Vegetation surveys

A targeted vegetation survey was undertaken as part of the Environmental Impact Assessments for Lots 20 and Lots 31-34 (Lot 62).

None of the vegetation units on site were regarded as occurrences of Threatened Ecological Communities under either the EPBC Act or BC Act. Nor were any of the units regarded as occurrences of a State listed Priority Ecological Community.

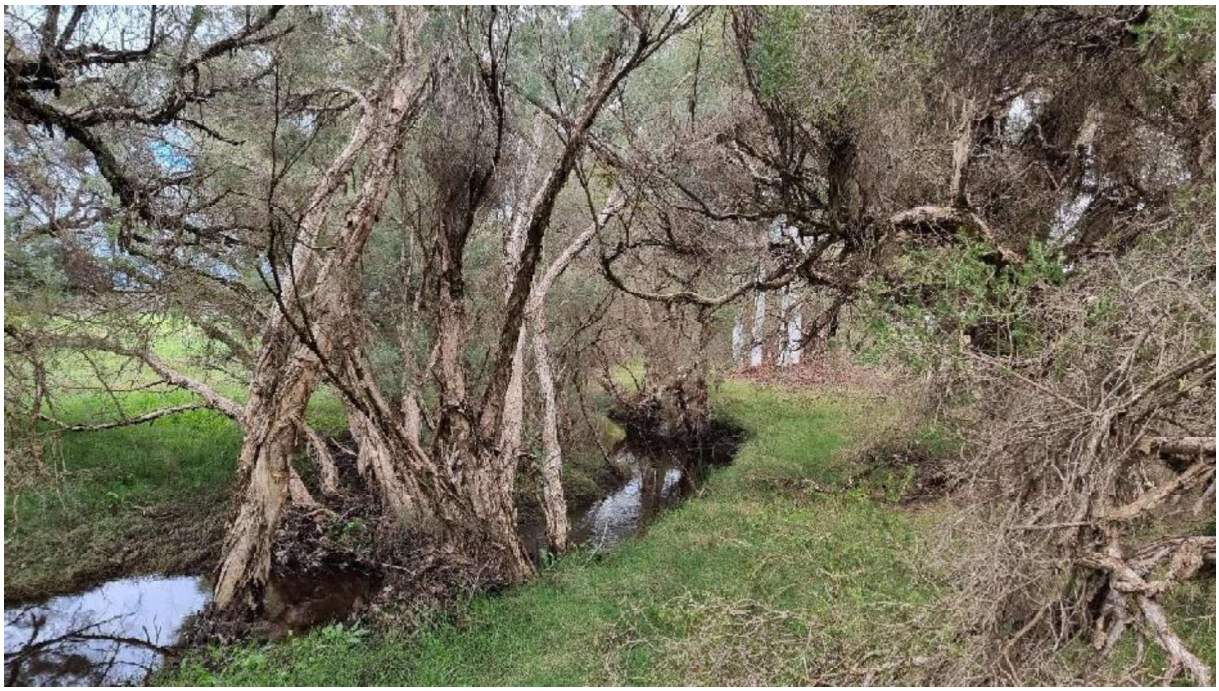
Most of the native vegetation was in Completely Degraded (92%) condition due to long-term grazing impacts.

Please find the vegetation survey attached below.

Reconnaissance and Targeted Flora and Vegetation Survey

Western Extension

Keysbrook, Western Australia



Prepared for Doral Mineral Sands
February 2023

Ecoedge

PO Box 9179, Picton WA 6229
0484 771 825 | enquiries@ecoedge.com.au

Version	Origin	Review	Review date	Release approval	Issue date
V1	E. Hutt	R. Smith	15/2/2023		
V2	R. Smith	C. Spencer	21/2/2023		
Final draft	D. Brace	Ecoedge		Ecoedge	22/2/2023
Final		Doral		Ecoedge	23/2/2023

Executive Summary

Ecoedge Environmental Services was engaged by Doral Mineral Sands in May 2022 to undertake a Targeted and Reconnaissance Flora and Vegetation Survey of part of Lots 20, 62, 63 and 211 located in Keysbrook, Western Australia (hereafter referred to as the survey area) The survey area occurs in two local government areas - the Shire of Serpentine-Jarrahdale and the Shire of Murray. The survey area is approximately 604.75 ha in size and is predominantly cleared agricultural land.

Doral are planning to extend their current Keysbrook mining operations and required the survey as part of their investigations into future mining opportunities across the landholding and to support environmental planning approval processes.

The survey was carried out on 12 and 13 July, 18 August, 16 September and 10 November 2022 in accordance with the EPA (2016) Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment.

Forty-nine species of vascular flora were identified within the survey area, of which 27 (55%) were introduced non-native taxa. There were another six taxa that were amenity plantings.

No Threatened or Priority flora or other flora of conservation significance were found.

One of the introduced species, Cape tulip (**Moraea flaccida*) is a Declared Pest plant in Western Australia under the *Biosecurity and Agriculture Management Act 2007*.

Seven vegetation mapping subunits were recognized and mapped for the survey area:

- Marri, and Jarrah-Sheoak open forest or woodland, subunits A1 and A2
- Low woodland of *Melaleuca preissiana* or *M. rhaphiophylla*, subunits B1 and B2
- *Sedgeland of Juncus pallidus*, unit C.

None of the vegetation units on site were regarded as occurrences of Threatened Ecological Communities under either the EPBC Act or BC Act. Nor were any of the units regarded as occurrences of a State listed Priority Ecological Community.

Most of the native vegetation was in Completely Degraded (92%) condition due to long-term grazing impacts. Phytophthora dieback disease also has played a part of degradation of the native vegetation in the past.

Three vegetation complexes are mapped for the survey area: the Bassendean Complex – Central and South (26.87%), the Guildford Complex (5.09%) and the Southern River Complex (18.53%). Each of these complexes are below the desired Commonwealth 30% pre-European retention target.

The single Conservation category wetland (0.775 ha) within the boundary of the survey area is in Completely Degraded condition. Almost all vegetation within the Resource Enhancement wetlands was also classed as Completely Degraded vegetation condition.

Parcels of vegetation within the south-eastern part of survey area have been assigned 1a ecological linkage values (1a). This are due to their close proximity to the regional ecological axis line located to the south-east of the survey area. These areas, however, have limited linkage values due to the overall Degraded condition of the vegetation and separation from other parcels of vegetation by expanses of pasture.

There are no Perth Metropolitan Regional Ecological Linkages within the survey area. The closest is located approximately 3km to the north of the survey area and are associated with the Bush Forever site BF77 Yangedi swamp link.

There is one mapped ESA in the north western portion of the survey area. This ESA is associated with the Conservation Category wetland UFI 14870. Another ESA intersects with the survey area boundary in the south eastern corner and is associated with the Conservation Category wetland UFI 14465.

There are no Bush Forever sites within the survey area. The closest Bush Forever site is approximately 2.5km away and is associated with BF77 Yangedi Swamp.

Contents

Table of Tables

Table of Figures

Statement of limitations

Reliance on data

In the preparation of this report, Ecoedge Environmental Services has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Unless stated otherwise in the report, Ecoedge has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Ecoedge will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to Ecoedge.

Report for the benefit of the Client

The report has been prepared for the benefit of the Client and no other party. Ecoedge assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of Ecoedge or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

1 Introduction

Ecoedge Environmental Services (Ecoedge) was engaged by Doral Mineral Sands (Doral) in May 2022 to undertake a Reconnaissance and Targeted Flora and Vegetation survey of part of Lots 20, 62, 63 and 211 located in Keysbrook, Western Australia (hereafter referred to as the survey area) **Figure 1**. The survey area is approximately 604.75 ha in size and contains approximately 38 ha of native vegetation **Figure 2**.

The survey area transverses the border of two local government areas - the Shire of Serpentine-Jarrahdale and the Shire of Murray. The town of Keysbrook is situated approximately 4.6 km to the northeast of the survey area with Hopeland Road running along the western boundary of the survey area and the South Western Highway approximately 4.7 km to the east. The surrounding area is predominantly used for agricultural purposes.

Doral are planning to extend their current Keysbrook mining operations and required the flora and vegetation survey as part of their investigations into future mining opportunities across the landholding and to support environmental planning approval processes. This survey area is referred to as the Keysbrook Western Extension.

The flora and vegetation survey was undertaken in spring 2022, in accordance with the Environmental Protection Authority (EPA) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

This report compiles the findings of the survey.

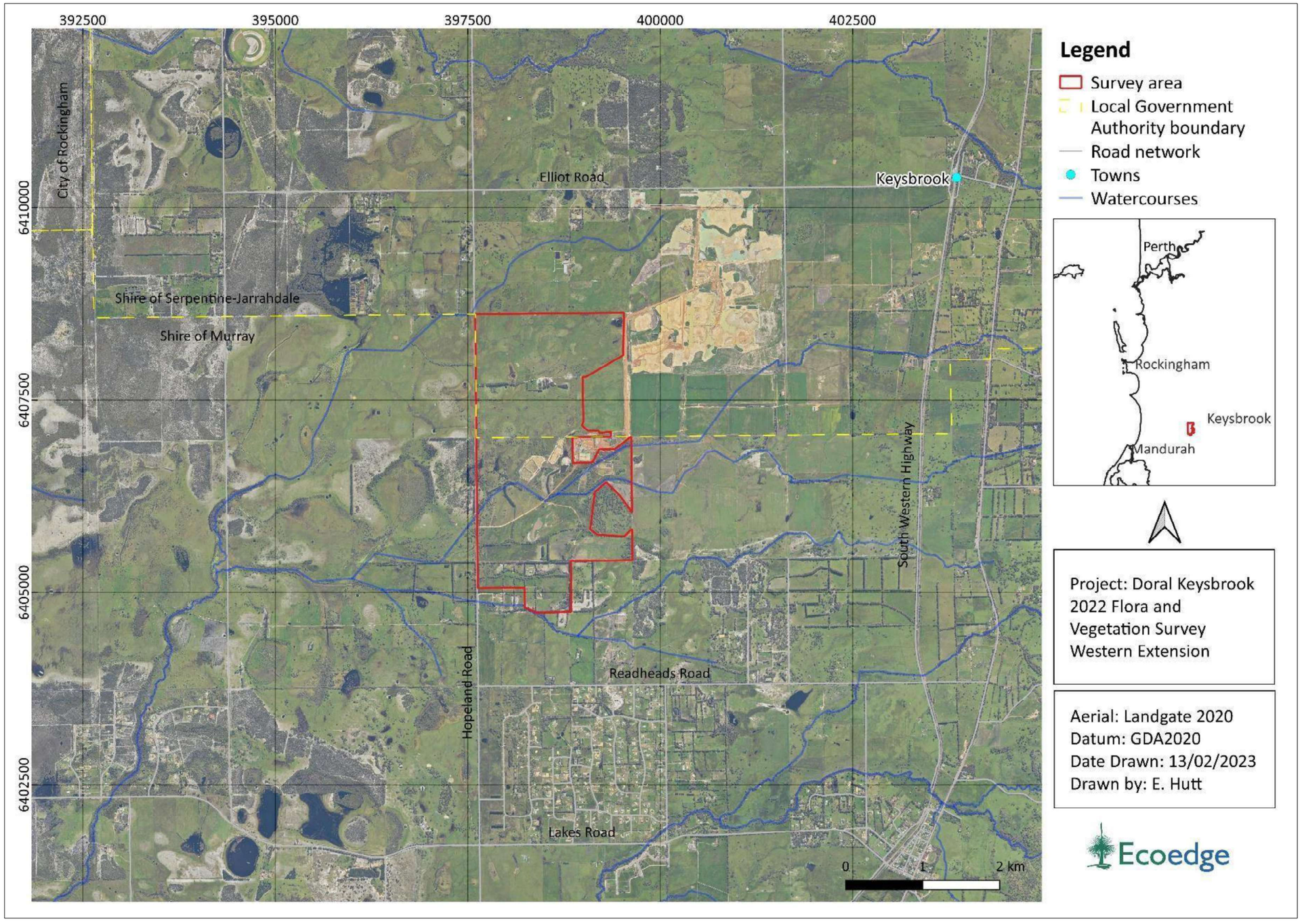


Figure 1. Aerial photograph showing the regional location of the survey area.

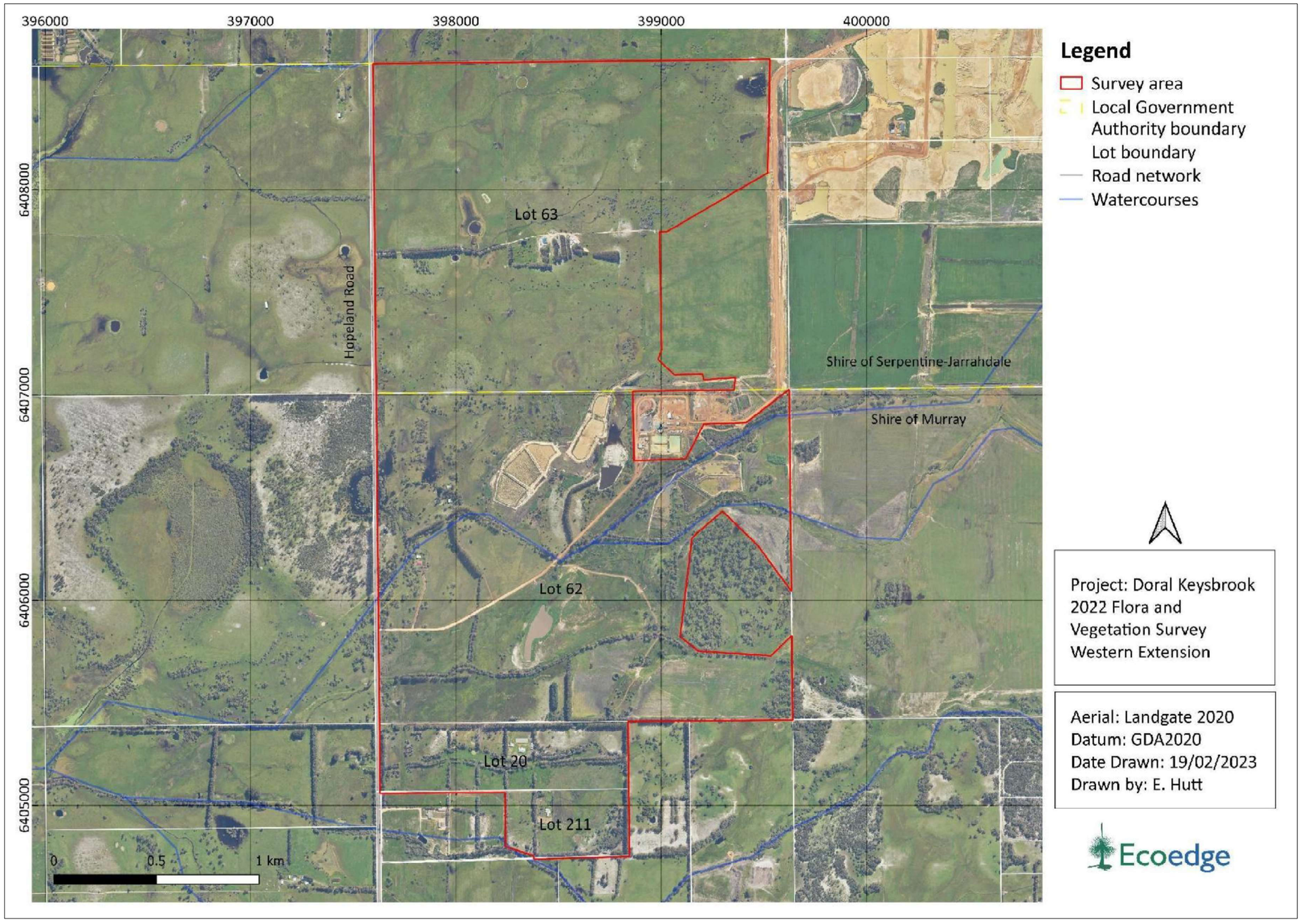


Figure 2. Aerial photograph showing the survey area.

2 Scope

The scope of the survey comprised two main parts, a desktop study and a field survey.

2.1 Desktop study

A desktop study over a 10 km radius of the survey areas was required prior to the field survey work to identify key features and constraints, which were in, or nearby the survey area, such as significant flora, significant vegetation/ecological communities, unusual or rare soil/landscape systems, surface water values, conservation estate, poorly represented vegetation associations and or vegetation complexes and environmentally sensitive areas (ESA).

2.2 Field survey

The reconnaissance and targeted field survey was required to ground-truth outcomes of the desktop assessment, with a focus on the delineation of all significant flora and significant vegetation, vegetation condition, mapping of weeds of national significance (WONS), declared pest plants listed under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and mapping of riparian vegetation.

The survey and report were required to be undertaken in accordance with the Environmental Protection Authority (EPA) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016) and other State and Commonwealth guidelines for threatened species and communities, such as approved conservation advice for *Environmental Protection and Biodiversity Act 1999* (EPBC Act) threatened species and communities.

3 Methods

3.1 Desktop assessment

Prior to the field survey, a desktop assessment within a 10 km buffer of the survey area was undertaken to provide contextual information on the flora and vegetation within the survey area. The desktop studies included a review of the following information.

- Regional geology and soil mapping (van Gool 1990, DPIRD 2017).
- Vegetation complex mapping of the South West Forest Region of Western Australia (Mattiske and Havel 1998) as updated by Webb et al. (2016).
- Beard's Pre-European Vegetation Association mapping dataset (DPIRD-006) (Beard et al. 2013, DPIRD 2019).
- WA Threatened and Priority Ecological Communities DBCA database extracts (DBCA 2021b) and TEC and PEC listings (DBCA 2018, DBCA 2021a, DBCA 2022b).
- Federal Protected Matters Search Tool results (DCCEEW 2022a).
- NatureMap search results (DBCA 2021c).
- Extract from the Department's Threatened Flora database and the WA Herbarium database (DBCA 2021d).
- Geomorphic Wetlands, Swan Coastal Plain dataset DBCA-019 (DBCA 2022a).
- Environmentally sensitive areas distribution maps and data (DWER 2021).
- Surface Hydrology Lines (National) (Crossman & Li 2015).
- Regional Ecological Linkages (Molloy et al. 2009).
- DBCA legislated lands and waters data set DBCA-11 (DBCA 2017).
- DBCA Bush Forever Area dataset DPLH-019 (DBCA 2019a).

The assessment also included a review of the following surveys.

