cinnamomi*

The second vegetation type across the survey area is characterised as *Melaleuca preissiana* open woodland, with subdominants *Xanthorrhoea preissii* and *Dasypogon bromeliifolius* (VT2: MpXpDb). This was also mapped as VT2 – Melaleuca Woodland during the reconnaissance survey. This is also

characteristic of the Swan Coastal Plain, with *Melaleuca preissiana* damplands situated on Bassendean land system. This community is diverse and dense shrubs grow in soils that are saturated for short periods in winter (Gibson et al. 1994). A total of 1.118 ha of VT2 occurs within the clearing area.

An additional vegetation type; VT4 – Tuart Woodland, was mapped during the initial reconnaissance survey. Quadrat NR26 was established within this initial mapping and was confirmed to be VT2 – MpXpDb with no Tuart trees recorded within or near the quadrat. Tuart trees were recorded within a disturbed area adjacent to existing ranges. It is difficult to determine if the tuart trees are natural or planted as no Tuarts were recorded in any other section of the survey area including the clearing area.

The survey area contains several cleared areas for the existing shooting range mainly adjacent to the west- southeast central track. These were classified as Completely Degraded. In the surrounding areas vegetation was mostly classified as Good to account for disturbances such as weeds and nearby clearing. However, some of the surrounding vegetation was noted as Very Good to Excellent.

Species richness was higher within VT1 (33-40) compared to VT2 (19-28). Several factors may have contributed to the difference in species richness including the frequency of weeds and the structural composition. Seasonal wetlands have already been noted to have lower species richness than other communities in the Swan Coastal Plain (Gibson et al. 1994). Weed frequency is also moderately higher in these communities, which impacts the level of species richness. VT2 had a higher incidence of *Pentameris airoides* subsp. *airoides*, *Lysimachia arvensis*, *Hypochaeris radicata, Briza minor*, and *Bromus diandrus* compared to VT1. As a result, the percentage of weeds as a proportion of total species richness is quite high.

Two conservation listed damplands (seasonally waterlogged) occur on the Eastern corner of the survey area. One of our sample sites (NR19; Plate 3) occurred within one of these listed damplands, which was classified as VT2 (*Melaleuca preissiana* dampland). The condition in this site was very good, with slight disturbances of weed and old fire damage. The other two sites that occur in this vegetation type occur on the Western boundary of the survey area, with NR26 connecting with the extent of Lake Pinjar (classified as a multiple use sumpland). These sites are subject to seasonal inundation during winter when rainfall is high.

Plate 3 Site NR19 in area of conservation listed dampland

Vegetation mapping was undertaken by running multivariate statistical analysis on the quadrats. The Sorensen (Bray–Curtis) distance measure showed a strong alignment (50% to 79% similarity) between sites with two clear groups emerging all with a minimum of three sites per vegetation type and therefore meeting the requirements of the EPA guidelines. Sorensen grouped seven sites (NR01, NR06, NR08, NR10, NR12, NR20, NR24) into a supergroup with a similarity of >68% which was combined to form VT1. Sorensen grouped the remaining three sites (NR19, NR26, NR29) with a lower similarity >50% making up VT2.

Several TECs and PECs were identified in the desktop assessment. Statistical analysis was undertaken to determine their presence in the survey area. Each site was individually run against the Keighery (2012) dataset which returned an alignment (32% to 51%) with three FCTs, of which, two are PECs; SCP21c and SCP23b. All VT1 quadrats aligned with SCP23b, with one VT1 quadrat, NR20, also aligning with SCP21c. VT2 quadrats aligned with SCP4 which are not listed as a TEC or PEC.

The Commonwealth listed Banksia Woodlands of the Swan Coastal Plain ecological community TEC corresponds to several Banksia dominated state listed Threatened and Priority Ecological Communities including SCP21c and SCP23b. Based on the occurrence of these PECs the Banksia Woodlands of the Swan Coastal Plain also occurs within the survey area and represents 339.415 ha (VT1 and VT1 burnt), of which 4.901 ha occurs within the clearing area.

FCT SCP21c - Low lying Banksia attenuata woodlands or shrublands (Priority 3)

This FCT occurs on Bassendean systems between Gingin and Bunbury occupying low lying wetter sites dominated by *Melaleuca preissiana, Banksia attenuata, B. menziesii, Regelia ciliata, Eucalyptus marginata* (Jarrah) or *Corymbia calophylla* (Marri) (Gibson et. el., 1994). One quadrat, NR20, is aligned with a similarity of 42%. NR20 is also aligned with FCT SCP23b, also a PEC, with the same similarity of 42%. NR20 is located between two wetlands and may represent a transitional site where it contains a combination of Banksia upland species (VT1) and species associated with wetter sites including *Melaleuca preissiana*.

FCT SCP23b - Swan Coastal Plain Northern Banksia attenuata - Banksia menziesii woodlands (Priority 3)

FCT SCP23b is restricted to the Bassendean system from Melaleuca Park to Gingin. It comprises of intact Banksia woodlands which still remain north of Perth (Gibson et. al., 1994). All seven VT1 quadrats strongly aligned (42% to 51%) with this FCT which is most likely due to similar floristic composition of the quadrats to the Keighery sites, particularly the Keighery Ellenbrook sites (ELE17, ELE25, ELE28).

Approximately 6 ha is proposed to be cleared on the western side of the existing shooting ranges. The proposed clearing will involve clearing approximately 4.901 ha of Very Good condition VT1 - BaXpEp (burnt and unburnt) which was determined to be PEC - SCP23b - Swan Coastal Plain Northern Banksia attenuata - Banksia menziesii woodlands. The clearing does occur within 0.496 ha of the Lake Pinjar multiple use wetland in Very Good condition. No Threatened or Priority flora populations were recorded within the proposed clearing area.

7.0 CONCLUSION AND RECOMMENDATIONS

An autumn reconnaissance survey and detailed spring flora and vegetation survey was completed for the survey area in April and October 2022. A summary of the flora and vegetation values is provided below:

- Flora:
    - No Threatened or Priority flora were recorded
    - No Declared Plants or WONS recorded
    - 74 conservation significant flora identified in the desktop assessment, two were considered to have a high likelihood of occurrence - *Pithocarpa corymbulosa* (Priority 3) and *Stylidium longitubum* (Priority 4)
    - A total of 102 flora species recorded including 88 (86%) locally native species and 14 (14%) introduced species.

- Vegetation:
    - Eleven TECs and PECs within 10km of the survey area were identified in the desktop assessment, five were considered to have a high likelihood of occurrence in the survey area (each classified as TECs and PECs).
    - Three vegetation types are present – two Banksia woodlands and one Melaleuca woodlands
    - One TEC present within the clearing area - Banksia Woodlands of the Swan Coastal Plain (Endangered) representing 4.901 ha
    - One PEC present within the clearing area – SCP23b Low lying Banksia attenuata woodlands or shrublands (Priority 3) within the clearing area also representing 4.901 ha
    - One PEC present outside the clearing area in the wider survey area – SCP21c Swan Coastal Plain Northern Banksia attenuata - Banksia menziesii woodlands (Priority 3)
    - Condition was mainly Very Good in the clearing area
    - One multiple use wetland – Lake Pinjar representing 0.496 ha.

The following recommendations from the outcome of the assessment are made:

- Avoid clearing vegetation type VT1 which represents Banksia Woodlands of the Swan Coastal Plain TEC and Swan Coastal Plain Northern Banksia attenuata - Banksia menziesii woodlands PEC
- Minimise clearing Very Good - Excellent condition vegetation where possible.