- Ecoedge (2022). Detailed, Reconnaissance and Targeted Flora and Vegetation Survey Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road Keysbrook, Western Australia
- Ecoedge (2021). Detailed, Reconnaissance and Targeted Flora and Vegetation Survey, Lot 64 Elliot Road Keysbrook, Western Australia
- Onshore Environmental (2019). Field Assessment of Keysbrook Leucoxene Conservation Areas & Revegetation Considerations, prepared for Keysbrook Leucoxene Pty Ltd.
- Rockwater Hydrogeological and Environmental Consultants (2018). Keysbrook Project Wetland Vegetation Monitoring. Report prepared for MZI Resources Ltd.
- MBS (2004). Vegetation and Fauna Assessment of Exploration Licence 70/2407 Keysbrook, Prepared for Olympia Resources Limited.
- Bennett Environmental Consulting (BEC) (2004). Vegetation and Flora of Exploration Licence 70/2407 Keysbrook Western Australia, Prepared for MBS Environmental Pty Ltd.

3.2 Significant flora likelihood of occurrence

Prior to undertaking the survey, an assessment of the likelihood of occurrence of Threatened and Priority flora taxa identified from the desktop assessment was undertaken. The rationale for determining the pre- and post-likelihood of occurrence is provided in **Appendix 1**.

3.3 Field survey

The survey was carried out on 12 and 13 July, 18 August, 16 September and 10 November 2022 by Russell Smith (flora permit FB62000500) and Ben Eckermann (flora permit FB62000262) in accordance with the Environmental Protection Authority (EPA) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016). The earlier visit included a targeted survey for *Drakaea elastica* and *D. micrantha*.

A list of all vascular flora encountered during the survey was compiled, either in the field or from photographs and notes taken to enable later identification. Taxonomy and conservation status were checked against the latest WA Herbarium census download (DBCA 2021f).

Plant communities were described using data collected at 61 vegetation mapping note points and 155 vegetation condition points. This information as well as recent aerial photography was used to map vegetation unit and condition within the survey area.

Location of data collection points (vegetation mapping note points and vegetation condition points) and survey track files was recorded on a handheld global position system (GPS).

Vegetation condition was assessed using the method of the EPA (2016). (**Appendix 2**).

4 Survey limitations

Potential limitations with regard to the assessment are addressed in **Table 1.**

Table 1. Limitations of the field survey with regard to assessment adequacy and accuracy.

Aspect	Constraint	Comment
Scope	Not a constraint	The survey scope was prepared in consultation with the client and was designed to comply with EPA requirements.
Proportion of flora identified	Not a constraint	The survey was carried out over several months to included peak flowering seasons for the southern Swan Coastal Plain.
Climatic and seasonal effects	Minimal	Rainfall for the year till the end of October 2022 was 81% of average for the Serpentine weather station. However, the drier than average season did not appear to have affected growth and flowering of native species.
Availability of contextual information	Not a constraint	Comprehensive regional surveys of remnant vegetation, as well as more localised surveys, have been carried out on the southern Swan Coastal Plain.
Completeness of the survey	Not a constraint	The whole search area was covered on foot. Flowering was good.
Skill and knowledge of the botanists	Not a constraint	The senior field botanist conducting the survey has had extensive experience in botanical surveys in south-west Australia over a period of 25 years.
Disturbance (fire, grazing, clearing etc.)	Moderate	The survey area has historically been grazed by livestock, and it is ongoing.

5 Results desktop assessment

5.1 Biogeographic region and location

The survey area is situated within the Swan Coastal Plain (SWA02) sub-region of the Swan Coastal Plain biogeographic region, as defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Commonwealth of Australia, 2016). The survey area comprises four parcels of land totalling approximately 604.75 ha and is situated approximately 4.6 kilometres east of the Keysbrook townsite. It occurs across two local government areas – the Shire of Serpentine-Jarrahdale and the Shire of Murray. The surrounding land has been predominantly cleared for agriculture (**Figure 1**).

5.2 Tenure DBCA managed land

The survey area is not, nor in proximity to areas designated as a Conservation reserve under the Conservation and Land Management Act 1984.

5.3 Landform and soils

The survey area occurs on the Swan Coastal Plain (SCP), which is bounded by the Darling Scarp to the east, Indian Ocean to the west, Moore River to the north and Dunsborough to the south. The SCP is built up of two belts of sediments that differ in origin: aeolian sediments in the west and alluvial sediments in the east. The aeolian sediments comprise three major dune systems: The Bassendean Dune System is the most easterly and oldest system; the Quindalup System is the most westerly and youngest system, with the Spearwood system located in between. These wind deposited dunes press up against the Pinjarra plain, which is built up of alluvium deposited by streams from the Darling Plateau. Its alluvial soils are predominantly clays and silts; in places, low dunes of aeolian sands from the west may overlay the alluvial soils (Seddon 1972).

The survey area is occurs across the Bassendean land system (212_Bs) and the Pinjarra land system (213_Pj). The Bassendean land system is comprised predominantly of sand dunes and sand plains of deep, pale grey, siliceous sand intervened with sandy and clayey swamps with some black, peaty soils (van Gool 1990). The Pinjarra land system is predominantly poorly drained coastal plain, characterised by semi-wet soils that can range from grey deep sandy duplexes to brown loamy earths, pale sands and clays (van Gool 1990). These systems have been divided into soil phases based on local soil conditions, with the soil phases found in the survey area described in **Table 2** and shown in **Figure 3**.

Table 2. Soil Mapping Units occurring within the survey area (van Gool 1990).

System	Subsystem	Description
Bassendean (212_Bs)	212Bs_B1	Extremely low to very low relief dunes, undulating sandplain, and discrete sand rises with deep bleached grey sands, sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.
	212Bs_B2	Flat to very gently undulating well drained sandplain of the surface. Deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
	212Bs_B4	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.
	212Bs_B6	Imperfectly drained sandplain and broad extremely low rises. Deep or very deep grey siliceous sands.
Pinjarra (213_Pj)	213Pj_B2	Well to moderately well drained flat to very gently undulating sandplain. Deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
	213Pj_P11	Shallow brown loamy soils or less commonly, very shallow sands over ironstone pavement which is a clear barrier to drainage.
	213Pj_P1b	Flat to very gently undulating plain. Imperfectly drained and moderately susceptible to salinity in limited areas. Deep acidic mottled yellow duplex (or 'effective duplex') soils. Moderately deep pale sand to loamy sand over clay.
	213Pj_P2	Flat to very gently undulating plain. Poor to imperfectly drained. Deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam over clay.
	213Pj_P7	Seasonally inundated swamps and depressions with very poorly drained variable acidic mottled yellow and gley duplex soils.
	213Pj_P8	Broad poorly drained flats and poorly defined stream channels. Moderately deep to deep sands over mottled clays. These may be acidic or less commonly alkaline gley and yellow duplex soils to uniform bleached or pale brown sands over clay.

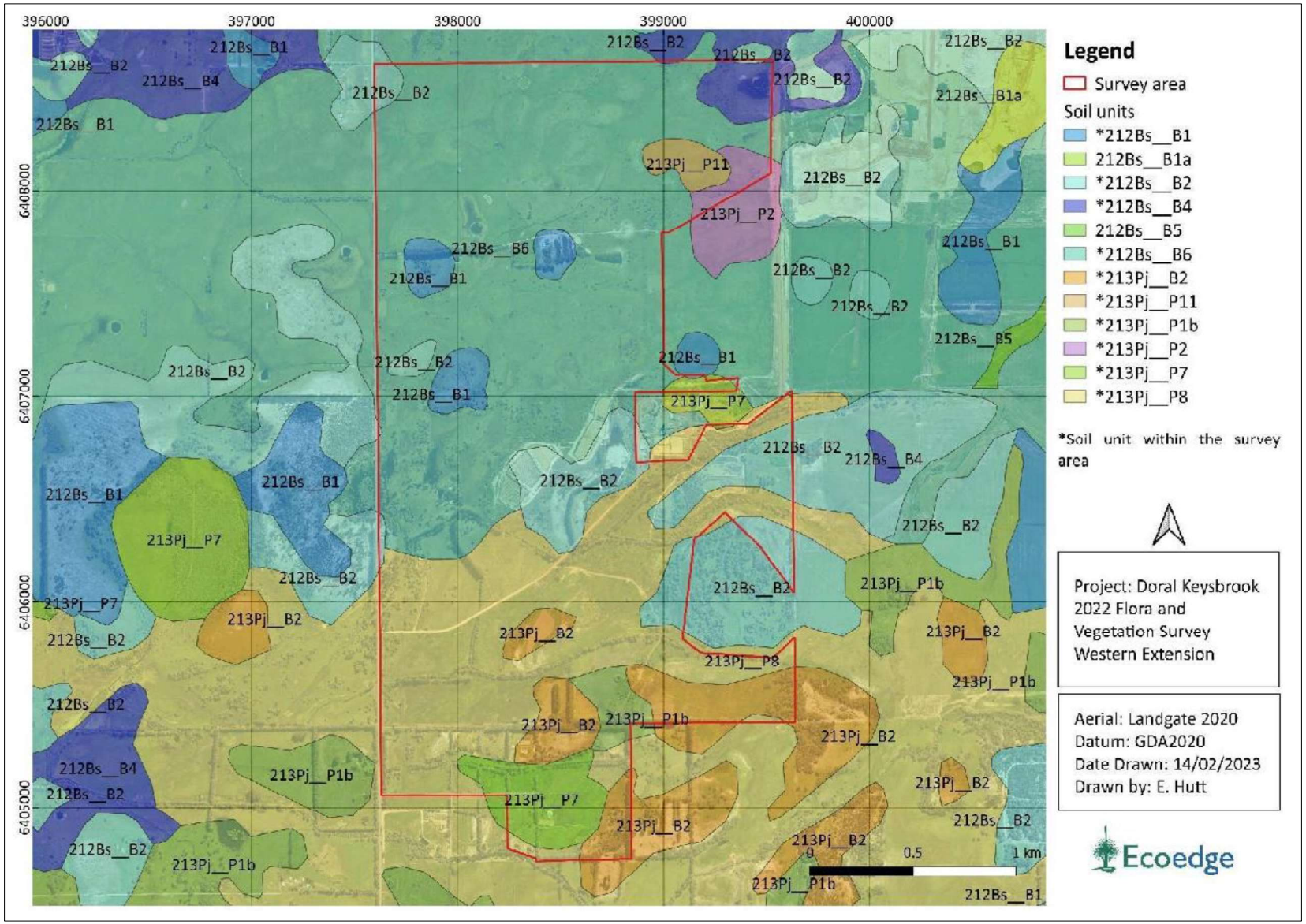


Figure 3. Soil subsystems mapped in and nearby the survey area (DPIRD 2017).

5.4 Vegetation description according to pre-European mapping datasets

5.4.1 Vegetation complexes

Three vegetation complexes occur within the survey area, according to the 1:50,000 mapping of South West Forest Region of Western Australia (Mattiske & Havel 1998) and the 1:250,000 mapping of vegetation complexes on the SCP (Heddle et al. 1980) as updated by Webb et al. (2016). These are described in **Table 3** and shown in **Figure 4**.

Table 3. Vegetation complexes mapped for the survey area (Webb et al. 2016).

Vegetation Complex	Description
Bassendean Complex – Central and South (44)	Vegetation ranges from woodland of *Eucalyptus marginata* (Jarrah) - *Allocasuarina fraseriana* (Sheoak) - Banksia species to low woodland of Melaleuca species and sedge lands on the moister sites. This area includes the transition of *Eucalyptus marginata* (Jarrah) to *Eucalyptus todtiana* (Pricklybark) in the vicinity of Perth.
Guildford Complex (32)	A mixture of open forest to tall open forest of Corymbia calophylla (Marri) - Eucalyptus wandoo (Wandoo) - Eucalyptus marginata (Jarrah) and woodland of Eucalyptus wandoo (Wandoo) (with rare occurrences of Eucalyptus lane-poolei (Salmon White Gum)). Minor components include Eucalyptus rudis (Flooded Gum) - Melaleuca rhaphiophylla (Swamp Paperbark).
Southern River Complex (42)	Open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus marginata* (Jarrah) - Banksia species with fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along creek beds.

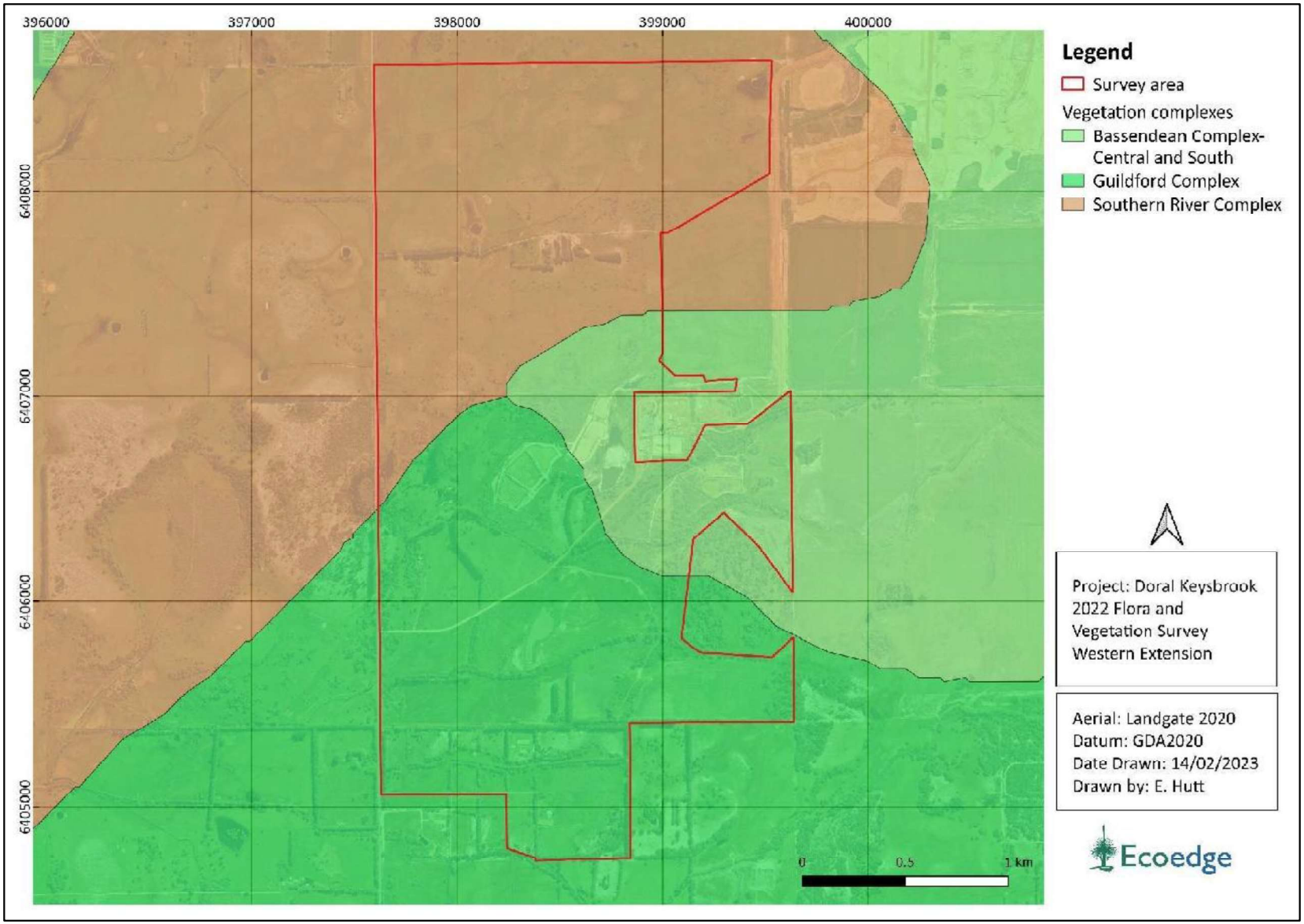


Figure 4. Vegetation complexes mapped in and nearby the survey area (Webb et al. 2016, DPaW 2018).

5.4.2 Vegetation associations

A systematic survey of native vegetation in Western Australia was undertaken by J. S. Beard (along with others) during the 1970s, which described vegetation systems in the southwest of WA at a scale of 1:250,000. Beard's vegetation mapping attempted to depict the vegetation as it might have been prior to European settlement in terms of type and extent (Beeston et al. 2001). The Beard Vegetation Association dataset, also referred to as the pre-European native vegetation extent dataset, was digitised by Shepherd et al. (2002).

Beard Vegetation Associations have been described to a minimum standard of Level 3 'Broad Floristic Formation' for the National Vegetation Inventory System (NVIS) (state-wide to regional scale) [1].

The survey area comprised only one Beard Vegetation Association: Association 968 'Medium woodland; jarrah, marri wandoo' (**Figure 5**).

[1] Beard's vegetation mapping units are referred to as 'associations' however these do not correspond to the NVIS Level 5 'Associations'. The NVIS system was developed long after Beard's work was completed, and while both classification systems use the same term, NVIS 'Associations' describe vegetation in greater detail.