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APPENDIX A DESKTOP ASSESSMENT RESULTS

Results of the desktop assessment are presented below.

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

Species	Conservation status		V	Habitat	Distance to survey area	Likelihood
	Cwth	WA				
Acacia anomala	VU	VU	August to September	Lateritic soils. Slopes.	11.6 km	Low
Acacia benthamii		P2	August to September	Sand. Typically, on limestone breakaways.	6.2 km	Medium
Acacia drummondii subsp. *affinis*		P3	July to August	Lateritic gravelly soils.	16 km	Low
Adenanthos cygnorum subsp. *chamaephyton*		P3	July or September to December or January	Grey sand, lateritic gravel.	5.2 km	Medium
Amanita carneiphylla		P3		In deep sand. Banksia woodlands.	14.2 km	Low
Amanita wadulawitu		P2		In deep sand. Banksia woodlands.	14.1 km	Low
Andersonia gracilis	EN	VU	September to November	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	20 km	Low
Anigozanthos humilis subsp. *chrysanthus*		P4	July to October	Grey or yellow sand.	14.8 km	Low
Anigozanthos viridis subsp. *terraspectans*	VU	VU	August to September	Grey sand, clay loam. Winter-wet depressions.	20 km	Low
Austrostipa mundula		P3		Associated with tuart woodland.	15.3 km	Low

Species	Conservation status		V	Habitat	Distance to survey area	Likelihood
	Cwth	WA				
Baeckea sp. *Limestone* (N. Gibson & M.N. Lyons 1425)		P1		Grey sand. Hill side. Assoc. Banksia woodland.	9.8 km	Medium
Caladenia huegelii	EN	CR	September to October	Grey or brown sand, clay loam.	8.3 km	Medium
Calectasia elegans		P2		Flat to gentle slopes. Grey sand.	5.1 km	Medium
Chamaescilla gibsonii		P3	September	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	11.6 km	Low
Chamelaucium lullfitzii	EN	VU			20 km	Low
Conostylis bracteata		P3	August to September	Sand, limestone. Consolidated sand dunes.	13 km	Low
Conostylis pauciflora subsp. *euryrhipis*		P4	August to October	White, grey, or yellow sand. Consolidated dunes.	14.1 km	Low
Conostylis pauciflora subsp. *pauciflora*		P4	August to October	Grey sand, limestone. Hillslopes, consolidated dunes.	14.9 km	Low
Cyathochaeta teretifolia		P3		Grey sand, sandy clay. Swamps, creek edges.	7.4 km	Low
Darwinia foetida	CR	EN		Moist flat; dark grey sand.	11.5 km	Low
Diuris drummondii	VU	VU	November to December or January	Low-lying depressions, swamps.	12.2 km	Low
Diuris micrantha	VU	VU		Brown loamy clay. Winter-wet swamps, in shallow water.	20 km	Low

Species	Conservation status		V	Habitat	Distance to survey area	Likelihood
	Cwth	WA				
Diuris purdiei	EN	EN	September to October	Grey-black sand, moist. Winter-wet swamps.	20 km	Low
Drakaea elastica	EN	CR	October to November	White or grey sand. Low-lying situations adjoining winter-wet swamps.	20 km	Low
Drakaea micrantha	VU	EN		White-grey sand.	20 km	Low
Drosera occidentalis		P4	October to December or January		13.8 km	Low
Eleocharis keigheryi	VU	VU	August to November	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	16 km	Low
Eryngium pinnatifidum subsp. *palustre* (G.J. Keighery 13459)		P3		Winter wet flats. Brown sandy loam over clay.	15.8 km	Low
Eucalyptus argutifolia	VU	VU	March to April	Shallow soils over limestone. Slopes or gullies of limestone ridges, outcrops.	5.9 km	Medium
Fabronia hampeana		P2		Lower dune. Dry pale grey sand.	12.9 km	Low
Grevillea althoferorum subsp. *fragilis*	EN	CR		Flat plain at base of scarp. Greyish-yellow sand.	16.6 km	Low
Grevillea curviloba subsp. *curviloba*	EN	CR			12.7 km	Low
Grevillea curviloba subsp. *incurva*	EN	EN		Wet flat. Grey sand.	12.4 km	Low

Species	Conservation status		V	Habitat	Distance to survey area	Likelihood
	Cwth	WA				
Guichenotia tuberculata		P3		Sand clay over laterite, sand.	13.7 km	Low
Hibbertia helianthemoides		P4	July or September to October	Clayey sand over sandstone or loam over quartzite. Hills and scree slopes.	6 km	Low
Hibbertia leptotheca		P3		Limestone. Dunes.	14.1 km	Low
Hydrocotyle lemnoides		P4		Swamps.	13.7 km	Low
Hydrocotyle striata		P1			10.5 km	Low
Isotropis cuneifolia subsp. *glabra*		P3	September	Sand, clay loam. Winter-wet flats.	12.2 km	Low
Jacksonia gracillima		P3		Grey sand, on mid-slope with exposed limestone. Fire > 5 years.	13.3 km	Low
Jacksonia sericea		P4		Hilltop, sand over limestone.	5.7 km	Medium
Lasiopetalum membranaceum		P3		Sand over limestone.	13.4 km	Low
Lepidium pseudotasmanicum		P4		Loam, sand.	14.7 km	Low
Leucopogon maritimus		P1			14.5 km	Low
Leucopogon sp. *Yanchep* (M. Hislop 1986)		P3		Light grey-yellow sand, brown loam, limestone, laterite, granite. Coastal plain, breakaways, valley slopes, low hills.	10.9 km	Low

Species	Conservation status		V	Habitat	Distance to survey area	Likelihood
	Cwth	WA				
Leucopogon squarrosus subsp. *trigynus*		P2		Mid slope. Grey sand. Bassendean dunes.	9.4 km	Medium
Macarthuria keigheryi	EN	EN	September to December or February to March	White or grey sand.	20 km	Low
Marianthus paralius	EN	EN		White sand over limestone. Low coastal cliffs.	13.3 km	Low
Melaleuca sp. Wanneroo (G.J. Keighery 16705)	EN	EN		Limestone.	5.7 km	Medium
Netrostylis sp. Chandala (G.J. Keighery 17055)		P2			10.5 km	Low
Ornduffia submersa		P4		Small ephemeral creek flowing east towards Ellen Book on large palusplain wetland. Brown / white sandy clay with more clay in the channel of the creek. Area burnt > 10 years ago.	12.7 km	Low
Persoonia rudis		P3	September to December or January	White, grey, or yellow sand, often over laterite.	15.9 km	Low
Pimelea calcicola			September to November	Sand. Coastal limestone ridges.	9 km	Medium
Pithocarpa corymbulosa		P3	January to April	Gravelly or sandy loam. Amongst granite outcrops.	300 m	High

Species	Conservation status		V	Habitat	Distance to survey area	Likelihood
	Cwth	WA				
Platysace ramosissima		P3	October to November	Sandy soils.	11.6 km	Low
Poranthera moorokatta		P2		Crest of low dune with yellow sand (ant mounds). Greater than 10 years since a fire.	8.7 km	Medium
Sarcozona bicarinata		P3	August	White sand.	12.9 km	Low
Schoenus capillifolius		P3	October to November	Brown mud. Claypans.	17.8 km	Low
Schoenus griffinianus		P4	September to October	White sand.	9.9 km	Medium
Sphaerolobium calcicola		P3	June or September to November	White-grey-brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	14.3 km	Low
Stenanthemum sublineare		P2	October to December	Littered white sand. Coastal plain.	5.1 km	Medium
Stylidium aceratum		P3	October to November	Sandy soils. Swamp heathland.	15.6 km	Low
Stylidium longitubum		P4	October to December	Sandy clay, clay. Seasonal wetlands.	2.2 km	High
Stylidium maritimum		P3	September to November	Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland.	5.3 km	Medium

Species	Conservation status		V	Habitat	Distance to survey area	Likelihood
	Cwth	WA				
Stylidium paludicola		P3	October to December	Peaty sand over clay. Winter wet habitats. Marri and Melaleuca woodland, Melaleuca shrubland.	12.1 km	Low
Stylidium squamellosum		P2	October to November	Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	17.5 km	Low
Styphelia filifolia		P3		Coastal plain. Bassedean dunes.	4.7 km	Medium
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	CR	CR	October	Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	20 km	Low
Synaphea grandis		P4	October to November	Laterite.	16.2 km	Low
Thelymitra dedmaniarum	EN	CR	November to December or January	Granite.	14.4 km	Low
Thelymitra stellata	EN	EN	October to November	Sand, gravel, lateritic loam.	20 km	Low
Thelymitra variegata		P2	June to September	Sandy clay, sand, laterite.	20 km	Low
Tripterococcus sp. Brachylobus (A.S. George 14234)		P4		Seasonal Wetland, flat ground, black fine peaty clay loam sand, poor drainage, wet during winter/spring.	2.3 km	Medium
Verticordia serrata var. *linearis*		P3	September to October	White sand, gravel. Open woodland.	12.2 km	Low

Table A-2 Conservation significant ecological communities identified in desktop assessment

Ecological Community	Conservation Status		Description	Distance to Survey Area	Likelihood
	Cwth	WA			
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Priority 3	The ecological community is a woodland associated with the Swan Coastal Plain (and some adjacent areas) of southwest Western Australia. It typically has a prominent tree layer of Banksia sometimes with scattered eucalypts and other tree species present within or above the Banksia canopy. The understorey is species rich and has many wildflowers, including sclerophyllous shrubs, sedges, and herbs	Within the survey area	High
Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Priority 3	The ecological community occurs as woodlands or forests or other structural forms where the primary defining feature is the presence of Eucalyptus gomphocephala (Tuart) trees in the uppermost canopy layer. The name of this tree species reflects one of its various Noongar names. The ecological community includes the assemblage of plants, animals and other organisms that occur in association with Tuart.	Within 5km	High

SCP21c	Endangered	Priority 3	Low lying *Banksia attenuata* woodlands or shrublands. This type occurs sporadically between Gingin and Bunbury and is largely restricted to the Bassendean system. The type tends to occupy lower lying wetter sites and is variously dominated by *Melaleuca preissiana*, *Banksia attenuata, B. menziesii, Regelia ciliata, Eucalyptus marginata* or *Corymbia calophylla*. Structurally, this community type may be either a woodland or occasionally shrubland.	Within 5km	High
SCP22	Endangered	Priority 3	Low lying sites generally consisting of *Banksia ilicifolia – B. attenuata* woodlands, but *Melaleuca preissiana* woodlands and scrubs are also recorded. Occurs on Bassendean and Spearwood systems in the central Swan Coastal Plain north of Rockingham. Typically, has very open understorey, and sites are likely to be seasonally waterlogged.	Within 5km	High
SCP23b	Endangered	Priority 3	Swan Coastal Plain *Banksia attenuata* - *Banksia menziesii* woodlands. These woodlands occur in the Bassendean system, from Melaleuca Park to Gingin. Occurs in reasonably	Within 5km	High

			extensive Banksia woodlands north of Perth.		
SCP10a	Critically Endangered	Endangered	Shrublands on dry clay flats. The microtopography is generally shallower and they have thin skeletal soils. This vegetation community type has a high species richness and includes the aquatic annuals and geophytes typical of other clay pan and clay flat vegetation community types (e.g., *Schoenus natans* (floating bog-rush), *Crassula natans*, *Eryngium pinnatifidum* subsp. palustre ms, *Wurmbea dioica* subsp. alba (early nancy) and *Amphibromus nervosus*).	Within 5km	Medium
SCP20a	Endangered	Endangered	*Banksia attenuata* woodlands over species rich dense shrublands (floristic community type 20a as originally described in Gibson et al. (1994). The community occurs on sands near Koondoola and at the base of the Darling Scarp largely between Chittering and Gosnells. It is usually dominated by *Banksia attenuata* (slender banksia) occasionally with *Eucalyptus marginata* (jarrah) with *Bossiaea eriocarpa* (common brown pea), *Conostephium pendulum* (pearl flower), *Hibbertia huegelii*, *Hibbertia hypericoides* (yellow buttercups),	Within 10km	Medium

			Petrophile linearis (pixie mops), *Scaevola repens*, *Stirlingia latifolia* (blueboy), *Mesomelaena pseudostygia* and *Alexgeorgea nitens* being common in the understorey		
SCP24		Priority 3	Northern Spearwood shrublands and woodlands. Heaths with scattered *Eucalyptus gomphocephala* occurring on deeper soils north from Woodman Point. Most sites occur on the Cottesloe unit of the Spearwood system. The heathlands in this group typically include *Banksia sessilis, Calothamnus quadrifidus*, and *Schoenus grandiflorus.*	Within 5km	Medium
SCP26a		Endangered	*Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges. The community occurs on skeletal soil on limestone ridge slopes and ridge tops north and south of Perth. The community comprises species-rich thickets, heaths and scrubs dominated by *Melaleuca huegelii* (chenille honeymyrtle), *Melaleuca systena* (coastal honeymyrtle) and *Banksia sessilis* (parrot bush) commonly over *Grevillea preissii* (spider net grevillea) and *Acacia lasiocarpa* (pajang). A suite of	Within 5km	Medium

			herbs commonly occurs under the shrub layer		
Mound Springs SCP	Endangered	Critically Endangered	The community occurs in tumulus springs (organic mound springs) on the Swan Coastal Plain. Typical and common native vascular plant species associated with the tumulus springs are the trees *Banksia littoralis* (swamp banksia), *Melaleuca preissiana* (moonah) and *Eucalyptus rudis* (flooded gum), and the shrubs *Taxandria linearifolia* (willow myrtle), *Pteridium esculentum* (bracken fern), *Astartea scoparia* (common astartea) and *Cyclosorus interruptus* (swamp shieldfern)	Within 10km	Low
CAVES SCP01	Endangered	Critically Endangered	Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain	Within 10km	Low

APPENDIX B SPECIES LIST

Family	Species
Aizoaceae	**Carpobrotus edulis*
Anarthriaceae	*Lyginia imberbis*
Apiaceae	*Daucus glochidiatus*
	Xanthosia huegelii
Asparagaceae	*Lomandra nigricans*
	Lomandra odora
	Thysanotus patersonii
Asteraceae	**Arctotis stoechadifolia*
	Asteraceae sp. 1
	Asteraceae sp. 2
	Gnephosis angianthoides
	Hyalosperma cotula
	**Hypochaeris glabra*
	**Hypochaeris radicata*
	Podotheca gnaphalioides
	Siloxerus humifusus
	**Sonchus oleraceus*
	**Ursinia anthemoides*
	Waitzia suaveolens var. *suaveolens*
Casuarinaceae	*Allocasuarina fraseriana*
Celastraceae	*Tripterococcus brunonis*
Colchicaceae	*Burchardia congesta*
Crassulaceae	*Crassula colorata*
Cyperaceae	*Caustis dioica*
	Isolepis marginata
Dasypogonaceae	*Dasypogon bromeliifolius*
Dilleniaceae	*Hibbertia huegelii*
	Hibbertia hypericoides
	Hibbertia subvaginata
Droseraceae	*Drosera erythrorhiza*