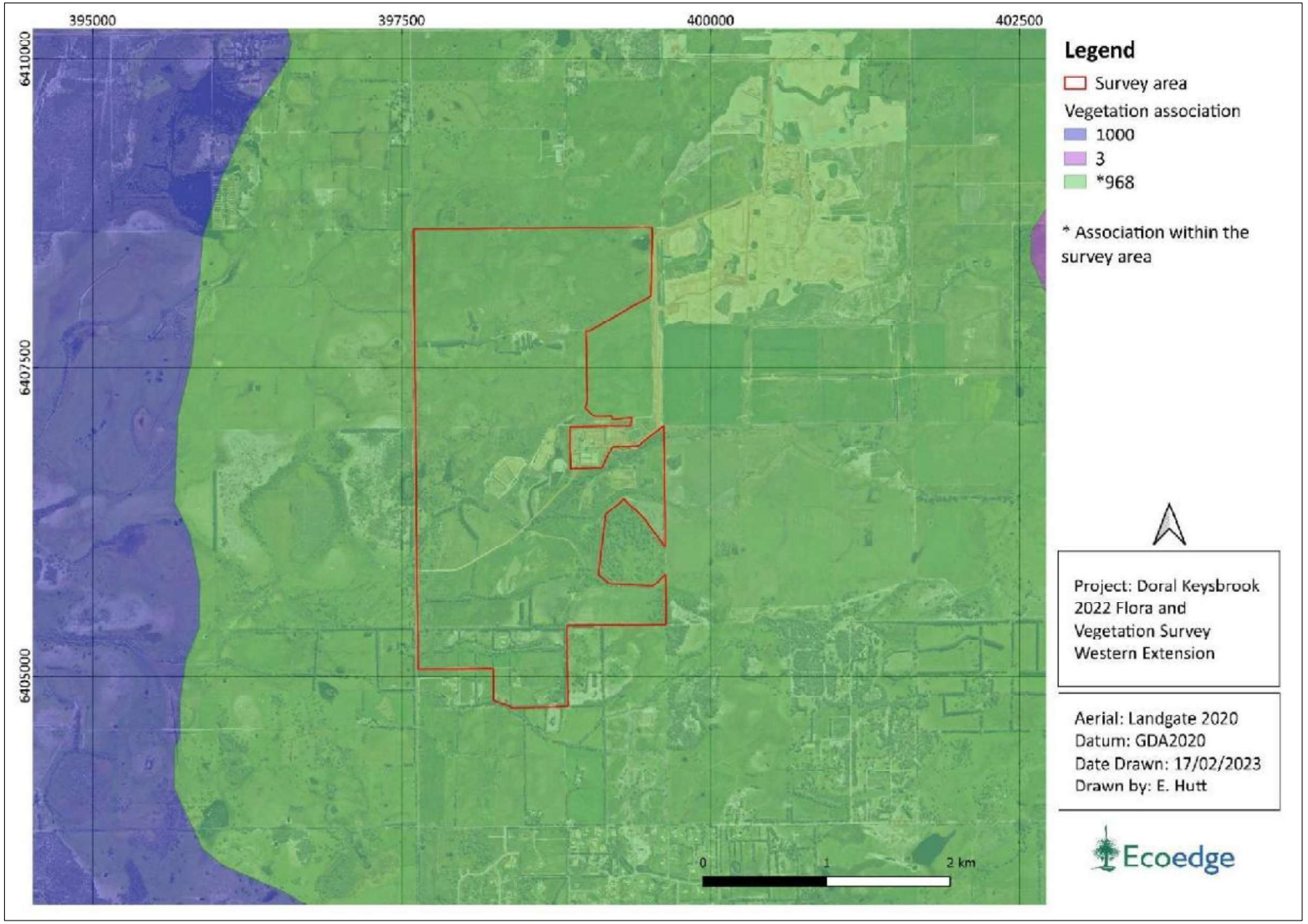


Figure 5. Vegetation associations mapped within and adjacent to the survey area (Beard et al. 2013).

5.4.3 Assessment of remaining extent against pre-European extent

In 2001, the Commonwealth of Australia stated National Targets and Objectives for Biodiversity Conservation, which recognised that the retention of 30%, or more, of the pre-clearing extent of each ecological community was necessary if Australia's biological diversity was to be protected (Environment Australia 2001).

In its report on the Statewide Vegetation Statistics incorporating the Comprehensive, Adequate and Representative (CAR) Reserve Analysis, the Government of Western Australia provides information on the pre-European and current extent of the ecological communities of Western Australia and reports on the status of the CAR reserve system for WA (Government of Western Australia, 2019a). This system is also based on the National retention targets of 30% overall. Only reserves managed by DBCA under the *Conservation and Land Management Act 1984* are considered for inclusion in the "CAR Reserve Analysis".

An assessment of the three vegetation complexes found within the survey area against the *Statewide Vegetation Statistics* (Government of Western Australia 2019) is presented in **Table** 4. The extent remaining of all three complexes falls below the 30% state-wide retention target at a state wide and local government level, with the exception of the Bassendean Complex – Central and South in the Shire of Serpentine-Jarrahdale, which exceeded the retention target with 32.14%.

Table 5 presents the same statistics for the one Beard Vegetation Association mapped across the survey area: Association 968. While at a state wide level, the extent remaining of this association exceeds the retention target at 32.02%, the association is poorly represented at IBRA and local government area levels, falling below 10% extent remaining.

The red, orange and yellow shading in the tables indicates the status of the Commonwealth 30% retention target.

Status of the Commonwealth retention target	>30%	<30%	<10%

Table 4. Vegetation complexes mapped within the survey area with regard to the Commonwealth retention targets (Government of Western Australia, 2019).

Vegetation Complex	Pre-European (ha)	Current Extent (ha)	% Remaining	% Remaining in DBCA Reserves
Bassendean Complex - Central and South (44)				
Swan Coastal Plain	87,476.25	23,508.66	26.87	5.0
Shire of Murray	13,703.04	3,314.45	24.19	-
Shire of Serpentine-Jarrahdale	9,852.42	3,166.25	32.14	-
Guildford Complex (32)				
Swan Coastal Plain	90,513.13	4,607.91	5.09	0.32
Shire of Murray	28,559.76	1,530.61	5.36	-
Shire of Serpentine-Jarrahdale	12,986.67	552.25	4.25	-
Southern River Complex (42)				
Swan Coastal Plain	58,781.48	10,832.18	18.43	1.60
Shire of Murray	6,556.41	1,459.96	22.27	-
Shire of Serpentine-Jarrahdale	7,653.19	674.36	8.81	-

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

Table 5. The vegetation association within the survey area with regards to the Commonwealth retention targets (GoWA 2019a).

Beard Vegetation Association	Pre-European (ha)	Current Extent (ha)	% Remaining	% remaining in DBCA Managed Land*
Association 968				
State-wide	296,877.84	95,048.82	32.02	18.45
IBRA region: Swan Coastal Plain (SWA)	136,188.20	9,017.32	6.62	1.43

Beard Vegetation Association	Pre-European (ha)	Current Extent (ha)	% Remaining	% remaining in DBCA Managed Land*
IBRA sub-region Perth (SWA02)	136,188.20	9,017.32	6.62	1.43
Shire of Murray	47,585.28	4,135.26	8.69	2.41
Shire of Serpentine-Jarrahdale	24,351.49	1,121.13	4.60	0.57

* Excludes Crown Freehold Department Interest Lands that are managed under Section 8(a) of the CALM Act.

5.5 Conservation areas

The DWER offset calculator requires information on the following areas.

- Crown reserve established under the CALM Act 1984 or Land Administration Act 1997 for the purpose of conservation (**section 5.2**),
- Bush Forever Area (**section 5.11**),
- Conservation covenant, (**section 5.2**),
- Other conservation area.

The survey area does not contain any of these conservation areas.

5.6 Threatened and Priority ecological communities

Ecological communities are defined by Western Australia's DBCA (previously DPaW and the Department of Environment and Conservation (DEC)) as "...naturally occurring biological assemblages that occur in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole, they provide many of the processes which support specific ecosystems and provide ecological services." (DEC, 2013).

Under Section 27 of the *Biodiversity Conservation Act 2016* (BC Act), the Western Australian Minister for Environment may list communities considered to be under significant threat as a Threatened ecological community (TEC). These TECs can be listed under one of three conservation categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU). The BC Act also provides for listing communities as collapsed ecological communities.

Possible TECs that do not meet survey criteria are added to the DBCA's Priority ecological community lists under Priorities 1, 2 or 3 (referred to as P1, P2, P3). Ecological communities that are adequately known, 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 (P4). These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (P5) (DEC 2013).

The current listing of Threatened and Priority ecological communities is specified in DBCA (2018, 2021). The conservation categories for these Threatened and Priority ecological communities are defined in **Appendix 3**.

TECs can also be listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There are three categories of TEC under the EPBC Act: Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (Department of Climate Change, Energy, the Environment and Water) (DCCEEW 2022b). These are defined in **Appendix 4.**

Under both the State BC Act and the Federal EPBC Act, ministerial authorisation is required where significant permanent modification to a TEC will occur.

Noting that if an occurrence of a TEC is found during a survey conducted under the auspices of the *Environmental Protection Act 1986* (EP Act), it must be mandatorily reported to the Chief Executive Officer of the DBCA under Section 49 of the BC Act.

The desktop assessment found four EPBC Act listed TEC and eight BC Act listed TEC occurring within 10 km of the survey area, based on results generated from an extract from the DBCA databases (DBCA 2021b) and a 10 km radius Protected Matters Search Tool (PMST) query (DCCEEW 2022b). Two PECs were recorded in the search area. These communities are listed in **Table 6.**

Of these communities, only the Banksia Woodlands of the Swan Coastal Plain TEC PEC have buffers mapped over the survey area **Figure 6** (DBCA 2021b).

Copies of the NatureMap (excel) and PMST data searches are provided in **Appendix 5.**

Table 6. Threatened and Priority ecological communities occurring and possibly within 10 km of the survey area (DBCA 2021b, DCCEEW 2022b).

Community Name	Status (WA)	Status (EPBC Act)
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain (SCP3c)	T (CR)	EN
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain (SCP3a)	T (CR)	EN
Claypans of the Swan Coastal Plain – comprising of four state-listed ecological communities, three of which occur in the study area: • Herb rich saline shrublands in clay pans (SCP07) – Vulnerable • Herb rich shrublands in clay pans (SCP08) – Vulnerable • Shrublands on dry clay flats. (SCP10a) – Endangered.	T (VU-EN)	CR
'Banksia Woodlands of the Swan Coastal Plain' – a federally listed TEC which can occur in a number of State-listed communities, two of which occur in the study area: • *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (SCP20b) • Low lying *Banksia attenuata* woodlands or shrublands (SCP21c)	P3	EN
Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain (SCP15)	T (VU)	-
Corymbia calophylla - Eucalyptus marginata woodlands on sandy clay soils of the southern Swan Coastal Plain (SCP3b)	T (VU)	-

Note: This table only includes formally recognised TECs that are known of and mapped, and included in the DBCA's database.

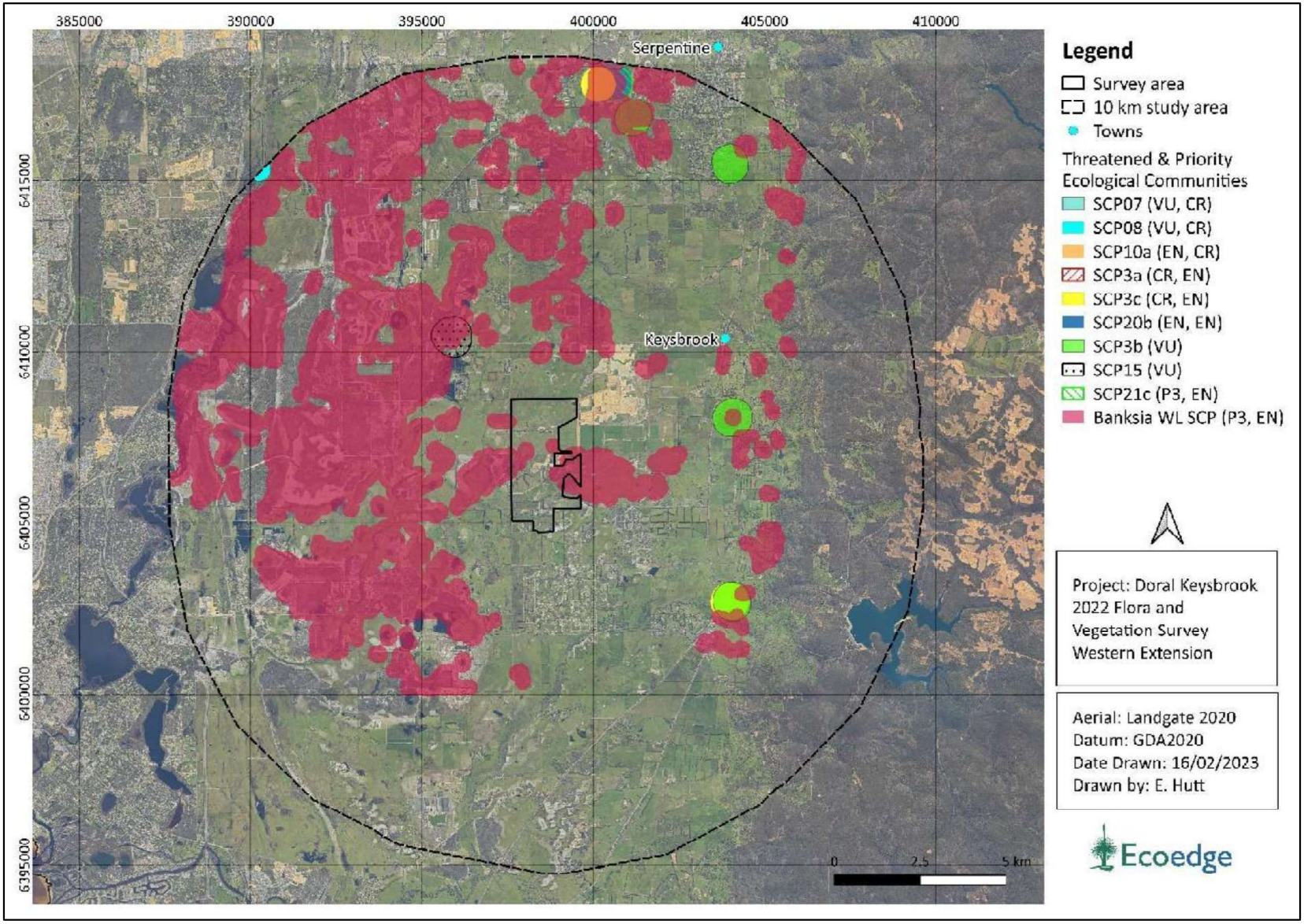


Figure 6. Location of TECs and PECs within a 10 km radius of the survey area (DBCA 2021b).

5.7 Threatened and Priority flora

Species of flora are defined as having a Threatened or Priority conservation status where their extant populations are restricted geographically and/or under threat of possible extinction. The DBCA recognises these threats and consequently applies regulations towards population and species protection.

Threatened extant flora species are listed under Section 19 of the BC Act. They are ranked according to their level of threat using the International Union for Conservation of Nature (IUCN) Red List categories and criteria of Critically Endangered (CR), Endangered (EN), Vulnerable (VU). It is an offence to "take" or damage Threatened flora without Ministerial approval. Section 5 of the Act defines "to take" as "… to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means".

Priority flora is under consideration for future declaration as "Threatened flora", dependent on more information. Species classified as Priority One to Three (referred to as P1, P2 and P3) require further survey to determine their status. Priority Four (P4) species are adequately known rare or Threatened species that require regular monitoring.

Threatened flora lists are formally reviewed annually, whilst the Priority flora list is subject to a less formal ongoing review. The current listing of Threatened and Priority flora was updated on the 6 October 2022 (DBCA, 2022b).

Categories of Threatened and Priority flora as defined by the BC Act are presented in **Appendix 6** (DBCA 2019b).

Threatened flora may also be protected under the Commonwealth EPBC Act and be listed in one of six categories; the definitions of these categories are summarised in **Appendix 7** (DCCEEW 2020).

Threatened or Priority flora occurring within 10 km of the project area generated from a NatureMap search, DBCA Threatened and Priority data search query and a Protected Matters Search Tool query, **Appendix 5** (DBCA 2021c, DBCA 2021d, DCCEEW 2022b). Full details are provided in a likelihood of occurrence table in **Appendix 8.** A number of the species listed in **Appendix 8** could potentially occur within the survey area, based on an assessment of their preferred habitats. There was one P3 species that has a pre-survey likelihood of occurring (**Table 7**). **Table 8** provides a summary of the pre survey likelihood of occurrence. Location of Threatened and Priority flora within a 10 km radius of the survey area (DBCA 2021d) are shown in **Figure 7**.

Table 7. Significant flora assessed as likely to occur within the survey area.

No.	Species	Conservation status
1	*Acacia benthamii*	P3

Table 8. Likelihood of occurrence according to conservation status.

Likelihood of occurrence	Total number	Priority 1	Priority 2	Priority 3	Priority 4	Threatened
Likely	**1**	-	1	-	-	-
Possible	**8**	1	1	1	2	3
Unlikely	**40**	4	1	12	8	15
Total	**49**	**5**	**3**	**13**	**10**	**18**

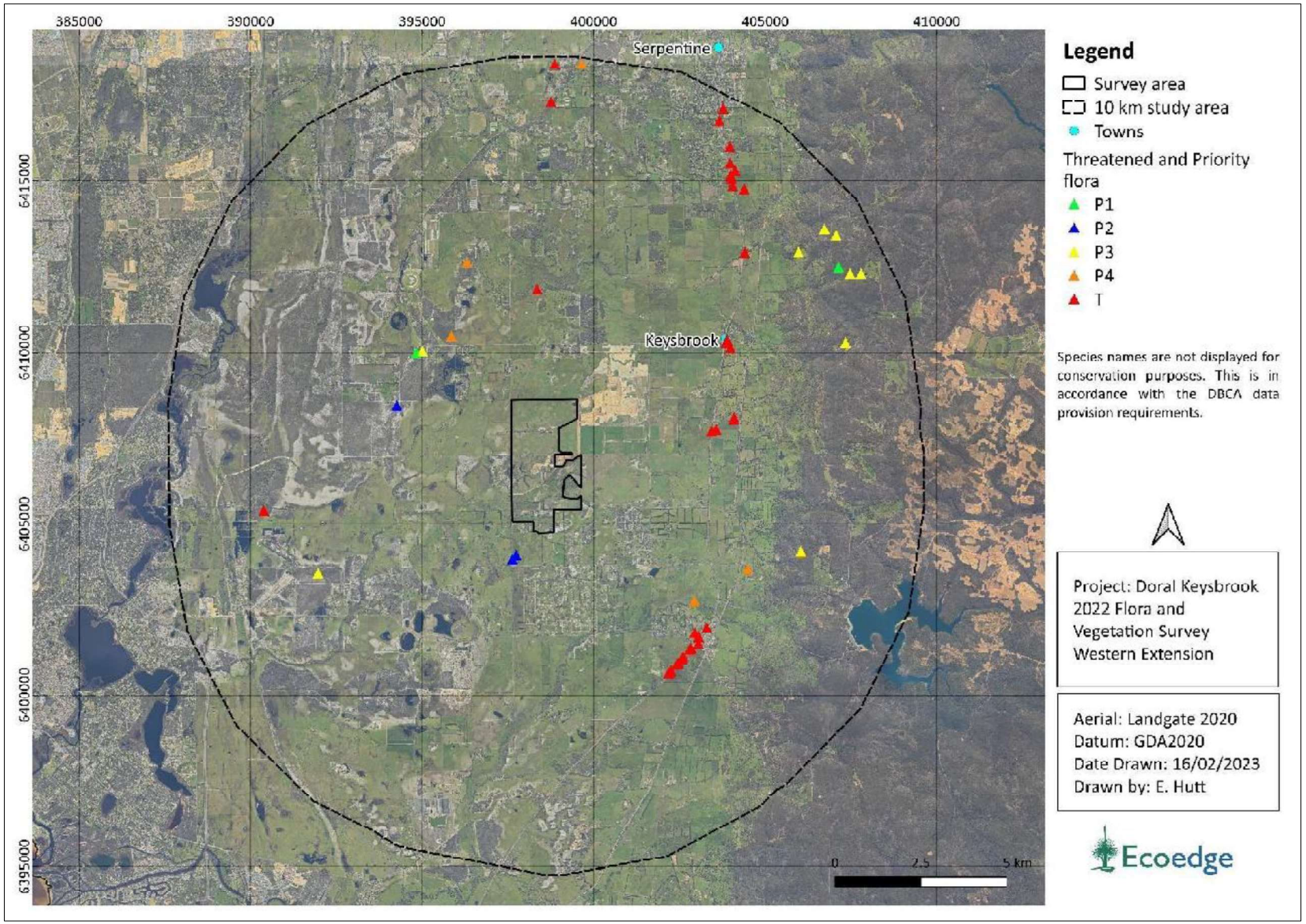


Figure 7. Location of Threatened and Priority flora occurring within a 10 km radius of the survey area (DBCA 2021d).