Family	Species
Droseraceae	*Drosera macrantha*
	Drosera minutiflora
Ericaceae	*Andersonia lehmanniana*
	Conostephium pendulum
	Conostephium preissii
	Ericaceae sp. 1
	Leucopogon polymorphus
	Styphelia conostephioides
Euphorbiaceae	**Euphorbia terracina*
Fabaceae	*Acacia huegelii*
	Acacia pulchella
	Aotus procumbens
	Bossiaea eriocarpa
	Daviesia angulata
	Euchilopsis linearis
	Gastrolobium capitatum
	Gompholobium aristatum
	Gompholobium tomentosum
	Isotropis cuneifolia
	Jacksonia floribunda
	Jacksonia furcellata
Goodeniaceae	*Dampiera linearis*
Haemodoraceae	*Anigozanthos humilis*
	Conostylis candicans
	Conostylis juncea
Hemerocallidaceae	*Tricoryne elatior*
Iridaceae	**Gladiolus caryophyllaceus*
	Patersonia occidentalis
Loranthaceae	*Nuytsia floribunda*
Montiaceae	*Calandrinia tholiformis*
Myrtaceae	*Calytrix sapphirina*
	Corymbia calophylla

Family	Species
Myrtaceae	*Eremaea pauciflora*
	Hypocalymma angustifolium
	Kunzea glabrescens
	Kunzea praestans
	Leptospermum erubescens
	Melaleuca preissiana
	Melaleuca radula
	Melaleuca seriata
	Regelia ciliata
	Verticordia nitens
Orchidaceae	Orchidaceae sp. 1
	Caladenia flava
	Elythranthera brunonis
Poaceae	**Briza maxima*
	**Briza minor*
	**Bromus diandrus*
	**Bromus hordeaceus*
	**Pentameris airoides* subsp. *airoides*
Polygalaceae	*Comesperma integerrimum*
	Comesperma virgatum
Primulaceae	**Lysimachia arvensis*
Proteaceae	*Adenanthos cygnorum*
	Banksia attenuata
	Banksia ilicifolia
	Banksia menziesii
	Conospermum stoechadis
	Conospermum triplinervium
	Grevillea leucopteris
	Petrophile linearis
	Stirlingia latifolia
Restionaceae	*Desmocladus flexuosus*
Rubiaceae	*Opercularia vaginata*

Family	Species
Rutaceae	*Philotheca spicata*
Stylidiaceae	*Stylidium araeophyllum*
	Stylidium dichotomum
	Stylidium diuroides
	Stylidium piliferum
	Stylidium schoenoides
Xanthorrhoeaceae	*Xanthorrhoea preissii*
Zamiaceae	*Macrozamia riedlei*

* Denotes a weed species

APPENDIX C SPECIES WITHIN VEGETATION TYPES

Species within each vegetation type.

Species	VT1 – BaXpEp	VT2 – MpXpDb	Opportunistic species
Acacia huegelii	X		
Acacia pulchella	X		
Adenanthos cygnorum	X	X	
Allocasuarina fraseriana			X
Andersonia lehmanniana	X		
Anigozanthos humilis	X		
Aotus procumbens	X		
**Arctotis stoechadifolia*		X	
Asteraceae sp. 1	X		
Asteraceae sp. 2			X
Banksia attenuata	X		
Banksia ilicifolia		X	
Banksia menziesii	X		
Bossiaea eriocarpa	X		
**Briza maxima*	X	X	
**Briza minor*		X	
**Bromus diandrus*		X	
**Bromus hordeaceus*	X		
Burchardia congesta	X	X	
Caladenia flava	X	X	
Calandrinia tholiformis			X
Calytrix sapphirina			X
**Carpobrotus edulis*	X		
Caustis dioica	X		
Comesperma integerrimum			X
Comesperma virgatum	X		
Conospermum stoechadis	X		

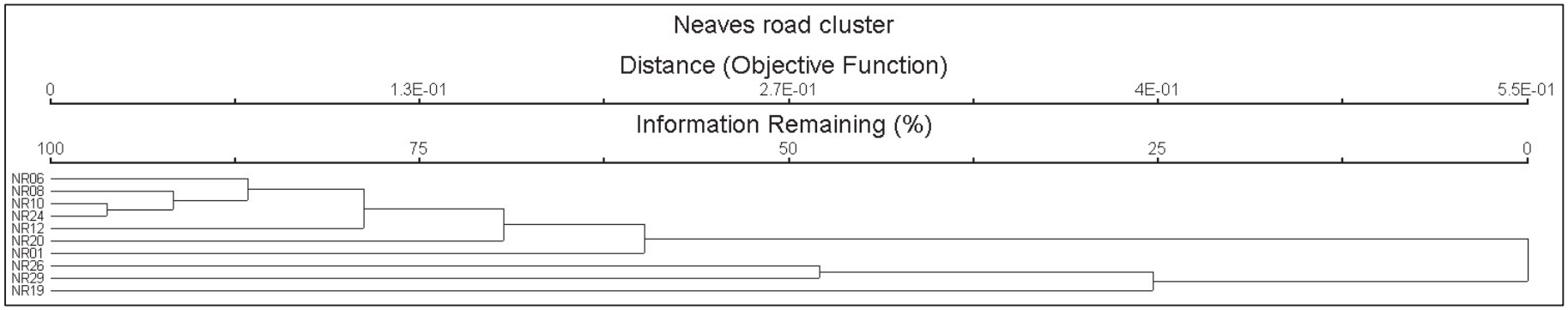
Species	VT1 – BaXpEp	VT2 – MpXpDb	Opportunistic species
Conospermum triplinervium	X		
Conostephium pendulum	X		
Conostephium preissii	X		
Conostylis candicans	X	X	
Conostylis juncea	X		
Corymbia calophylla		X	
Crassula colorata		X	
Dampiera linearis	X		
Dasypogon bromeliifolius	X	X	
Daucus glochidiatus	X	X	
Daviesia angulata			X
Desmocladus flexuosus	X		
Drosera erythrorhiza	X	X	
Drosera macrantha	X	X	
Drosera minutiflora	X		
Elythranthera brunonis	X		
Eremaea pauciflora	X		
Ericaceae sp. 1	X		
Euchilopsis linearis			X
**Euphorbia terracina*			X
Gastrolobium capitatum	X		
**Gladiolus caryophyllaceus*	X	X	
Gnephosis angianthoides	X		
Gompholobium aristatum	X	X	
Gompholobium tomentosum	X	X	
Grevillea leucopteris			X
Hibbertia huegelii	X	X	
Hibbertia hypericoides	X		
Hibbertia subvaginata	X	X	
Hyalosperma cotula	X	X	

Species	VT1 – BaXpEp	VT2 – MpXpDb	Opportunistic species
Hypocalymma angustifolium		X	
**Hypochaeris glabra*	X	X	
**Hypochaeris radicata*		X	
Isolepis marginata	X		
Isotropis cuneifolia	X		
Jacksonia floribunda	X		
Jacksonia furcellata	X		
Kunzea glabrescens	X	X	
Kunzea praestans	X		
Leptospermum erubescens	X		
Leucopogon polymorphus	X	X	
Lomandra nigricans	X		
Lomandra odora	X		
Lyginia imberbis	X		
**Lysimachia arvensis*		X	
Macrozamia riedlei	X		
Melaleuca preissiana	X	X	
Melaleuca radula	X		
Melaleuca seriata	X		
Nuytsia floribunda		X	
Opercularia vaginata	X	X	
Orchidaceae sp. 1		X	
Patersonia occidentalis	X	X	
**Pentameris airoides* subsp. *airoides*	X		
Petrophile linearis	X	X	
Philotheca spicata	X		
Podotheca gnaphalioides	X	X	
Regelia ciliata	X		
Siloxerus humifusus		X	
**Sonchus oleraceus*			X