5.8 Wetlands and watercourses

Wetlands on the Swan Coastal Plain have been classified into types using the geomorphic wetland classification system of Semeniuk & Semeniuk (1995), which is based on the characteristics of landform and water permanence, for example, lakes, palusplains and damplands. These are described in **Table 9.** The Swan Coastal Plain wetlands have also been evaluated and assigned an appropriate management category and corresponding category objective, providing guidance on the nature of the management and protection the wetland should be afforded. These categories are described in **Table 10.**

Table 9. Wetland types (adapted from Semeniuk & Semeniuk, 1995).

Management Category	Basin	Flat	Channel	Slope	Highland
Permanently inundated	Lake		River		
Seasonally inundated	Sumpland	Floodplain	Creek		
Intermittent inundation	Playa	Barlkarra	Wadi		
Seasonally waterlogged	Dampland	Palusplain	Trough	Paluslope	Palusmont

Table 10. Definitions of and objectives for the different wetland management categories (EPA 2008).

Management Category	Definition	Category Objective
Conservation	Wetlands with high conservation value for both natural or human use.	To preserve wetland (natural) attributes and functions.
Resource Enhancement	Wetlands with moderate natural and human use attributes that can be restored or enhanced.	To restore wetlands through maintenance and enhancement of wetland functions and attributes.
Multiple Use	Wetlands that score poorly on both natural and human use attributes.	To use, develop and manage wetlands in the context of water, town and environmental planning.

A system of wetlands is mapped across the survey area, expressed as seasonally waterlogged palusplain covering most of the northern and western portions of the survey area, dipping down to areas of seasonally waterlogged damplands in the south-eastern corner (**Figure 8**). In the middle of the survey area, two unnamed drainage canal lines enter from the east of the survey area and merge before exiting on the western boundary (**Figure 8**).

Most of these wetlands have been categorised as Multiple Use with smaller areas scattered within the survey area categorised as Resource Enhancement (**Figure 9**). One Conservation Category wetland (UFI 14870), which is 0.775 ha in size, occurs in the northwest of the survey area (**Figure 9**)**.**

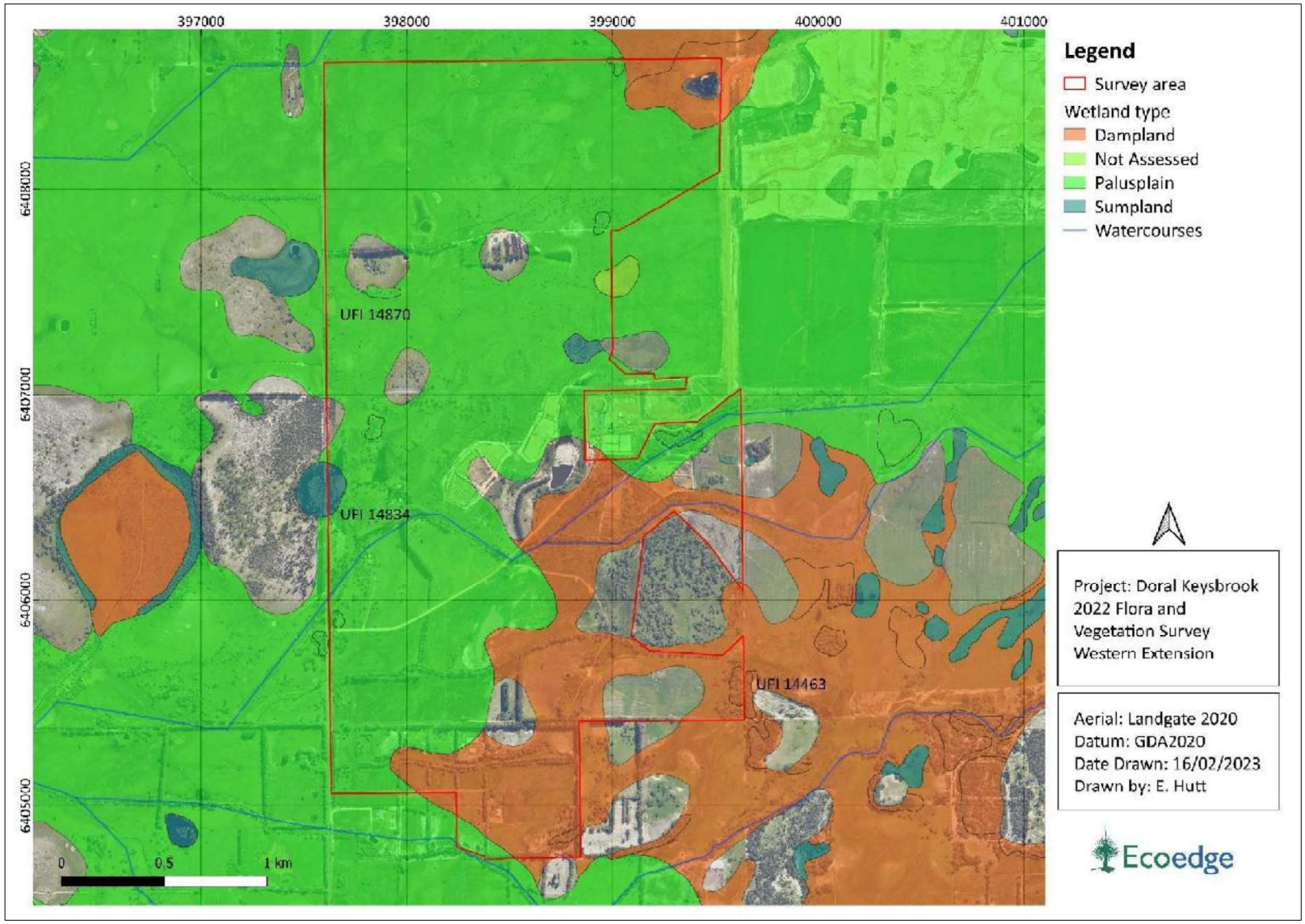


Figure 8. Geomorphic wetlands within and in proximity to the survey area (DBCA 2022a).

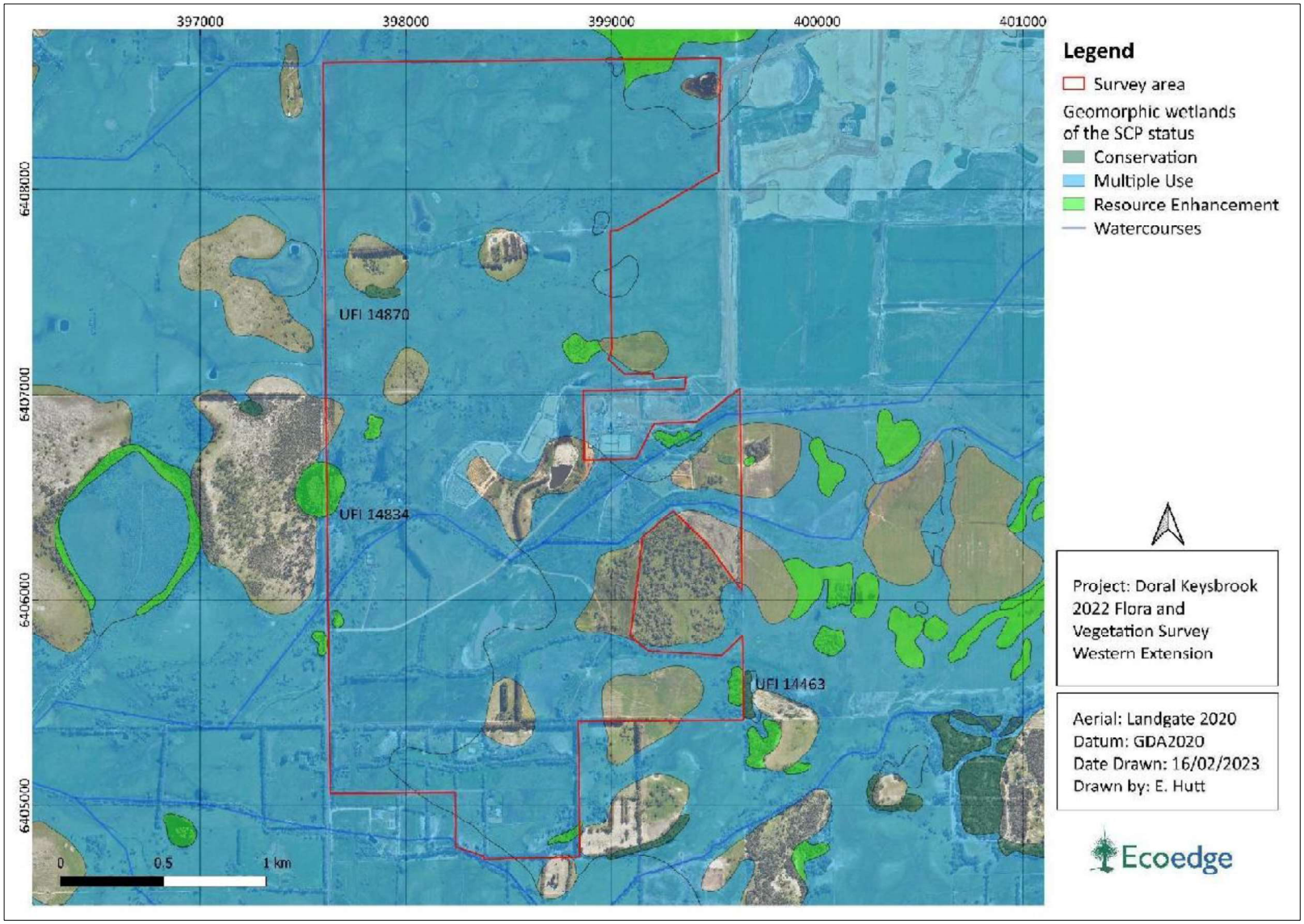


Figure 9. Geomorphic wetland status within and in proximity to the survey area (DBCA 2022a).

5.9 Regional ecological linkages

Regional ecological linkages "link protected patches of regional significance by retaining the best (condition) patches available as stepping stones for flora and fauna between regionally significant areas" (Molloy et al. 2009).

Regional ecological linkages have been mapped by Molloy et al. (2009) across the SW of WA in an area spanning between just north of Mandurah to Walpole in the southeast.

Molloy et al. (2009) assessed and assigned 'proximity value' (PV) ratings to all patches of remnant native vegetation as a way of indicating the value of their connectivity with regional ecological linkages. This was based on their distance from the nearest mapped regional ecological linkage axis line and connected parcels of remnant vegetation (**Table 11**).

Table 11. Linkage proximity values rating assigned to patches of remnant vegetation within a landscape by Molloy et al. (2009).

Proximity value	Description
1a	with an edge touching or < 100 m from a linkage
1b	with an edge touching or < 100 m from a natural area selected in 1a
1c	with an edge touching or < 100 m from a natural area selected in 1b
2a	with an edge touching or < 500 m from a linkage
2b	with an edge touching or < 500 m from a natural area selected in 2a
2c	with an edge touching or < 500 m from a natural area selected in 2b
3a	with an edge touching or < 1000 m from a linkage
3b	with an edge touching or < 1000 m from a natural area selected in 3a
3c	with an edge touching or < 1000 m from a natural area selected in 3b

Regional Ecological linkages have also been mapped for the Perth Metropolitan Region Scheme area. These linkages link patches of remnant vegetation judged to be of regional significance, such as Bush Forever Sites.

A regional ecological axis line mapped by Molloy et al. (2009) intersects with the survey area in the south-eastern corner. This axis line crosses into the survey area approximately 28 m at its deepest point and the length of its intersection is approximately 169 m. There are vegetation parcels linked to this axis line in the south-eastern corner with a linkage PV rating of 1a. On the eastern side of the survey area, further vegetation parcels are categorised as 1b, 1c and 2a PV ratings based on their levels of separation from the axis line and nearby canal lines.

There is a Perth Metropolitan Regional Ecological Link located approximately 3km to the north of the survey area and are associated with Bush forever site BF77 Yangedi swamp link (**Figure** 10).

5.10 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are protected under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. They are selected for their environmental values at State or National levels (Government of Western Australia, 2005). They include:

- Defined wetlands and riparian vegetation within 50 m,
- Areas covered by Threatened ecological communities,
- Area of vegetation within 50 m of Threatened flora,
- Bush Forever sites,
- Declared World Heritage property sites.

There is one mapped ESA in the north western portion of the survey area (**Figure 11**). This ESA is associated with the Conservation Category wetland UFI 14870. Another ESA intersects with the survey area boundary in the south eastern corner and is associated with the Conservation Category wetland UFI 14465 and the regional ecological axis line described in **subsection 5.9** and mapped in **Figure 10.** The wetlands were previously described in **subsection 5.8** and mapped in **Figure 9**.

5.11 Bush Forever sites

The Bush Forever program is a strategic plan implemented in 2000 by the State Government for the conservation of bushland within the Swan Coastal Plain portion of WA. A key objective of the program was to retain the Swan Coastal Plain's rich biodiversity by identifying and protecting the most significant and representative areas of the SCP's 26 naturally occurring vegetation complexes (Department of Environmental Protection 2000). The protection and management of these sites when considering land use planning processes is addressed by State Planning Policy 2.8 – Bushland policy for the Perth Metropolitan Region.

There is one Bush Forever site (BF77 Yangedi Swamp) in proximity to the survey area, however it is approximately 2.5 km to the north west and has no ecological or vegetation connections to the survey area (**Figure 10**).

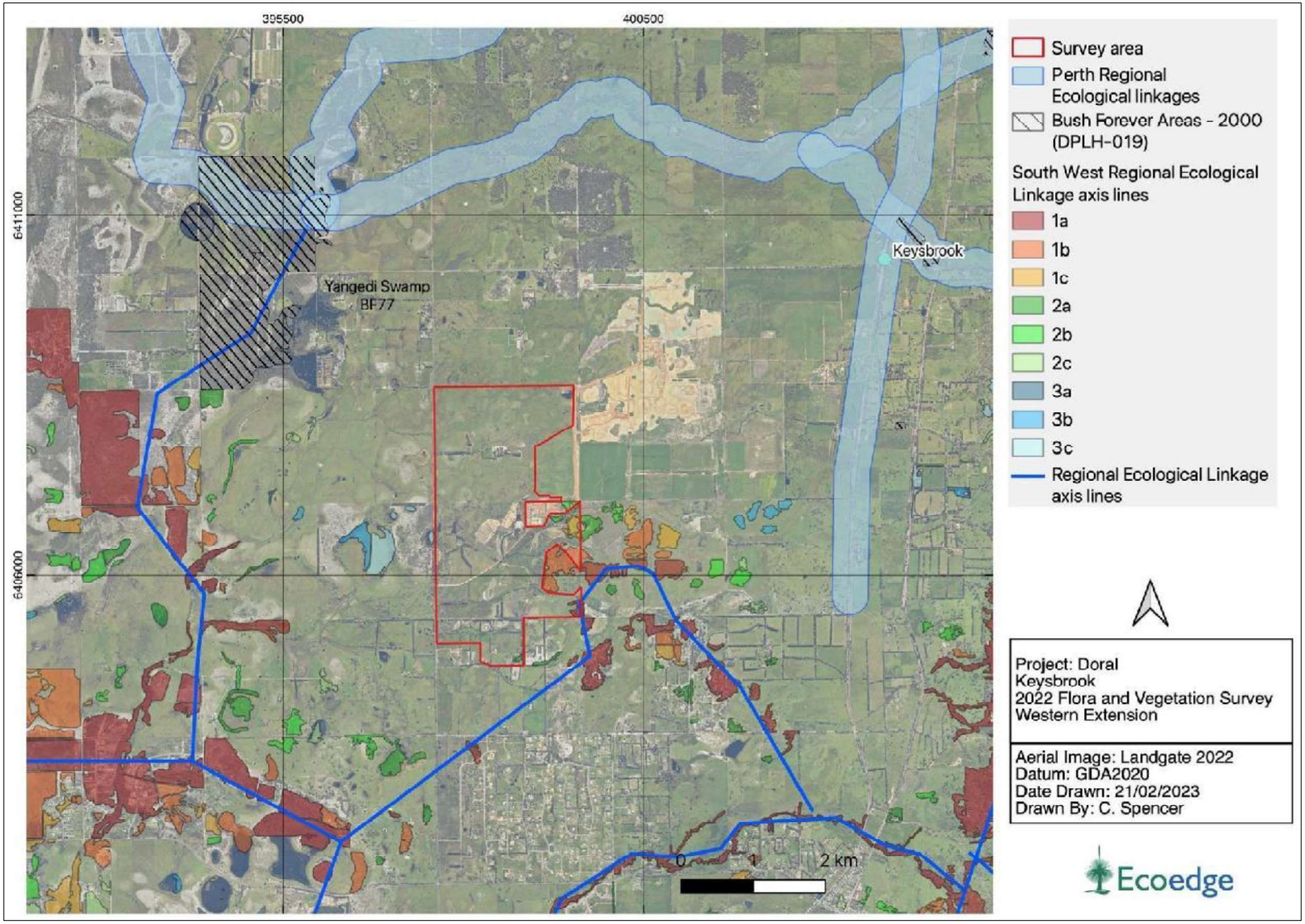


Figure 10. The survey area in relation to regional ecological linkages (Molloy et al. 2009) and Bush Forever Sites (DBCA 2019a).

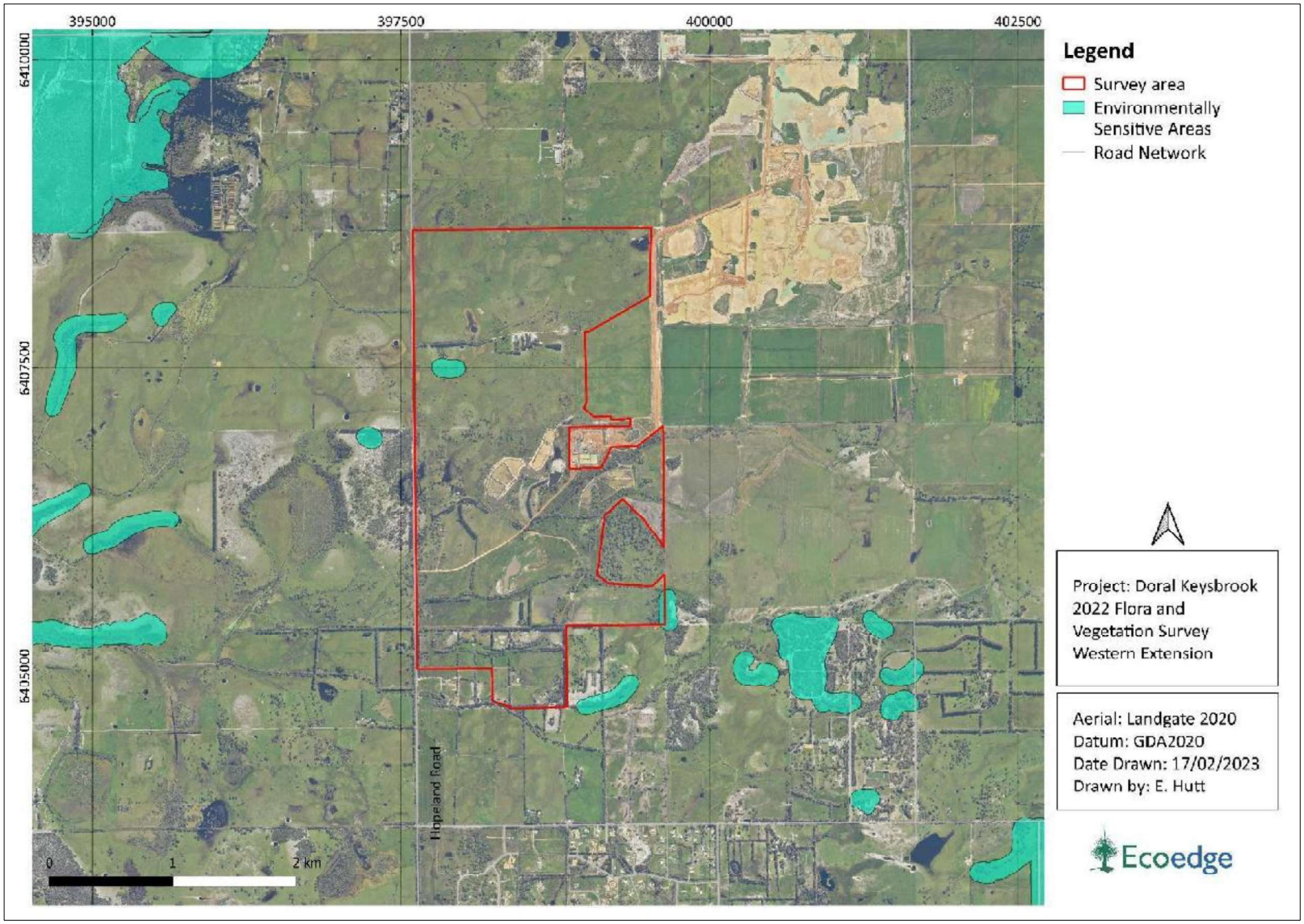


Figure 11. Environmental Sensitive Areas in proximity to the survey area (DWER 2021).

5.12 Other reports

A number of ecological reports, including flora and vegetation surveys, have been prepared over and surrounding the survey area. Summaries of six reports relevant to the current survey are provided below. These are relevant because they occur over or are directly adjacent to the survey area and present the most current assessment of the survey to date. They are presented in chronological order.

MBS Environmental (2004). Vegetation and fauna assessment of Exploration Licence 70/2407. Prepared for Olympia Resources Limited.

- Survey area focused on several free title farming properties (**Figure 12**).
- Preliminary field assessment and reconnaissance survey occurred over the period of 19-20 May 2004.
- Objectives were to identify, assess and map vegetation types, identify habitats where significant flora may occur, and provide recommendations on further flora surveys if required.
- 'Open Marri woodland' and '*Regelia ciliata, Hypocalymma augustifolium* dominated seasonal wetland' vegetation types were found in the Linga East property and were recorded as being in Very Good condition.
- *'Kunzea glabrescens* thickets with patches of *Banksia ilicifolia'* was recorded in the Linga West property and was in Good condition.
- The vegetation on the remaining properties were recorded as being in Degraded to Completely Degraded condition due to clearing, grazing and fire.
- No TEC or PECs or Threatened flora were recorded in the survey.

Bennett Environmental Consulting Pty Ltd (2004). Vegetation and flora of Exploration Licence 70/2407 Keysbrook Western Australia. Prepared for MBS Environmental.

- The survey area focused on the remnant vegetation found in MBS (2004) survey (**Figure** 12).
- A detailed and targeted survey was conducted over 27-28 October 2004.
- The objective of this survey was to map the vegetation and list flora and to record any Threatened and Priority flora occurring in the survey area.
- A total of 40 vascular plants, 119 genera ad 169 species were recorded.
- Nine different vegetation units, representing six Floristic Community Types were recorded and ranged from Very Good to Completely Degraded in condition. All vegetation had been impacted by grazing or clearing.
- Potential TECs and PECs were either too small or too degraded to meet the threshold to be considered as a TEC or PEC.

- No Threatened flora was recorded during the survey.

Rockwater Hydrogeological and Environmental Consultants (2018). Keysbrook Project Wetland Vegetation Monitoring. Report prepared for MZI Resources Ltd.

- Part of the objective of this survey was to monitor vegetation health of Conservation Category wetlands in the vicinity of the Keysbrook Mineral Sands Project as part of its Water Management Plan (MBS 2013).
- Monitoring was undertaken in autumn of 2018 with a series of photo monitoring points recorded (**Figure 12**).
- Wetland 14463 (**Figure 9**) was recorded as having disturbed Low Forest of *Corymbia calophylla* and *Melaleuca preissiana* over Open Low Sedges (*Tetraria capillaris* and *Mesomelaena tetragona*). Vegetation of the site was not considered representative of wetland vegetation in the area and the mapping data for the site had been questioned.
- It was noted that multiple disturbances had impacted understory vegetation at all locations of wetland monitoring and the majority of the sites contain degraded, parkland-cleared vegetation.
- There was no change in vegetative health in the wetlands south of the approved mining boundary and the wetlands within the vicinity of the survey area ranged from Completely Degraded to Degraded.

Onshore Environmental (2019). Field Assessment of Keysbrook Leucoxene Conservation Areas & Revegetation Considerations. Prepared for Keysbrook Leucoxene Pty Ltd.

- Surveys were undertaken in the Northern Conservation Area (50 ha) and the Southern Conservation Area (27 ha) (**Figure 12**).
- The objective of this survey was to describe and map vegetation types and condition, compile a species list for each vegetation type and develop revegetation recommendations to address native revegetation compliance obligations.
- A total of 107 plant taxa from 40 families and 84 genera were recorded from the two survey areas.
- No Threatened flora was recorded during this survey.
- Four vegetation units (MICcEr, MIMp, SDCcXpKaXb and SDEmAf) were recorded in the survey areas.
- 5% (4 ha) of the vegetation was rated as being in Good condition, and the remainder of the vegetation was rated as either Degraded (37% or 28.6 ha) and Completely Degraded (21% or 16.2 ha).
- *Phytophthora cinnamoni* was mentioned in the report but not mapped.

Ecoedge (2021). Detailed and Targeted Flora and Vegetation Survey Keysbrook, Western Australia. Prepared for Doral Mineral Sands.

- A detailed and targeted flora survey was undertaken in October 2020 as part of investigations into future mining opportunities.
- The survey area covered 17.4 ha (**Figure 12**).

- Seventy three species of vascular plants were identified in the survey area, with 19 (26%) introduced taxa.
- No Threatened flora was recorded.
- No Declared Pest Plants or Weeds of National Significance were found.
- Three vegetation units (Jarrah-Banksia-Sheoak woodland subunits A1 and A2, Jarrah-Marri open forest unit B and *Melaleuca preissiana* dampland subunits C1 and C2) were identified in the survey area.
- None of the vegetation units were regarded as occurrences of a TEC or PEC.
- Most of the native vegetation was in Completely Degraded (55%) or Degraded (39%) condition due to grazing and potentially *Phytophthora* dieback.

Ecoedge (2022). Detailed, Reconnaissance and Targeted Flora and Vegetation Survey. Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road Keysbrook, Western Australia. Prepared for Doral Mineral Sands.

- A detailed and targeted flora survey was undertaken In June 2021 as part of investigations into future mining opportunities.
- The survey area covered 530 ha (**Figure 12**).
- One hundred and nineteen species of vascular flora were identified within the survey area, 25 (21%) of which were introduced taxa.
- No Threatened flora was found within the survey area.
- Five vegetation units (EmCcBaBmOF, CcEmAfOF, CcEmXpOF, CcOF, ErMrOW) were identified and mapped within the survey area.

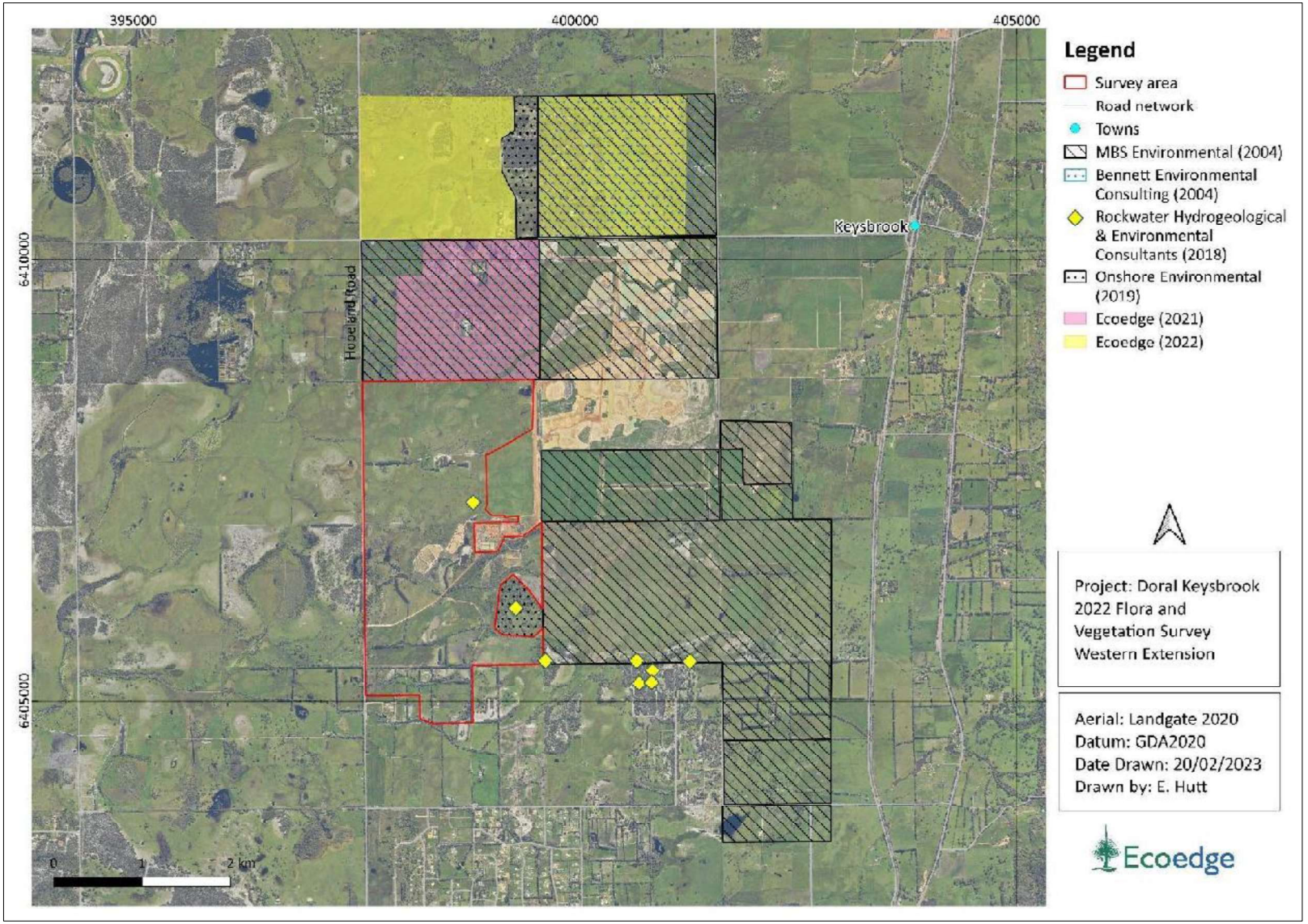


Figure 12. The location of the survey area in relation to other previous relevant flora and vegetation surveys.

6 Survey results

6.1 Flora

Forty-nine species of vascular flora were identified within the survey area, of which 27 (55%) were introduced non-native taxa. There were another six taxa that were amenity plantings. Families with the highest number of taxa were Myrtaceae (twelve species, four of them being plantings), and Poaceae (all introduced species).

Tracklog and vegetation condition notes were recorded, and locations are shown in **Appendix 9**. A list of species found during this survey is provided in **Appendix 10**.

6.2 Threatened and Priority flora

There were no threatened or priority flora or other species of conservation significance recorded within the survey area. Targeted surveys were carried out for the threatened orchids *Drakaea elastica* and *D. micrantha* on 18 August and 16 September.

6.3 Environmental weeds and Declared Pest plants

One of the introduced species, Cape tulip (**Moraea flaccida*) is a Declared Pest plant in Western Australia under the *Biosecurity and Agriculture Management Act 2007* (Department of Water Agriculture and the Environment, 2021[2]).

[2] Department of Water Agriculture and the Environment, 2021. Weeds of National Significance. http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html

7 Vegetation units

Seven vegetation mapping units or subunits were recognized and mapped for the survey area and are described in **Table 12**, below. The two dryland units, A1 and A2, were virtually all Completely Degraded, with almost no native taxa in the understorey. Two of the wetland or dampland units (B1, B2) were almost equally as degraded, while unit C, which consists of sedgeland was mainly classified as Degraded. Unit D, which covers only 0.4 ha, was classed as Good condition although it appears to mainly comprise plantings. Unit P was planted varieties of *Eucalyptus.* Photographs of each vegetation unit is provided in **Appendix 11**.

Because of their location on low sandy dunes units A1 and A2 may have contained *Banksia attenuata* or *B. menziesii* at one time, however through a combination of livestock grazing, intermittent frazing and the probable presence of Phytophthora dieback disease these species are no longer present.

None of the vegetation units resembles a TEC or PEC, because of their state of degradation.

Table 12. Description of vegetation units and subunits in the survey area.

Unit Code	Description
A1	Mid-height open forest or woodland of *Corymbia calophylla* (occasionally with *Allocasuarina fraseriana*, *Eucalyptus marginata*, *Melaleuca preissiana* or *Nuytsia floribunda*) over scattered *Kingia australis* tall shrubs over forbland including **Arctotheca calendula*, **Lolium* spp., **Lotus subbiflorus*, **Rumex* spp., **Trifolium repens* on grey loamy sand.
A2	Mid-height open forest or woodland of *Eucalyptus marginata* and *Allocasuarina fraseriana* over scattered *Xylomelum occidentale* low trees over forbland including **Arctotheca calendula*, **Lolium* spp., **Lotus subbiflorus*, **Rumex* spp., **Trifolium repens* on grey sand.
B1	Low woodland of *Melaleuca preissiana* or *M. rhaphiophylla* with isolated *Eucalyptus rudis*, **Eucalyptus mannifera* medium trees over forbland of **Arctotheca calendula*, **Hypochaeris glabra*, **Lotus subbiflorus* and **Ursinia anthemoides* and grassland of **Briza maxima*, **B. minor* **Ehrharta longiflora*, **Lolium multiflorum* on grey-brown sandy loam.
B2	Low woodland of *Melaleuca preissiana* or *M. rhaphiophylla* over forbland of **Arctotheca calendula*, **Hypochaeris glabra*, **Lotus subbiflorus* and grassland of **Briza maxima*, **B. minor* **Lolium multiflorum* (and **Cotula coronopifolia* in damper areas) on grey-brown loam.
C	Sedgeland of *Juncus pallidus*, with scattered emergent **Eucalyptus globulus* or *Melaleuca preissiana* or *M. rhaphiophylla* low/medium trees over forbland of **Arctotheca calendula*, **Romulea rosea*, **Rumex conglomeratus* and open grassland of **Avena barbata*, **Cenchrus clandestinus*, **Eragrostis curvula* on grey sandy loam.
D	Tall shrubland of *Acacia saligna*, *Jacksonia sternbergiana*, *Kunzea glabrescens* and *Regelia ciliata* on grey sand. [Mainly plantings].
P	Amenity plantings of eucalyptus species, including **Eucalyptus camaldulensis*, **E. mannifera*.

8 Vegetation condition

As mentioned above, almost all vegetation in the survey area was in Completely Degraded condition (**Table 13**). The reasons for this are mainly due to physical disturbance (clearing) followed by a long period of livestock grazing. It is likely that Phytophthora dieback disease has played a role in vegetation degradation as well. There is only one small patch of vegetation, on the western boundary of the survey area, that was mapped as Good condition, and this is an area of revegetation.

Table 13. Vegetation condition in the Keysbrook survey area.

Condition	Area (ha)	%
Good	0.39	0.58
Degraded	5.18	7.75
Completely Degraded	61.29	91.67
Sub-total	66.86	100.00
Cleared	537.68	
Total	604.54	

Table 14. Proportion of vegetation units in vegetation condition classes.

Vegetation unit	Condition	Area (ha)	%
A1	Completely Degraded	15.3	95.4
	Degraded	0.7	4.6
	Sub-total	16.0	100.0
A2	Completely Degraded	3.9	100.0
	Sub-total	3.9	100.0
B1	Completely Degraded	9.1	95.4
	Degraded	0.4	4.6
	Sub-total	9.6	100.0
B2	Completely Degraded	4.4	76.9
	Degraded	1.3	23.1
	Sub-total	5.7	100.0
C	Completely Degraded	0.3	10.4
	Degraded	2.7	89.6
	Sub-total	3.0	100.0
D	Good	0.4	100.0
	Sub-total	0.4	100.0
Total Native Vegetation		38.5	

P (Planted)		28.3	
Total vegetated area		**66.9**	

9 Wetlands and watercourses

According to the geomorphic wetlands dataset Multiple Use wetland covers virtually the whole of the survey area, with five small areas of Resource Enhancement wetland also being present.

Three vegetation units (B1, B2 and C) comprise wetland vegetation and a fourth (D) consists of planted wetland taxa, such as *Acacia saligna* and *Regelia ciliata*.