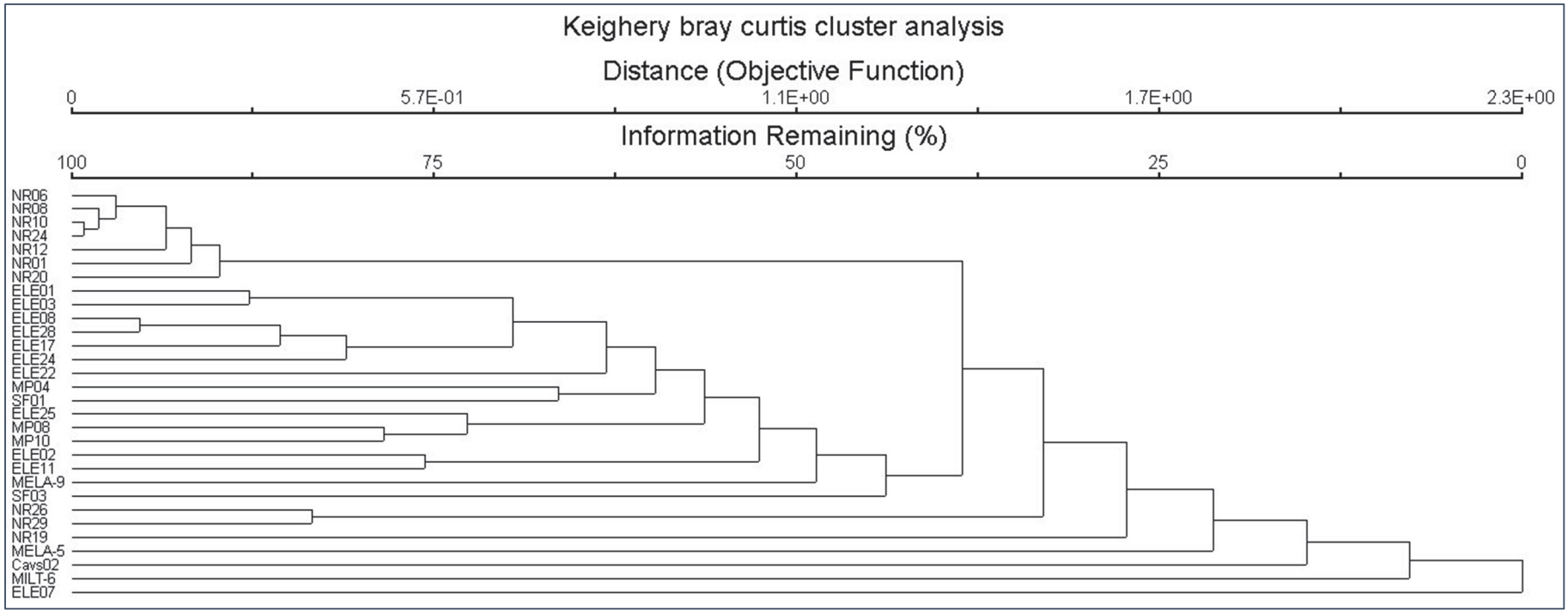
Species	VT1 – BaXpEp	VT2 – MpXpDb	Opportunistic species
Stirlingia latifolia	X	X	
Stylidium araeophyllum		X	
Stylidium dichotomum	X		
Stylidium diuroides	X		
Stylidium piliferum	X		
Stylidium schoenoides	X	X	
Styphelia conostephioides	X		
Thysanotus patersonii	X	X	
Tricoryne elatior	X		
Tripterococcus brunonis	X	X	
**Ursinia anthemoides*	X	X	
Verticordia nitens	X		
Waitzia suaveolens var. *suaveolens*	X		
Xanthorrhoea preissii	X	X	
Xanthosia huegelii			X

APPENDIX D STATISTICAL ANALYSIS

Cluster analysis dendrogram showing similarities between survey sites.



Cluster analysis dendrogram showing similarities between closest Keighery (2012) quadrats and survey sites.



APPENDIX E QUADRAT DATA

Site: NR1

Date	3/10/2022	**Botanist**	CK ZW
Waypoint	NR1NW	**Landform**	Plain
NW Corner Latitude	-31.616753	**Slope and Aspect**	Negligible
NW Corner Longitude	115.826102	**Soil type**	Sand
Rock cover (%)	NA	**Soil colour**	Grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Excellent	**Disturbance**	
Vegetation description	VT1: *Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* low sparse shrubland.		

Photo

Species	Stratum	Cover (%)
Acacia huegelii	Shrub (0-1 m)	< 1
Acacia pulchella	Shrub (0-1 m)	< 1
Andersonia lehmanniana	Shrub (0-1 m)	< 1
Asteraceae sp.	Herb	< 1
Banksia attenuata	Tree (<10 m)	1 – 4
Banksia menziesii	Tree (<10 m)	1 – 4
Bossiaea eriocarpa	Shrub (0-1 m)	< 1
Burchardia congesta	Herb	< 1
Caustis dioica	Sedge	< 1
Conostephium pendulum	Shrub (0-1 m)	< 1
Dasypogon bromeliifolius	Shrub (0-1 m)	1 – 4
Daucus glochidiatus	Herb	< 1
Desmocladus flexuosus	Sedge	< 1
Drosera erythrorhiza	Herb	< 1
Drosera macrantha	Herb	< 1
Elythranthera brunonis	Herb	Assoc.
Eremaea pauciflora	Shrub (0-1 m)	1 – 4
Gastrolobium capitatum	Shrub (0-1 m)	< 1
**Gladiolus caryophyllaceus*	Shrub (0-1 m)	< 1
Gnephosis angianthoides	Shrub (0-1 m)	< 1
Hibbertia huegelii	Shrub (0-1 m)	< 1
Hibbertia subvaginata	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
**Hypochaeris glabra*	Herb	< 1
Isotropis cuneifolia	Herb	< 1
Leucopogon polymorphus	Shrub (0-1 m)	< 1
Lyginia imberbis	Sedge	< 1
Melaleuca radula	Shrub (0-1 m)	1 – 4

Species	Stratum	Cover (%)
Patersonia occidentalis	Shrub (0-1 m)	< 1
Petrophile linearis	Shrub (0-1 m)	< 1
Philotheca spicata	Shrub (0-1 m)	< 1
Stylidium dichotomum	Herb	< 1
Stylidium diuroides	Herb	< 1
Stylidium schoenoides	Herb	< 1
**Ursinia anthemoides*	Herb	< 1
Xanthorrhoea preissii	Shrub (0-1 m)	1 – 4

* Denotes a weed species

Site: NR06

Date	3/10/2022	**Botanist**	CK ZW
Waypoint	NR06NW	**Landform**	Plain
NW Corner Latitude	-31.619373	**Slope and Aspect**	Negligible
NW Corner Longitude	115.849111	**Soil type**	Sand
Rock cover (%)	NA	**Soil colour**	Grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Excellent	**Disturbance**	
Vegetation description	VT1: *Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* low sparse shrubland.		