One Conservation Category wetland (UFI 14870) occurs in the northwest of the survey area. The vegetation within this wetland (subunit B2) is Completely Degraded and therefore it doesn't warrant its status as CC. All vegetation in the Resource Enhancement wetland areas was in Completely Degraded condition, except for a small circular wetland on the western boundary (wetland UFI 14834) in Degraded condition, with 0.44 ha of vegetation unit B2.

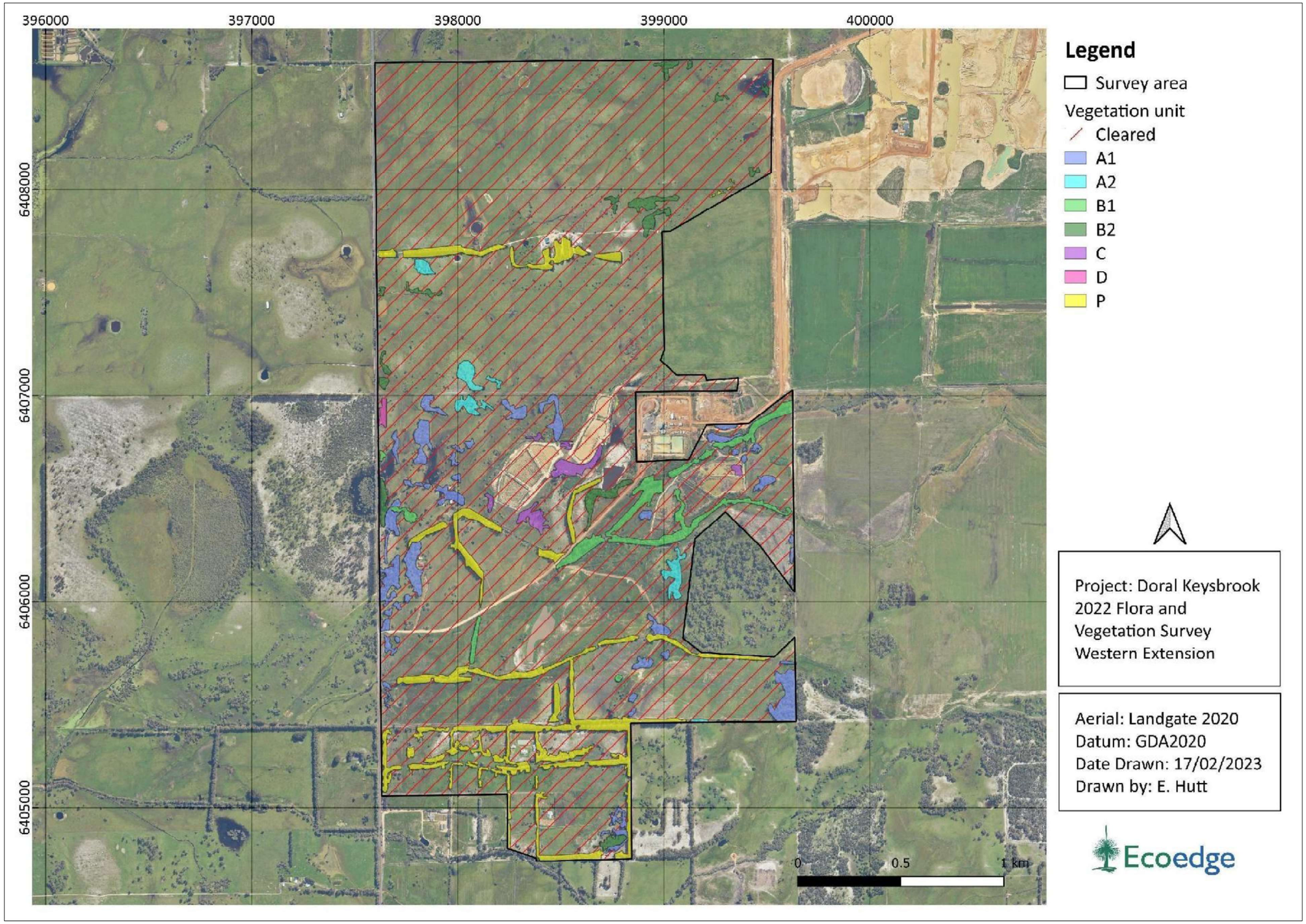


Figure 13. Vegetation units for the survey area.

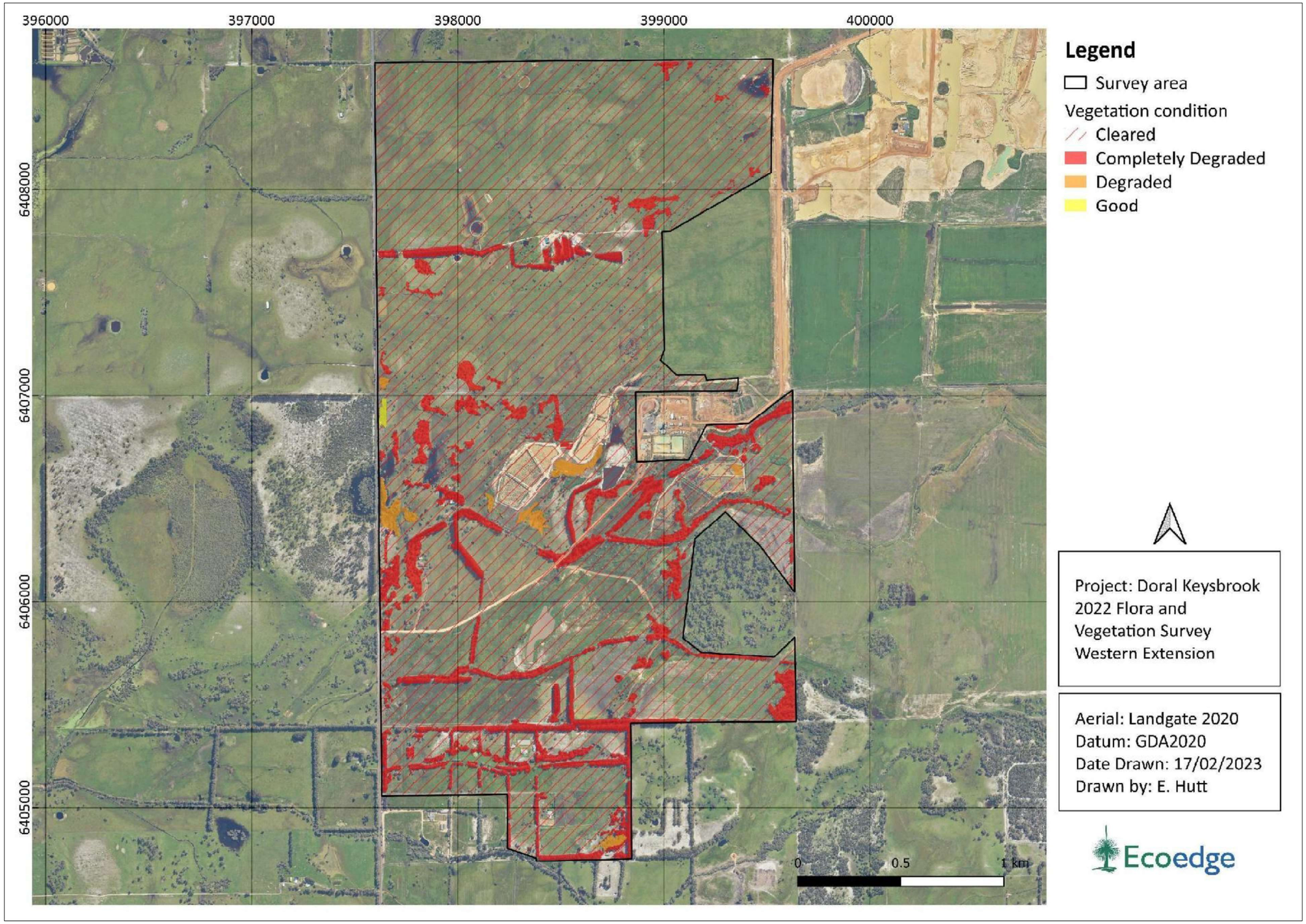


Figure 14. Vegetation condition for the survey area.

10 Discussions and conclusions

10.1 Significance of the flora

10.1.1 Threatened and Priority flora

There were no Threatened or Priority flora or other flora of conservation significance in the survey area. Hence the flora does not have particular conservation value.

10.1.2 Post-survey likelihood assessment

After completing the survey, an assessment was made of the residual likelihood of 49 Threatened and Priority List flora known or potentially occurring within 10 km of the survey area (**Appendix 8**). Of this flora, 17 were deemed to have an 'unlikely' residual likelihood of occurring within the survey area because there was no suitable habitat. The following rates for each species are provided in **Appendix 8.**

1. No suitable habitat was observed, and the taxon is known to be restricted to a narrow and clearly defined habitat type.
2. Suitable or potential habitat was present and appropriately searched, but the taxon was not observed.
3. Suitable habitat present, but these areas were too degraded for the taxon to occur, for example, due to weed invasion and/or clearing.

The other 32 taxa were deemed to have an 'unlikely' residual likelihood of occurring in the survey area because, although potential habitat was present, its condition was too degraded for them to occur there. That is, they were not found, suitable habitat may have been present in the past, but that habitat was now too degraded for them to occur there. Additionally, because these areas of previously suitable habitat were thoroughly searched at an appropriate time if they had been present, they would have been seen.

10.2 Significance of the vegetation

Because of its state of degradation very little of the vegetation has any particular conservation significance. None of the vegetation units can be inferred to be an occurrence of a TEC, because of the level of degradation. Vegetation units A1 and A2 may have originally had *Banksia attenuata* and *B. menziesii* and thus been part of the 'Banksia woodlands of the Swan Coastal Plain' TEC, but these species have disappeared, and the vegetation no longer resembles the threatened community.

Vegetation units B1 and B2 resemble the '*Melaleuca preissiana* damplands' community (SWAFCT04) of Gibson et al. (1994). This floristic community type is not a TEC or PEC. Vegetation unit C is so degraded that it is difficult to ascertain what the original community may have been, but it is likely also to have been the '*Melaleuca preissiana* damplands' community (SWAFCT04).

10.3 Wetland communities

There are five small areas of Resource Enhancement wetland within the survey area, which is otherwise virtually all classed as Multiple Use wetland. Most vegetation in the Resource Enhancement wetland areas was Completely Degraded. The only exception was a small circular wetland on the western boundary with 0.44 ha of vegetation in Degraded condition. None of the Multiple Use or Resource Enhancement wetlands warrant upgrading to Conservation category.

There is one mapped ESA in the north western portion of the survey area. This ESA is associated with the Conservation Category wetland UFI 14870. Another ESA intersects with the survey area boundary in the south eastern corner and is associated with the Conservation Category wetland UFI 14465.

There are no Bush Forever sites within the survey area. The closest Bush Forever site is approximately 2.5km away and is associated with BF77 Yangedi Swamp.

10.4 Regional ecological linkages

There are south-eastern parcels of vegetation within the survey area that have some limited ecological linkage values. These are due to the proximity to the regional ecological axis line located to the southeast of the survey area (**Figure 10**) and have limited linkage values due to the overall degraded condition of the vegetation and separation from other parcels of vegetation by expanses of pasture.

There is no statutory basis for the protection of this vegetation as an ecological linkage. However, the importance of ecological linkages, in general, has been recognised as an environmental policy consideration in EPA and Planning policy (EPA, 2008 and references therein).

11 References

Beard, J. S., Beeston, G.R., Harvey, J.M., Hopkins, A. J. M. and Shepherd, D. P. (2013). The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir. Second edition. Conservation Science Western Australia 9: 1-152.

Beeston, G.R., Hopkins, A.J.M. and Shepherd, D.P. (eds) (2001). *Land-use and Vegetation, Western Australia*. Agriculture Western Australia, South Perth and National Land and Water Resources Audit, Canberra, from: http://www.agriculture.gov.au/abares/aclump/Documents/WA%20Luse%201997%20Report.pdf

Bennett Environmental Consulting Pty Ltd. (2004). Vegetation and Flora of Exploration Licence 70/2407 Keysbrook, Western Australia. Prepared for MBS Environmental, Perth.

Commonwealth of Australia and the State of Western Australia (1999). *Regional Forest Agreement for the South-West Forest Region of Western Australia*. Commonwealth and Western Australia Regional Forest Agreement Steering Committee. Canberra, Australia.

Commonwealth of Australia (2016). *Interim Biogeographic Regionalisation for Australia (IBRA), Version 7 (Subregions)*. Department of Climate Change, Energy, the Environment and Water. https://data.gov.au/data/dataset/interim-biogeographic-regionalisation-for-australia-ibra-version-7-subregions.

Crossman, S. & Li, O. (2015). Surface Hydrology Lines (National). Geoscience Australia, Canberra. http://pid.geoscience.gov.au/dataset/ga/83130.

Department of Biodiversity, Conservation and Attractions (DBCA) (2017). DBCA – Legislated Lands and Waters (DBCA-011). Last updated 11 June 2022. https://catalogue.data.wa.gov.au/dataset/dbca-legislated-lands-and-waters.

Department of Biodiversity, Conservation and Attractions (DBCA) (2018). Threatened ecological communities endorsed by the Minister for the Environment (June 2018). https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/threatened_ecological_communities_endorsed_by_the_minister_for_the_environment_june_2018.pdf.

Department of Biodiversity, Conservation and Attractions (DBCA) (2019a). Bush Forever Areas 2000 (DPLH-019). Last updated 2 October 2019. https://catalogue.data.wa.gov.au/dataset/bush-forever-areas-2000-dop-071.

Department of Biodiversity, Conservation and Attractions (DBCA) (2019b). Conservation codes for Western Australian Flora and Fauna (updated 10 December 2020). https://www.dpaw.wa.gov.au/images/Conservation%20codes%20for%20Western%20Australian%20Flora%20and%20Fauna%20179KB.pdf.

Department of Biodiversity, Conservation and Attractions (DBCA) (2021a). Priority ecological communities for Western Australia, Version 32. Species and Communities Program, Department of Biodiversity, Conservation and Attractions, 15 July 2021. https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities

Department of Biodiversity, Conservation and Attractions (2021b). *Extract from the Department's Threatened and Priority Ecological Community database and the* DBCA Species and Communities Branch dated 16 April 2021.

Department of Biodiversity, Conservation and Attractions (2021c). *Naturemap, Western Australian Herbarium*. Accessed 16 April 2021.

Department of Biodiversity, Conservation and Attractions (2021d). *Extract from the Department's Threatened and Priority Flora and the Western Australian Herbarium databases*. DBCA Species and Communities Branch dated 9 April 2021.

Department of Biodiversity, Conservation and Attractions (DBCA) (2022a). Geomorphic Wetlands, Swan Coastal Plain dataset DBCA-019, last updated 22 August 2022. https://catalogue.data.wa.gov.au/dataset/geomorphic-wetlands-swan-coastal-plain

Department of Biodiversity, Conservation and Attractions (DBCA) (2022b). Threatened and Priority Flora list (6 October 2022). Department of Biodiversity, Conservation and Attractions. https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2020). Categories of Threatened species under the EPBC Act. https://www.environment.gov.au/biodiversity/threatened/species.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2022a). *Protected Matters Search Tool query*. Generated 31 October 2022.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2022b). Categories of Threatened ecological communities under the EPBC Act. https://www.dcceew.gov.au/environment/biodiversity/threatened/communities/about#What_is_a_threatened_ecological_community_TEC.

Department of Environment and Conservation (DEC) (2013). *Definitions, categories and criteria for threatened and priority ecological communities*. Department of Environment and Conservation, Perth, Western Australia.

Department of Environmental Protection (DEP) (1996). System 6 and Part System 1 Update Programme. Unpublished bushland plot and area records and analysis. Department of Environmental Protection, Perth, Western Australia.

Department of Environmental Protection (DEP) (2000). *Bush forever: keeping the bush in the city: final report.* Volume 1. Western Australian Planning Commission, Perth.

Department of Parks and Wildlife (DPaW) (2018). Vegetation Complexes – Swan Coastal Plain (DBCA-046). Last updated 24 August 2018.

Department of Primary Industries and Regional Development (DPIRD) (2017). Soil Landscape Mapping – Best Available (DPIRD-027). Last updated 13 July 2022. https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-best-available

Department of Primary Industries and Regional Development (DPIRD) (2019). Pre-European Vegetation (DPIRD-006). Last updated 23 July 2019. https://catalogue.data.wa.gov.au/dataset/pre-european-dpird-006.

Department of Water and Environmental Regulation (DWER) (2021). Clearing Regulations - *Environmentally Sensitive Areas* (DWER-046), last updated 9 November 2021. https://catalogue.data.wa.gov.au/dataset/clearing-regulations-environmentally-sensitive-areas-dwer-046.

Ecoedge (2021). Detailed and Targeted Flora and Vegetation Survey Keysbrook, Western Australia. Prepared for Doral Mineral Sands.

Ecoedge (2022). Detailed, Reconnaissance and Targeted Flora and Vegetation Survey. Lot 507, 508, 201 Elliot Road and Part Lot 56 Wescott Road Keysbrook, Western Australia. Prepared for Doral Mineral Sands.

Environment Australia (2001). National objectives and targets for biodiversity conservation 2001–2005. https://library.dbca.wa.gov.au/static/FullTextFiles/020395.pdf.

Environmental Protection Authority (EPA) (2008). Environmental Guidance for Planning and Development. Guidance Statement 33.

Environmental Protection Authority (EPA) (2016). *Technical Guidance Flora and Vegetation Surveys for Environmental Impact.* EPA, Perth, Western Australia.

http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/EPA/Technical/Guidance/FloraandVegetationsurvey_Dec13.pdf

Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M.N. (1994). A floristic survey of the southern Swan Coastal Plain: report to Heritage Council of W.A. and Australian Heritage Commission. Department of Conservation and Land Management, Western Australia.

Government of Western Australia (GoWA) (2005). Environmental Protection (Environmentally Sensitive Areas) Notice 2005 (Environmental Protection Act 1986). *Government Gazette, No.55*.

Government of Western Australia (GoWA) (2019a). 2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of March 2019. WA Department of Biodiversity, Conservation and Attractions, Perth. https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics

Government of Western Australia (GoWA) (2019b). 2018 South West Vegetation Complex Statistics. Current as of March 2019. WA Department of Biodiversity, Conservation and Attractions, Perth, https://catalogue.data.wa.gov.au/dataset/dbca

Heddle, E.M., Loneragan, O.W. and Havel, J.J. (1980). Vegetation of the Darling System. In: Atlas of Natural Resources, Darling System, Western Australia. Department of Conservation and Environment, Western Australia.

Mattiske, E.M. and Havel, J.J. (1998). Vegetation Mapping in the South West of Western Australia and Regional Forest Agreement vegetation complexes. Map sheets for Pemberton, Collie, Pinjarra, Busselton-Margaret River, Mt Barker, and Perth, Western Australia. Scale 1:250,000. Department of Conservation and Land Management, Perth.