Photo

Species	Stratum	Cover (%)
Acacia pulchella	Shrub (0-1 m)	< 1
Andersonia lehmanniana	Shrub (0-1 m)	< 1
Banksia attenuata	Tree (<10 m)	1 – 4
Banksia menziesii	Tree (<10 m)	1 – 4
Bossiaea eriocarpa	Shrub (0-1 m)	< 1
**Briza maxima*	Grass	< 1
Burchardia congesta	Herb	< 1
Caustis dioica	Sedge	< 1
Conostephium preissii	Shrub (0-1 m)	< 1
Daucus glochidiatus	Herb	< 1
Drosera erythrorhiza	Herb	< 1
Drosera macrantha	Herb	< 1
Drosera minutiflora	Herb	< 1
Eremaea pauciflora	Shrub (0-1 m)	10 – 24
**Gladiolus caryophyllaceus*	Shrub (0-1 m)	< 1
Gompholobium tomentosum	Shrub (0-1 m)	< 1
Hibbertia huegelii	Shrub (0-1 m)	< 1
Hibbertia hypericoides	Shrub (0-1 m)	< 1
Hibbertia subvaginata	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
**Hypochaeris glabra*	Herb	< 1
Leptospermum erubescens	Shrub (0-1 m)	1 – 4
Leucopogon polymorphus	Shrub (0-1 m)	< 1
Melaleuca preissiana	Shrub (0-1 m)	1 – 4
Melaleuca radula	Shrub (0-1 m)	< 1
Opercularia vaginata	Herb	< 1
Philotheca spicata	Shrub (0-1 m)	< 1
Podotheca gnaphalioides	Herb	< 1

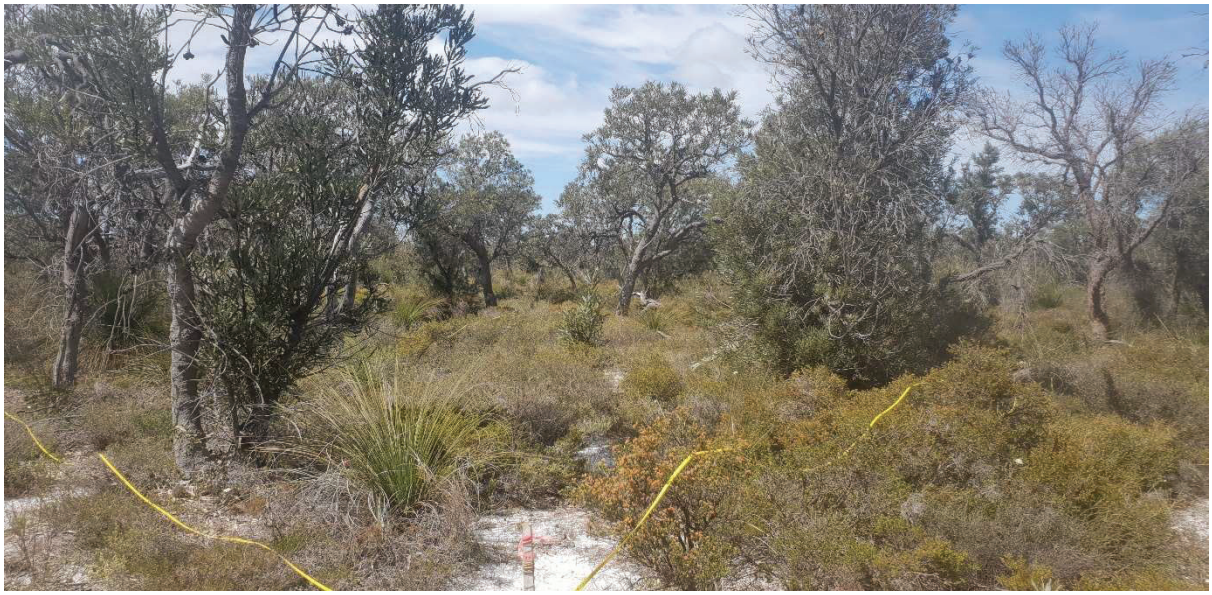
Species	Stratum	Cover (%)
Stylidium dichotomum	Herb	< 1
Styphelia conostephioides	Shrub (0-1 m)	< 1
**Ursinia anthemoides*	Herb	< 1
Waitzia suaveolens var. *suaveolens*	Herb	< 1
Xanthorrhoea preissii	Shrub (1-2 m)	1 – 4

* Denotes a weed species

Site: NR08

Date	3/10/2022	**Botanist**	CK ZW
Waypoint	NR08NW	**Landform**	Plain
NW Corner Latitude	-31.611748	**Slope and Aspect**	Negligible
NW Corner Longitude	115.849141	**Soil type**	Sand
Rock cover (%)	NA	**Soil colour**	Grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Very Good	**Disturbance**	Potential Dieback
Vegetation description	VT1: *Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* low sparse shrubland.		

Photo



Species	Stratum	Cover (%)
Acacia pulchella	Shrub (0-1 m)	< 1
Andersonia lehmanniana	Shrub (0-1 m)	< 1
Aotus procumbens	Shrub (0-1 m)	< 1
Banksia attenuata	Tree (<10 m)	1 – 4
Banksia menziesii	Tree (<10 m)	5 – 9
Bossiaea eriocarpa	Shrub (0-1 m)	< 1
**Briza maxima*	Grass	< 1
Burchardia congesta	Herb	< 1
Caladenia flava	Herb	< 1
Conostephium pendulum	Shrub (0-1 m)	< 1
Conostephium preissii	Shrub (0-1 m)	< 1
Daucus glochidiatus	Herb	< 1
Drosera macrantha	Herb	< 1
Elythranthera brunonis	Herb	< 1
Eremaea pauciflora	Shrub (0-1 m)	5 – 9
**Gladiolus caryophyllaceus*	Shrub (0-1 m)	< 1
Gompholobium tomentosum	Shrub (0-1 m)	< 1
Hibbertia huegelii	Shrub (0-1 m)	< 1
Hibbertia subvaginata	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
**Hypochaeris glabra*	Herb	< 1
Jacksonia floribunda	Shrub (1-2 m)	< 1
Leptospermum erubescens	Shrub (0-1 m)	1 – 4
Melaleuca preissiana	Shrub (1-2 m)	< 1
Melaleuca radula	Shrub (0-1 m)	< 1
Melaleuca seriata	Shrub (0-1 m)	< 1
Opercularia vaginata	Herb	< 1
Patersonia occidentalis	Shrub (0-1 m)	< 1

Species	Stratum	Cover (%)
Petrophile linearis	Shrub (0-1 m)	< 1
Philotheca spicata	Shrub (0-1 m)	< 1
Stylidium dichotomum	Herb	< 1
Styphelia conostephioides	Shrub (0-1 m)	< 1
**Ursinia anthemoides*	Herb	< 1
Xanthorrhoea preissii	Shrub (0-1 m)	1 – 4

* Denotes a weed species

Site: NR10

Date	3/10/2022	**Botanist**	CK ZW
Waypoint	NR10NW	**Landform**	Plain
NW Corner Latitude	-31.61021	**Slope and Aspect**	Negligible
NW Corner Longitude	115.842359	**Soil type**	Sand
Rock cover (%)	NA	**Soil colour**	Grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Excellent	**Disturbance**	Fire
Vegetation description	VT1: *Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* low sparse shrubland.		