MBS Environmental (2004). Vegetation and Fauna Assessment of Exploration Licence 70/2407 Keysbrook, Prepared for Olympia Resources Limited.

Molloy, S., O'Connor, T., Wood, J. and Wallrodt, S. (2009). South West Regional Ecological Linkages Technical Report. Western Australian Local Government Association (WALGA) and the Department of Environment and Conservation (DEC). West Perth.

NVIS Technical Working Group (2017). Australian Vegetation Attribute Manual: National Vegetation Information System, Version 7.0. Department of the Environment and Energy, Canberra. Prep by Bolton, M.P., deLacey, C. and Bossard, K.B. (Eds).

Onshore Environmental (2019). Field Assessment of Keysbrook Leucoxene Conservation Areas & Revegetation Considerations. Prepared for Keysbrook Leucoxene Pty Ltd.

Rockwater Hydrogeological and Environmental Consultants (2018). Keysbrook Project Wetland Vegetation Monitoring. Report prepared for MZI Resources Ltd.

Seddon, G. (1972), Sense of Place a response to an environment the swan coastal plain Western Australia. University of Western Australia Press, Perth.

Semeniuk, C.A. and Semeniuk, V. (1995). A Geomorphic Approach to Global Classification for Inland Wetlands. Vegetation, 118, 103-124.

van Gool, D. (1990), Land resources in the northern section of the Peel-Harvey catchment, Swan Coastal Plain, Western Australia Map. Department of Agriculture and Food, Western Australia, Perth. Map.

Webb, A., Kinloch, J., Keighery, G. and Pitt, G. (2016). The Extension of Vegetation Complex Mapping to Landform boundaries within the Swan Coastal Plain Landform and Forested Region of South West Western Australia. Department of Parks and Wildlife, Bunbury, WA.

Appendix 1 Threatened and Priority flora Likelihood of occurrence assessment methodology.

Rating	Presurvey rationale	Post survey rationale
Recorded		Taxon was or has been recorded in the survey area.
Likely	Known to occur within one kilometre (km) of the survey area with suitable habitat known or predicted to occur within the survey area.	The taxon is known to occur within one km of the survey area and very suitable habitat was present, but the taxon was not observed for one of the following reasons. **L1.** The taxon was dormant at the time of survey and could therefore not be located. **L2.** The habitat was compromised, for example due to a recent fire. **L3.** The survey area is challenging to survey.The taxon is non- descript and difficult to find because, for example, it occurs in large areas of rocky granite outcrops, or within an expanse of open water.
Possible	Known to occur within a five-ten km of the survey area with suitable habitat known or predicted to occur within the survey area.	The taxon is known from within a five to ten km radius of the survey area, and suitable habitat for the species was present, but despite a thorough search being carried out, the species was not observed. The taxon may however be present for any of the following reasons. **P1.** The taxon was dormant at the time of survey and could therefore not be located. **P2.** The habitat was compromised, for example, due to a recent fire. **P3.** The survey area is challenging to survey. The taxon is non- descript and difficult to find because, for example, it occurs in large areas of rocky granite outcrops, or within an expanse of open water.
Unlikely	Known or predicted to occur within ten km, but no suitable habitat is known or predicted to occur within the survey area.	The taxon was not found and is unlikely to be present for one or more of the following reasons: **U1.** No suitable habitat was observed, and the taxon is known to be restricted to a narrow and clearly defined habitat type. **U2.** Suitable or potential habitat was present and appropriately searched, but the taxon was not observed. **U3.** Suitable habitat present, but these areas were too degraded for the taxon to occur, for example, due to weed invasion and/or clearing.

Example of application of pre and post-survey likelihood of occurrence

Taxon	Cons Status	Flowering	Description	Pre survey likelihood	Post Survey Likelihood
Drakaea elastica	T (EN)	Aug -Oct	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow. White or grey sand. Low-lying situations adjoining winter-wet swamps.	**Likely**	**Unlikely (U3)**

Appendix 2. Vegetation condition scale (EPA 2016).

Vegetation Condition	South West and Interzone Botanical Provinces
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, 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.

Appendix 3. Categories of Threatened ecological communities under the EPBC Act.

Category	Definition
Critically endangered (CR)	If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
Endangered (EN)	If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
Vulnerable (VU)	If, at that time, an ecological, community is not critically endangered or endangered but is facing a high risk of extinction in the wild in the medium–term future (indicative timeframe being the next 50 years).

Appendix 4. Categories of threatened and priority ecological communities under the BC Act.

Conservation code	Category
(T) Threatened ecological community pursuant to Sect 27 of the *Biodiversity Conservation Act 2016.*	
T	(T) 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.
	(T) 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.
	(T) 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.
(P) Priority species – possible threatened communities.	
P1	Poorly known 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.

Conservation code	Category
P2	Poorly known 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	Poorly known communities a) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: b) communities 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; c) communities made up of large, and/or widespread occurrences, that 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	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. 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.
P5	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.

Appendix 5. NatureMap reports and Protected Matters Search Tool

Naturemap information from DBCA

Taxon	WA Cons	T Rank
Hibbertia acrotoma	1	
Thysanotus anceps	3	
Morelotia australiensis	T	
Isopogon autumnalis	3	
Acacia benthamii	2	
Halgania corymbosa	3	
Acacia drummondii subsp. *affinis*	3	
Stachystemon exilis	1	
Styphelia filifolia	3	
Lasiopetalum glutinosum subsp. *glutinosum*	3	
Anthocercis gracilis	T	
Calectasia grandiflora	2	
Calothamnus graniticus subsp. *leptophyllus*	4	
Lepyrodia heleocharoides	3	
Aponogeton hexatepalus	4	
Acacia horridula	3	
Stylidium ireneae	4	
Senecio leucoglossus	4	
Verticordia lindleyi subsp. *lindleyi*	4	
Stylidium longitubum	4	
Drosera occidentalis	4	
Acacia oncinophylla subsp. *oncinophylla*	3	
Acacia oncinophylla subsp. *patulifolia*	4	
Grevillea pimeleoides	4	
Eryngium pinnatifidum subsp. *Palustre* (G.J. Keighery 13459)	3	
Verticordia plumosa var. *ananeotes*	T	
Lasiopetalum pterocarpum	T	
Johnsonia pubescens subsp. *cygnorum*	2	
Pimelea rara	4	
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	T	
Synaphea sp. Pinjarra Plain (A.S. George 17182)	T	
Synaphea sp. Pinjarra (R. Davis 6578)	T	
Stackhousia sp. Red-blotched corolla (A. Markey 911)	3	
Synaphea sp. Serpentine (G.R. Brand 103)	T	
Meionectes tenuifolia	3	
Cyanothamnus tenuis	4	
Cyathochaeta teretifolia	3	
Caladenia huegelii	T	CR
Synaphea odocoileops	1	

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 31-Oct-2022

Summary

Matters of National Environment Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	34
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Lands:	6
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	10
Regional Forest Agreements:	1
Nationally Important Wetlands:	None
EPBC Act Referrals:	12
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Peel-yalgorup system	10 - 20km upstream from Ramsar site	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area	In feature area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area	In buffer area only
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area	In buffer area only
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area	In buffer area only
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community may occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Botaurus poiciloptilus			
Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Calyptorhynchus banksii naso](#) Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Charadrius leschenaultii](#) Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Falco hypoleucos](#) Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
[Leipoa ocellata](#) Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Rostratula australis](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
[Zanda baudinii listed as Calyptorhynchus baudinii](#) Baudin's Black-Cockatoo, Long-billed Black-cockatoo [87736]	Endangered	Roosting known to occur within area	In feature area
[Zanda latirostris listed as Calyptorhynchus latirostris](#) Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737]	Endangered	Breeding known to occur within area	In feature area
MAMMAL			
[Bettongia penicillata ogilbyi](#) Woylie [66844]	Endangered	Species or species habitat may occur within area	In buffer area only
[Dasyurus geoffroii](#) Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Pseudocheirus occidentalis](#) Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area	In feature area
OTHER			
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
PLANT			
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area	In buffer area only
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area	In buffer area only
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area	In feature area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area	In feature area
Lasiopetalum pterocarpum Wing-fruited Lasiopetalum [64922]	Endangered	Species or species habitat known to occur within area	In buffer area only
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Synaphea sp. Pinjarra (R. Davis 6578) Club-leafed Synaphea [82880]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Synaphea sp. Pinjarra Plain (A.S. George 17182) [86878]	Endangered	Species or species habitat known to occur within area	In feature area
Synaphea sp. Serpentine (G.R. Brand 103) [86879]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Synaphea stenoloba Dwellingup Synaphea [66311]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Tetraria australiensis Southern Tetraria [10137]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area	In feature area
Verticordia plumosa var. ananeotes Tufted Plumed Featherflower [23871]	Endangered	Species or species habitat may occur within area	In buffer area only

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat likely to occur within area	In feature area
[Charadrius leschenaultii](#) Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
[Tringa nebularia](#) Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Unknown		
Commonwealth Land - [50852]	WA	In buffer area only
Commonwealth Land - [50855]	WA	In buffer area only
Commonwealth Land - [50854]	WA	In buffer area only
Commonwealth Land - [51239]	WA	In buffer area only
Commonwealth Land - [51240]	WA	In buffer area only
Commonwealth Land - [51919]	WA	In buffer area only

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Charadrius leschenaultii](#) Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
[Rostratula australis as Rostratula benghalensis (sensu lato)](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
[Thinornis cucullatus as Thinornis rubricollis](#) Hooded Plover, Hooded Dotterel [87735]		Species or species habitat may occur within area overfly marine area	In buffer area only
[Tringa nebularia](#) Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area overfly marine area	In buffer area only

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Karnet	Nature Reserve	WA	In buffer area only
Lambkin	Nature Reserve	WA	In buffer area only
North Dandalup	Nature Reserve	WA	In buffer area only
NTWA Bushland covenant (0076)	Conservation Covenant	WA	In buffer area only
NTWA Bushland covenant (0077)	Conservation Covenant	WA	In buffer area only
NTWA Bushland covenant (0086)	Conservation Covenant	WA	In buffer area only
NTWA Bushland covenant (0089)	Conservation Covenant	WA	In buffer area only
Serpentine	National Park	WA	In buffer area only
Unnamed WA46587	Nature Reserve	WA	In buffer area only
Unnamed WA50643	5(1)(h) Reserve	WA	In buffer area only

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

RFA Name	State	Buffer Status
South West WA RFA	Western Australia	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Huntly Bauxite Mine Transition	2022/09204		Assessment	In buffer area only
Controlled action				
Alcoa Pinjarra Refinery Production Increase and Bauxite Export	2020/8743	Controlled Action	Completed	In buffer area only
Clearing, mining and rehabilitation Scrivener Road	2015/7577	Controlled Action	Further Information	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Gravel reserves			Request	
Construction of Road and Extension of Utilities on Turner Street, Serpentine	2008/4670	Controlled Action	Post-Approval	In buffer area only
Mineral Sands Mine	2005/2163	Controlled Action	Post-Approval	In buffer area only
Natural Gas Pipeline Expansion	2006/2813	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
'Looping 10' gas transmission pipeline from Kwinana to Hopelands	2005/2212	Not Controlled Action	Completed	In buffer area only
Development of a wholesale nursery	2012/6622	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Serpentine Sports Reserve, Protection of Dieback Free Area	2008/4337	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

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

Threatened, migratory and marine species

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

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix 6. Definitions of conservation codes for Threatened and Priority flora.

Conservation code	Category
(T) Threatened species pursuant to Sect 19 of the BC Act 2016.	
T	(T) CR – Critically endangered 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*".
	(T) EN - Endangered 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*".
	(T) VU - Vulnerable 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*".
(P) Priority species – possible Threatened species.	
P1	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.
P2	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.

Conservation code	Category
P3	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.
P4	(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.

Appendix 7. Categories of Threatened species under the EPBC Act.

Category	Definition
Extinct (Ex)	A native species is eligible to be included in the ***extinct*** category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (ExW)	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CR)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Appendix 8. Pre and post survey likelihood of occurrence table.

Pre and post survey likelihood of threatened and priority flora occurring within the survey area, based on a comparison of known (DBCA 2022d) and potential species (DCCEEW 2022a) within the 10 km radius study area.[1]

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
Thelymitra stellata	T	Oct to Nov.	Tuberous, perennial, herb, 0.15-0.25 m high. Fl. yellow & brown. Sand, gravel, lateritic loam.	Unlikely	Unlikely (U1) - no suitable habitat
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	T (CR)	Oct	Dense, clumped shrub, to 0.3 m high, to 0.4 m wide. Fl. Yellow. Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	Possible	Unlikely (U3) – suitable habitat but too degraded
Synaphea sp. Pinjarra (R. Davis 6578)	T (CR)	Sep - Oct	Compact shrub, to 0.5 m high, to 0.7 m wide. Leaves hairless, blue-green, 3 lobed to irregularly lobed. Spike extend beyond leaves, fairly crowded flowers Fl. yellow. Grey clayey sand. Swamp habitat.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Synaphea sp. Serpentine	T (CR)	Sep-Oct	Perennial, Plants clumped 0.6 m high to 0.5 m wide. Leaves 2-4 x tripartite, terminal lobes linear. Spikes long, undulating, infused with red. Fl. Yellow. Predominantly on flat terrain on grey-brown sandy loams to clay in seasonally wet areas.	Unlikely	Unlikely (U3) – suitable habitat but too degraded

[1] Note presurvey data downloads were conducted by Ecoedge (DBCA 2020c and DCCEEW 2022b) for a 10 km buffer. This data is included in the appendices.

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
Andersonia gracilis	T (EN)	Sep-Nov	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Fl. white-pink-purple. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Caladenia huegelii	T (EN)	Sep-Oct	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green, cream, red. Grey or brown sand, clay loam. (Jarrah banksia woodland usually associated with the Bassendean sand-dune system, rarely in the Spearwood system).	Possible	Unlikely (U3) – suitable habitat but too degraded
Drakaea elastica	T (EN)	Oct-Nov	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow. White or grey sand. Low-lying situations adjoining winter-wet swamps.	Possible	Unlikely (U3) – suitable habitat but too degraded
Eucalyptus x *balanites*	T (EN)	Oct to Dec or Jan to Feb	(Mallee), to 5 m high, bark rough, flaky. Fl. white. Sandy soils with lateritic gravel.	Unlikely	Unlikely (U1) - no suitable habitat
Lasiopetalum pterocarpum	T (EN)	Aug-Dec	Open, multi-stemmed shrub (with distinctly winged fruit), to 1.2 m high. Fl. pink. Dark red-brown loam or clayey sand over granite. On sloping banks near creeklines.	Unlikely	Unlikely (U1) - no suitable habitat
Synaphea sp. Pinjarra Plain (A.S. George 17182)	T (EN)	Sep to Nov	Erect, clumped shrub (sub-shrub), to 0.8 m high. Fl. yellow. Grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally	Unlikely	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
			wet areas, railroad reserves often with wet depressions or drains.		
Synaphea stenoloba	T (EN)	Aug-Oct	Caespitose shrub, 0.3–0.45 m high. Fl. Yellow. Sandy or sandy clay soils. Winter-wet flats, granite. Shrublands and woodlands on loamy soils.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Verticordia plumosa var. *ananeotes*	T (EN)	Nov-Dec	Erect, sparsely branched shrub, 0.3-0.5 m high. Fl. pink-purple/white. Sandy loam. Seasonally inundated plains.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Anthocercis gracilis	T (VU)	Sep to Oct	Erect, spindly shrub, to 0.6(-1) m high. Fl. yellow-green. Sandy or loamy soils. Granite outcrops.	Unlikely	Unlikely (U1) - no suitable habitat
Diuris drummondii	T (VU)	Nov-Jan	Tuberous, perennial, herb, 0.5-1.05 m high. Fl. yellow. Low-lying depressions, swamps.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Diuris micrantha	T (VU)	Sep-Oct	Tuberous, perennial, herb, 0.3–0.6 m high. Fl. yellow, brown. Brown loamy clay. Winter-wet swamps, in shallow water.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Drakaea micrantha	T (VU)	Sep-Oct	Tuberous, perennial, dwarf hammer orchid, 0.15–0.3 m high. Fl. red, yellow. Small heart shaped leaf with green veins. White-grey infertile sand in Eucalyptus marginata, Allocasuarina fraseriana woodland or forest. Often under Kunzea ericifolia, K. glabrescens with Paracaleana nigrita and other Drakaea species.	Unlikely	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
Eleocharis keigheryi	T (VU)	Aug-Nov	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green. Clay, sandy loam. Emergent in freshwater: creeks, claypans	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Morelotia australiensis	T (VU)	Nov-Dec	Rhizomatous, tufted perennial, grass-like or herb (sedge), to 1 m high. Fl. brown. Sandy soils associated with heavy soils on the Pinjarra Plain.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Drosera occidentalis	P1	Oct-Dec or Jan	Fibrous-rooted, rosetted perennial, herb, to 0.025 m high. Fl. pink/white. Peaty sand, margins of swamps, winter wet depressions and watersheds in open areas.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Drosera oreopodion	P1	Oct - Nov	Pygmy. White flower. White sand over laterite rock.	Unlikely	Unlikely (U1) - no suitable habitat
Hibbertia acrotoma	P1	Aug - ?	Perennial, prostrate shrub. 0.2 - 0.30 m high to 0.30- 0.40 m wide. Fl. Yellow.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Stachystemon exilis	P1	Sep - Nov	Monoeicious shrub/herb to 0.2 m high. Fl. Green yellow. Open, low-lying Banksia woodland in which B. ilicifolia is a significant component of the upper canopy. Other associated species are Melaleuca preissiana, M. thymoides, Adenanthos meisneri and Hypocalymma angustifolium.	Possible	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
Synaphea odocoileops	P1	Aug-Oct	Tufted, compact shrub, 0.2–0.5 m high. Fl. yellow. Brown-orange loam & sandy clay, granite. Swamps, winter-wet areas.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Acacia benthamii	P2	Aug-Sep	Shrub, ca 1 m high. Fl. Yellow. Sand. Typically on limestone breakaways also recorded in Open shrubland; Melaleuca rhaphiophylla, Pericalymma ellipticum, Xanthorrhoea preissii, Hakea ceratophylla, Calothamnus lateralis, Hibbertia stellaris.	Likely	Unlikely (U1) - no suitable habitat
Calectasia grandiflora	P2	Jun-Nov	Rhizomatous, perennial, herb (or undershrub), to 0.65 m high, without stilt roots. Fl. blue/purple. White, grey or yellow sand, sandy clay, gravel, laterite, granite. Swampy areas, rock outcrops, flats, slopes, ridges.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Johnsonia pubescens subsp. cygnorum	P2	Sep	Grey-white-yellow sands. Flats, seasonally-wet sites.	Possible	Unlikely (U3) – suitable habitat but too degraded
Acacia drummondii subsp. *affinis*	P3	Jul-Aug	Erect shrub, 0.3-1 m high. Fl. yellow. Lateritic gravelly soils.	Unlikely	Unlikely (U1) - no suitable habitat
Acacia horridula	P3	May-Aug	Harsh, slender, single-stemmed shrub, 0.3-0.6(-1) m high. Fl. yellow. Gravelly soils over granite, sand. Rocky hillsides.	Unlikely	Unlikely (U1) - no suitable habitat