Photo

Species	Stratum	Cover (%)
Acacia pulchella	Shrub (0-1 m)	< 1
Andersonia lehmanniana	Shrub (0-1 m)	< 1
Anigozanthos humilis	Herb	< 1
Banksia attenuata	Tree (<10 m)	1 – 4
Banksia menziesii	Tree (<10 m)	1 – 4
Bossiaea eriocarpa	Shrub (0-1 m)	< 1
Burchardia congesta	Herb	< 1
Caladenia flava	Herb	< 1
Comesperma virgatum	Herb	< 1
Conostephium preissii	Shrub (0-1 m)	< 1
Dasypogon bromeliifolius	Shrub (0-1 m)	< 1
Daucus glochidiatus	Herb	< 1
Drosera macrantha	Herb	< 1
Elythranthera brunonis	Herb	< 1
Eremaea pauciflora	Shrub (0-1 m)	1 – 4
Ericaceae sp.	Shrub (0-1 m)	< 1
**Gladiolus caryophyllaceus*	Shrub (0-1 m)	< 1
Gompholobium aristatum	Shrub (0-1 m)	< 1
Hibbertia huegelii	Shrub (0-1 m)	< 1
Hibbertia subvaginata	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
**Hypochaeris glabra*	Herb	< 1
Isolepis marginata	Sedge	< 1
Leptospermum erubescens	Shrub (0-1 m)	1 – 4
Leucopogon polymorphus	Shrub (0-1 m)	< 1
Melaleuca radula	Shrub (0-1 m)	< 1
Melaleuca seriata	Shrub (0-1 m)	< 1
Opercularia vaginata	Herb	< 1

Species	Stratum	Cover (%)
Patersonia occidentalis	Shrub (0-1 m)	< 1
Petrophile linearis	Shrub (0-1 m)	< 1
Philotheca spicata	Shrub (0-1 m)	< 1
Podotheca gnaphalioides	Herb	1 – 4
Stylidium dichotomum	Herb	< 1
Stylidium schoenoides	Herb	< 1
Tripterococcus brunonis	Shrub (0-1 m)	< 1
**Ursinia anthemoides*	Herb	< 1
Verticordia nitens	Shrub (0-1 m)	< 1
Xanthorrhoea preissii	Shrub (1-2 m)	1 – 4

* Denotes a weed species

Site: NR12

Date	3/10/2022	**Botanist**	CK ZW
Waypoint	NR12NW	**Landform**	Plain
NW Corner Latitude	-31.609302	**Slope and Aspect**	Negligible
NW Corner Longitude	115.836046	**Soil type**	Sand
Rock cover (%)	NA	**Soil colour**	Grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Excellent	**Disturbance**	
Vegetation description	VT1: *Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* low sparse shrubland.		

Photo

Species	Stratum	Cover (%)
Acacia huegelii	Shrub (0-1 m)	< 1
Acacia pulchella	Shrub (0-1 m)	< 1
Banksia attenuata	Tree (<10 m)	5 – 9
Banksia menziesii	Tree (<10 m)	5 – 9
Bossiaea eriocarpa	Shrub (0-1 m)	< 1
Burchardia congesta	Herb	< 1
Comesperma virgatum	Herb	< 1
Conostephium preissii	Shrub (0-1 m)	< 1
Conostylis juncea	Shrub (0-1 m)	< 1
Dasypogon bromeliifolius	Shrub (0-1 m)	1 – 4
Daucus glochidiatus	Herb	< 1
Drosera erythrorhiza	Herb	< 1
Drosera macrantha	Herb	< 1
Elythranthera brunonis	Herb	< 1
Eremaea pauciflora	Shrub (0-1 m)	< 1
**Gladiolus caryophyllaceus*	Shrub (0-1 m)	< 1
Gompholobium aristatum	Shrub (0-1 m)	< 1
Hibbertia huegelii	Shrub (0-1 m)	< 1
Hibbertia subvaginata	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
Jacksonia floribunda	Shrub (1-2 m)	< 1
Leptospermum erubescens	Shrub (0-1 m)	1 – 4
Leucopogon polymorphus	Shrub (0-1 m)	< 1
Lomandra nigricans	Sedge	< 1
Lomandra odora	Shrub (0-1 m)	< 1
Macrozamia riedlei	Shrub (0-1 m)	< 1
Melaleuca seriata	Shrub (0-1 m)	1 – 4
Opercularia vaginata	Herb	< 1

Species	Stratum	Cover (%)
Patersonia occidentalis	Shrub (0-1 m)	< 1
Petrophile linearis	Shrub (0-1 m)	< 1
Philotheca spicata	Shrub (0-1 m)	< 1
Tricoryne elatior	Herb	< 1
Xanthorrhoea preissii	Shrub (>2 m)	5 – 9

* Denotes a weed species

Site: NR19

Date	4/10/2022	**Botanist**	CK ZW
Waypoint	NR19NW	**Landform**	Wetland - dampland
NW Corner Latitude	-31.616456	**Slope and Aspect**	Negligible
NW Corner Longitude	115.842262	**Soil type**	Sand
Rock cover (%)	NA	**Soil colour**	Grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Very Good	**Disturbance**	Weeds, Fire
Vegetation description	VT2: *Melaleuca preissiana* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Dasypogon bromeliifolius* low sparse forbland		

Photo

Species	Stratum	Cover (%)
Adenanthos cygnorum	Shrub (>2 m)	< 1
Caladenia flava	Herb	< 1
Crassula colorata	Herb	< 1
Dasypogon bromeliifolius	Shrub (0-1 m)	1 – 4
Drosera macrantha	Herb	< 1
**Gladiolus caryophyllaceus*	Herb	< 1
Hibbertia huegelii	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
Hypocalymma angustifolium	Shrub (0-1 m)	< 1
**Hypochaeris glabra*	Herb	< 1
**Hypochaeris radicata*	Herb	< 1
Kunzea glabrescens	Shrub (>2 m)	1 – 4
Melaleuca preissiana	Tree (<10 m)	1 – 4
Orchidaceae sp. 1	Herb	< 1
Patersonia occidentalis	Shrub (0-1 m)	< 1
**Pentameris airoides* subsp. *airoides*	Grass	< 1
Podotheca gnaphalioides	Herb	1 – 4
Siloxerus humifusus	Herb	< 1
Tripterococcus brunonis	Shrub (0-1 m)	< 1
**Ursinia anthemoides*	Herb	< 1
Xanthorrhoea preissii	Shrub (1-2 m)	1 – 4

* Denotes a weed species

Site: NR20

Date	3/10/2022	**Botanist**	CK ZW
Waypoint	NR20NW	**Landform**	Plain
NW Corner Latitude	-31.614941	**Slope and Aspect**	Negligible
NW Corner Longitude	115.843906	**Soil type**	Sand
Rock cover (%)	NA	**Soil colour**	Grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Very Good	**Disturbance**	Potential Dieback
Vegetation description	VT1: *Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* low sparse shrubland.		

Photo

Species	Stratum	Cover (%)
Acacia pulchella	Shrub (0-1 m)	< 1
Andersonia lehmanniana	Shrub (0-1 m)	< 1
Banksia attenuata	Tree (<10 m)	1 – 4
Banksia menziesii	Tree (<10 m)	1 – 4
Bossiaea eriocarpa	Shrub (0-1 m)	< 1
Burchardia congesta	Herb	< 1
Caustis dioica	Sedge	< 1
Conostephium pendulum	Shrub (0-1 m)	< 1
Conostephium preissii	Shrub (0-1 m)	< 1
Dampiera linearis	Shrub (0-1 m)	< 1
Dasypogon bromeliifolius	Shrub (0-1 m)	1 – 4
Daucus glochidiatus	Herb	< 1
Drosera erythrorhiza	Herb	< 1
Elythranthera brunonis	Herb	< 1
Eremaea pauciflora	Shrub (0-1 m)	1 – 4
**Gladiolus caryophyllaceus*	Shrub (0-1 m)	< 1
Hibbertia huegelii	Shrub (0-1 m)	< 1
Hibbertia subvaginata	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
**Hypochaeris glabra*	Herb	< 1
Isolepis marginata	Sedge	< 1
Kunzea glabrescens	Shrub (>2 m)	< 1
Kunzea praestans	Shrub (>2 m)	Assoc.
Leptospermum erubescens	Shrub (0-1 m)	< 1
Leucopogon polymorphus	Shrub (0-1 m)	< 1
Melaleuca preissiana	Shrub (0-1 m)	< 1
Melaleuca radula	Shrub (0-1 m)	< 1
Melaleuca seriata	Shrub (0-1 m)	< 1

Species	Stratum	Cover (%)
Patersonia occidentalis	Shrub (0-1 m)	< 1
Stylidium piliferum	Herb	< 1
Thysanotus patersonii	Herb	< 1
Tricoryne elatior	Herb	< 1
**Ursinia anthemoides*	Herb	< 1
Xanthorrhoea preissii	Shrub (1-2 m)	5 – 9

* Denotes a weed species

Site: NR24

Date	3/10/2022	**Botanist**	CK ZW
Waypoint	NR24NW	**Landform**	Plain
NW Corner Latitude	-31.61823	**Slope and Aspect**	Negligible
NW Corner Longitude	115.834399	**Soil type**	Sand
Rock cover (%)	NA	**Soil colour**	Grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Excellent	**Disturbance**	
Vegetation description	VT1: *Banksia attenuata- B. menziesii* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Eremaea pauciflora* low sparse shrubland.		

Photo

Species	Stratum	Cover (%)
Acacia pulchella	Shrub (0-1 m)	< 1
Andersonia lehmanniana	Shrub (0-1 m)	< 1
Banksia attenuata	Tree (<10 m)	5 – 9
Banksia menziesii	Tree (<10 m)	1 – 4
Bossiaea eriocarpa	Shrub (0-1 m)	< 1
**Briza maxima*	Grass	< 1
**Bromus hordeaceus*	Grass	< 1
Burchardia congesta	Herb	< 1
Caladenia flava	Herb	< 1
**Carpobrotus edulis*	Shrub (0-1 m)	< 1
Comesperma virgatum	Herb	< 1
Conostephium preissii	Shrub (0-1 m)	< 1
Dasypogon bromeliifolius	Shrub (0-1 m)	< 1
Daucus glochidiatus	Herb	< 1
Drosera macrantha	Herb	< 1
Gastrolobium capitatum	Shrub (0-1 m)	< 1
**Gladiolus caryophyllaceus*	Herb	< 1
Hibbertia huegelii	Shrub (0-1 m)	1 – 4
Hibbertia subvaginata	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
**Hypochaeris glabra*	Herb	< 1
Jacksonia floribunda	Shrub (0-1 m)	< 1
Jacksonia furcellata	Shrub (1-2 m)	< 1
Leptospermum erubescens	Shrub (0-1 m)	1 – 4
Leucopogon polymorphus	Shrub (0-1 m)	< 1
Melaleuca radula	Shrub (0-1 m)	< 1
Opercularia vaginata	Herb	< 1
Patersonia occidentalis	Shrub (0-1 m)	< 1

Species	Stratum	Cover (%)
Petrophile linearis	Shrub (0-1 m)	< 1
Philotheca spicata	Shrub (0-1 m)	< 1
Stylidium schoenoides	Herb	< 1
Tripterococcus brunonis	Shrub (0-1 m)	< 1
**Ursinia anthemoides*	Herb	< 1
Verticordia nitens	Shrub (0-1 m)	< 1
Xanthorrhoea preissii	Shrub (1-2 m)	5 – 9

* Denotes a weed species

Site: NR26

Date	4/10/2022	**Botanist**	CK ZW
Waypoint	NR26NW	**Landform**	Wetland - dampland
NW Corner Latitude	-31.612834	**Slope and Aspect**	Negligible
NW Corner Longitude	115.817706	**Soil type**	Sandy loam
Rock cover (%)	NA	**Soil colour**	Dark grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Very Good	**Disturbance**	
Vegetation description	VT2: *Melaleuca preissiana* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Dasypogon bromeliifolius* low sparse forbland		

Photo

Species	Stratum	Cover (%)
**Arctotis stoechadifolia*	Herb	< 1
Banksia ilicifolia	Tree (<10 m)	Assoc.
**Briza maxima*	Grass	< 1
**Briza minor*	Grass	< 1
**Bromus diandrus*	Grass	< 1
Burchardia congesta	Herb	< 1
Corymbia calophylla	Tree (10-30 m)	1 – 4
Dasypogon bromeliifolius	Shrub (0-1 m)	5 – 9
Daucus glochidiatus	Herb	< 1
Drosera erythrorhiza	Herb	< 1
**Gladiolus caryophyllaceus*	Shrub (0-1 m)	< 1
Gompholobium aristatum	Shrub (0-1 m)	< 1
Gompholobium tomentosum	Shrub (0-1 m)	< 1
Hibbertia subvaginata	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
**Hypochaeris glabra*	Herb	< 1
Melaleuca preissiana	Tree (<10 m)	1 – 4
Nuytsia floribunda	Tree (<10 m)	Assoc.
Opercularia vaginata	Herb	< 1
Patersonia occidentalis	Shrub (0-1 m)	< 1
**Pentameris airoides* subsp. *airoides*	Grass	< 1
Petrophile linearis	Shrub (0-1 m)	< 1
Podotheca gnaphalioides	Herb	< 1
Siloxerus humifusus	Herb	< 1
Stylidium araeophyllum	Herb	< 1
Stylidium schoenoides	Herb	< 1
**Ursinia anthemoides*	Herb	< 1
Xanthorrhoea preissii	Shrub (>2 m)	5 – 9

* Denotes a weed species

Site: NR29

Date	4/10/2022	**Botanist**	CK ZW
Waypoint	NR29NW	**Landform**	Wetland - dampland
NW Corner Latitude	-31.615157	**Slope and Aspect**	Negligible
NW Corner Longitude	115.821125	**Soil type**	Sandy loam
Rock cover (%)	NA	**Soil colour**	Dark grey
Rock type	NA	**Fire history**	Long (> 3 yrs.)
Vegetation condition	Excellent	**Disturbance**	Fire
Vegetation description	VT2: *Melaleuca preissiana* open woodland over *Xanthorrhoea preissii* mid sparse shrubland over *Dasypogon bromeliifolius* low sparse forbland		

Photo

Species	Stratum	Cover (%)
Banksia ilicifolia	Shrub (>2 m)	Assoc.
**Briza minor*	Grass	< 1
Dasypogon bromeliifolius	Shrub (0-1 m)	5 – 9
Daucus glochidiatus	Herb	< 1
**Gladiolus caryophyllaceus*	Shrub (0-1 m)	< 1
Hibbertia subvaginata	Shrub (0-1 m)	< 1
Hyalosperma cotula	Herb	< 1
**Hypochaeris radicata*	Herb	< 1
Leucopogon polymorphus	Shrub (0-1 m)	< 1
**Lysimachia arvensis*	Herb	< 1
Melaleuca preissiana	Tree (<10 m)	5 – 9
Nuytsia floribunda	Tree (<10 m)	< 1
**Pentameris airoides* subsp. *airoides*	Grass	< 1
Podotheca gnaphalioides	Herb	< 1
Siloxerus humifusus	Herb	< 1
Stylidium schoenoides	Herb	< 1
Thysanotus patersonii	Vine	< 1
**Ursinia anthemoides*	Herb	< 1
Xanthorrhoea preissii	Shrub (1-2 m)	1 – 4

* Denotes a weed species