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
Acacia oncinophylla subsp. *oncinophylla*	P3	Aug-Oct	Shrub, 0.9-2.5 m high, 'minni-ritchi' bark, phyllodes mostly 8-13 cm long, 1-2 mm wide. Fl. yellow. Granitic soils.	Unlikely	Unlikely (U1) - no suitable habitat
Cyathochaeta teretifolia	P3	Oct-Jan	Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2 m high, to 1.0 m wide. Fl. brown. Grey sand, sandy clay. Swamps, creek edges.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Eryngium pinnatifidum subsp. palustre	P3	Oct - Nov	Tuberous perennial herb 20-30 cm, leaves soft & tubular, flowers bluish.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Halgania corymbosa	P3	Aug to Nov	Erect shrub, 0.35-1 m high. Fl. blue-purple. Gravelly soils, soils over granite.	Unlikely	Unlikely (U1) - no suitable habitat
Isopogon autumnalis	P3	Feb to June	Shrub, 0.5-1m high. Fl. cream or yellow.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Lasiopetalum glutinosum subsp. glutinosum	P3	Sep	Perennial erect open shrub, 0.4-0.6 m high. 0.6 m wide. Fl. pink. Open, low scrub over heath, on steep slopes of lateritic gravel, clay or sandy loam near granite outcrops and creeklines.	Unlikely	Unlikely (U1) - no suitable habitat
Lepyrodia heleocharoides	P3	Dec	Rhizomatous, slender, tufted perennial, herb (sedge-like), 0.15–0.25 m high. Moist peaty sand. Dry or seasonally inundated heath or woodland, swamps.	Unlikely	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
Meionectes tenuifolia	P3	Nov	Suckering spreading decumbent shrub with cream-green flowers - red style. Height to ca 25 cm. Broadly distributed across the Swan Coastal Plain, northern and southern Jarrah forests associated with ephemeral wetlands.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Stackhousia sp. Red-blotched corolla (A. Markey 911)	P3	Sep? to Nov	Limited information: Erect perennial herb 20 cm high. Flowers bright yellow. Jarrah forest, Wandoo woodland - loamy laterite gravel?	Unlikely	Unlikely (U1) - no suitable habitat
Styphelia filifolia	P3	Mar - May	Erect shrubs to 0.9 m high, 0.7 m wide, Fl white - Occurs sporadically from north of Eneabba to the Harvey area. Geraldton Sandplains and Swan Coastal Plain bioregions. Sandy soils of the coastal plain (with one known occurrence from the northern Darling Scarp), usually in Banksia or Jarrah woodland and in low-lying situations.	Possible	Unlikely (U3) – suitable habitat but too degraded
Thysanotus anceps	P3	Oct to Dec	Rhizomatous, leafless perennial, herb, to 0.4 m high. Fl. purple. White or grey sand, lateritic gravel, laterite.	Unlikely	Unlikely (U1) - no suitable habitat
Acacia oncinophylla subsp. patulifolia	P4	Aug-Nov or Nov-Dec	Shrub, 0.5-2.5(-3) m high, 'minni-ritchi' bark, phyllodes 4-9 cm long, 3-6 mm wide. Fl. yellow. Granitic soils, occasionally on laterite.	Unlikely	Unlikely (U1) - no suitable habitat

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
Aponogeton hexatepalus	P4	Jul-Oct	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green, white. Mud. Freshwater: ponds, rivers, claypans.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Calothamnus graniticus subsp. leptophyllus	P4	Jun-Aug	Erect, multi-stemmed shrub, 1-2 m high. Fl. red. Clay over granite, lateritic soils. Hillsides.	Unlikely	Unlikely (U1) - no suitable habitat
Cyanothamnus tenuis	P4	Aug-Nov	Procumbent or erect & slender shrub, 0.1–0.5 m high. Fl. blue, pink, white. Laterite, stony soils, granite.	Unlikely	Unlikely (U1) - no suitable habitat
Grevillea pimeleoides	P4		Upright shrub, 50 cm high x 40 cm wide. Yellow orange flowers. Granite hills near drainage line. Sandy loam with laterite. Open, sunny, well- drained position above drainage lines or water courses.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Pimelea rara	P4	Dec or Jan	Shrub, 0.2-0.35 m high. Fl. white. Lateritic soils.	Unlikely	Unlikely (U3) – suitable habitat but too degraded
Senecio leucoglossus	P4	Aug-Nov	Erect annual, herb, to 1.3 m high. Fl. white. Gravelly lateritic or granitic soils. Granite outcrops, slopes.	Unlikely	Unlikely (U1) - no suitable habitat
Stylidium ireneae	P4	Oct to Dec	Erect perennial herb, forming a small compact bush up to 15 cm in diameter. Stems maroon coloured. Corolla pale-pink, lobes laterally paired. Sandy loam.	Unlikely	Unlikely (U3) – suitable habitat but too degraded

Species	Cons Status*	Flowering	Description and Habitat	**Likelihood	***Post Survey Likelihood
			Valleys near creek lines, woodland, often with Agonis.		
Stylidium longitubum	P4	Oct-Dec	Erect annual (ephemeral), herb, 0.05-0.12 m high. Fl. Pink. Sandy clay, clay. Seasonal wetlands.	Possible	Unlikely (U3) – suitable habitat but too degraded
Verticordia lindleyi subsp. lindleyi	P4	May or Nov-Dec or Jan	Erect shrub, 0.2-0.75 m high. Fl. pink. Sand, sandy clay. Winter-wet depressions.	Possible	Unlikely (U3) – suitable habitat but too degraded

***Note: The BC Act Conservation Status is shown, EPBC Act status, where relevant, is in brackets.

****

Possible – Suitable habitat within the survey area.

Unlikely – No suitable habitat existing within the survey area.

Unknown – Data deficient.

*****

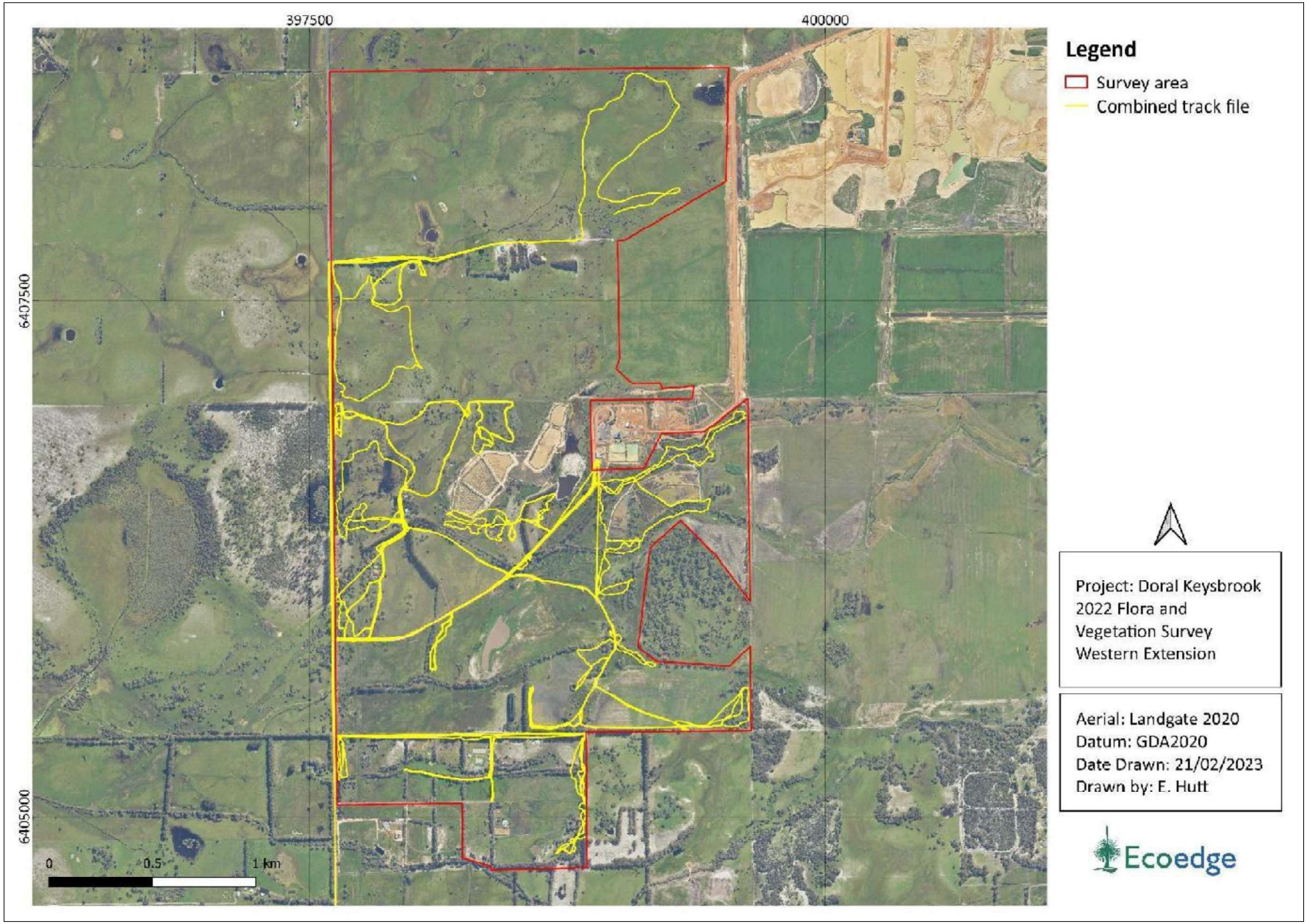
Observed - Taxon was positively identified on site during the survey.

Moderate - The taxon was not observed but suitable habitat was observed. The survey was conducted outside the recorded flowering season and it is difficult to distinguish or see in the absence of flowers.

Low – The taxon was not observed but suitable habitat was observed. The survey was conducted just outside the main flowering season or the taxon can be cryptic and difficult to find.

Very Low - The taxon was not observed but suitable habitat was observed. The survey was conducted within the main flowering season or the taxon can easily be identified even in the absence of flowers.

Appendix 9. Survey area sample sites



Appendix 10. List of vascular flora found within the survey area.

	FAMILY_NAME	LATIN NAME	NATURALISED	NOTE
1	Aizoaceae	*Carpobrotus edulis*	*	
2	Asteraceae	*Arctotheca calendula*	*	
3	Asteraceae	*Cotula coronopifolia*	*	
4	Asteraceae	*Cotula turbinata*	*	
5	Asteraceae	*Hypochaeris glabra*	*	
6	Asteraceae	*Ursinia anthemoides*	*	
7	Brassicaceae	*Raphanus raphanistrum*	*	
8	Casuarinaceae	*Allocasuarina fraseriana*		
9	Casuarinaceae	*Casuarina obesa*		Planted
10	Cyperaceae	*Cyperus eragrostis*	*	
11	Dasypogonaceae	*Kingia australis*		
12	Fabaceae	*Acacia saligna*		Planted
13	Fabaceae	*Jacksonia sternbergiana*		
14	Fabaceae	*Lotus subbiflorus*	*	
15	Fabaceae	*Ornithopus pinnatus*	*	
16	Fabaceae	*Trifolium repens*	*	
17	Iridaceae	*Moraea flaccida*	*	
18	Iridaceae	*Romulea rosea*	*	
19	Juncaceae	*Juncus pallidus*		
20	Lauraceae	*Cassytha racemosa*		
21	Loranthaceae	*Nuytsia floribunda*		
22	Myrtaceae	*Agonis flexuosa*		
23	Myrtaceae	*Astartea scoparia*		
24	Myrtaceae	*Callistemon glaucus*		Planted
25	Myrtaceae	*Corymbia calophylla*		
26	Myrtaceae	*Eucalyptus camaldulensis*		Planted
27	Myrtaceae	*Eucalyptus globulus*	*	
28	Myrtaceae	*Eucalyptus mannifera*	*	
29	Myrtaceae	*Eucalyptus rudis*		
30	Myrtaceae	*Hypocalymma angustifolium*		
31	Myrtaceae	*Kunzea glabrescens*		
32	Myrtaceae	*Kunzea recurva*		Planted
33	Myrtaceae	*Melaleuca preissiana*		
34	Myrtaceae	*Melaleuca rhaphiophylla*		
35	Myrtaceae	*Regelia ciliata*		Planted
36	Poaceae	*Avena barbata*	*	
37	Poaceae	*Briza maxima*	*	
38	Poaceae	*Briza minor*	*	
39	Poaceae	*Cenchrus clandestinus*	*	
40	Poaceae	*Cynodon dactylon*	*	
41	Poaceae	*Eragrostis curvula*	*	
42	Poaceae	*Lolium multiflorum*	*	
43	Poaceae	*Lolium perenne*	*	
44	Poaceae	*Lolium rigidum*	*	
45	Poaceae	*Vulpia bromoides*	*	
46	Polygonaceae	*Rumex acetosella*	*	
47	Polygonaceae	*Rumex conglomeratus*	*	
48	Proteaceae	*Banksia menziesii*		
49	Proteaceae	*Xylomelum occidentale*		

Appendix 11. Photographs and descriptions of each vegetation unit within the survey area.

Unit A1.

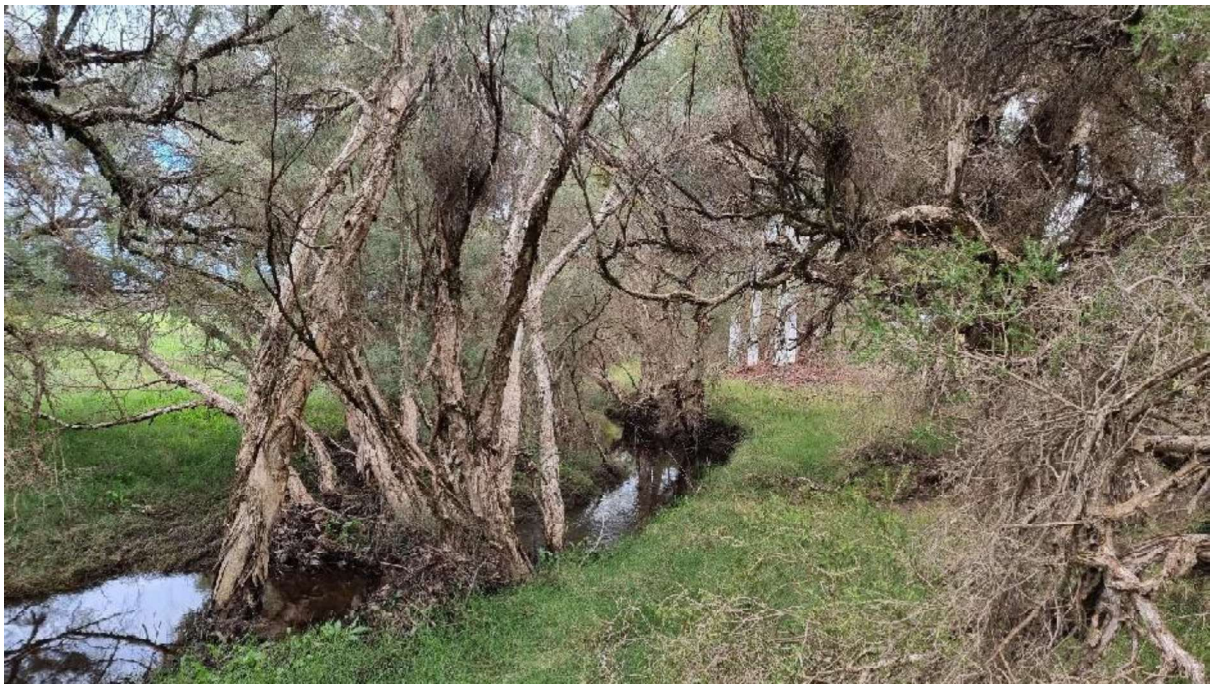
Mid-height open forest or woodland of *Corymbia calophylla* (occasionally with *Allocasuarina fraseriana*, *Eucalyptus marginata*, *Melaleuca preissiana* or *Nuytsia floribunda*) over scattered *Kingia australis* tall shrubs over forbland including **Arctotheca calendula*, **Lolium* spp., **Lotus subbiflorus*, **Rumex* spp., **Trifolium repens* on grey loamy sand.

Unit A2.

Mid-height open forest or woodland of *Eucalyptus marginata* and *Allocasuarina fraseriana* over scattered *Xylomelum occidentale* low trees over forbland including **Arctotheca calendula*, **Lolium* spp., **Lotus subbiflorus*, **Rumex* spp., **Trifolium repens* on grey sand.

Unit B1.

Low woodland of *Melaleuca preissiana* or *M. rhaphiophylla* with isolated *Eucalyptus rudis*, **Eucalyptus mannifera* medium trees over forbland of **Arctotheca calendula*, **Hypochaeris glabra*, **Lotus subbiflorus* and **Ursinia anthemoides* and grassland of **Briza maxima*, **B. minor* **Ehrharta longiflora*, **Lolium multiflorum* on grey-brown sandy loam.



Unit B2.

Low woodland of *Melaleuca preissiana* or *M. rhaphiophylla* over forbland of **Arctotheca calendula*, **Hypochaeris glabra*, **Lotus subbiflorus* and grassland of **Briza maxima*, **B. minor* **Lolium multiflorum* (and **Cotula coronopifolia* in damper areas) on grey-brown loam.

Unit C.

Sedgeland of *Juncus pallidus*, with scattered emergent **Eucalyptus globulus* or *Melaleuca preissiana* or *M. rhaphiophylla* low/medium trees over forbland of **Arctotheca calendula*, **Romulea rosea*, **Rumex conglomeratus* and open grassland of **Avena barbata*, **Cenchrus clandestinus*, **Eragrostis curvula* on grey sandy loam.

Unit D.

Tall shrubland of *Acacia saligna*, *Jacksonia sternbergiana*, *Kunzea glabrescens* and *Regelia ciliata* on grey sand. [Mainly plantings].

Unit P.

Amenity plantings of eucalyptus species, including **Eucalyptus camaldulensis*, **E. mannifera*.