BARTO GOLD MINING PTY LTD | SOUTHERN CROSS OPERATIONS

RHAPSODY NATIVE VEGETATION CLEARING PERMIT (PURPOSE PERMIT) – SUPPORTING DOCUMENT

Version 1, Revision: 0

M77/775, M77/790, M77/791

16 March 2023

REVISIONS

Rev. No	Date	Revision Description	Author	Reviewed By
1.0	16/03/2023	First draft	JH	TEJ

ACRONYMS

Acronym	Definition
BARTO	Barto Gold Mining Pty Ltd
SXO	Southern Cross Operations
km	Kilometres
NVCP	Native Vegetation Clearing Permit
DMIRS	Department of Mining Industry Regulation and Safety
WRL	Waste Rock Landform
MCP	Mine Closure Plan
ROM	Run Of Mine

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1. INTRODUCTION

1.1. OVERVIEW & PURPOSE OF THE REPORT

Barto Gold Mining Pty Ltd (Barto) owns and operates the Southern Cross Operations (SXO), located in the eastern wheatbelt region of Western Australia, within the Shire of Yilgarn. The project covers approximately 973 km^2 of tenements with operations centred at Marvel Loch, 30 kilometres (km) south of the township of Southern Cross and 360 km east of Perth (Figure 1).

At present, Barto is mining the Windmills operation approximately 5 km south-east of the operations centre at Marvel Loch (Figure 2).

A Part V Native Vegetation Clearing Permit (NVCP) was submitted to the Department of Mines, Industry Regulation and Safety (DMIRS) in August of 2021 for Windmills. This was subsequently approved in December 2021 for the clearing of 75Ha within a 97.24Ha purpose permit area (CPS 9409/1).

In March of 2022 an amendment to CPS 9409/1 was submitted by Barto for the realignment of the proposed haul road into the Windmills site. This amendment was also approved by DMIRS on the 19th of April 2022 (CPS 9409/2) for the clearing of 76.54Ha within a purpose permit area of 97.24Ha.

In November of 2022 a mining proposal was submitted for the development of the Rhapsody and Red Ox open pits (REGID 115104, approved January 2023) at Windmills. Clearing for Rhapsody and RedOx was approved under *Environmental Protection (Clearing of Native Vegetation) Regulations* 2004, clause 2(2) of Schedule 1 which allows clearing of up to 10 hectares per tenement per financial year for clearing authorised under the *Mining Act* 1978.

Due to changes in the Rhapsody mine plan, further clearing is now required to facilitate the project. The purpose of this document is to provide the necessary information and justification, as prescribed within the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* to seek approval under Part V of the EP Act for clearing of additional native vegetation for the purpose of mineral production and associated activities. This NVCP application seeks to clear up to 40 Ha of native vegetation within a 70.86 Ha Purpose Permit Area on Barto tenements M77/775, M77/790 & M77/791.

This NVCP application supporting document is structured to provides the following information:

- Description and map of the additional area proposed for clearing in regard to location, size and purpose;
- New site overview with a brief description of local climate, biogeographic region, geology, land use and land systems, soils, hydrology and hydrogeology;
- Description of the area to be cleared in regard to vegetation type, condition and representation in a regional context;
- List of flora species present and their conservation status;
- Identification of any Threatened or Priority flora within the proposed clearing area;
- Description of broad fauna habitat;
- A list of conservation significant terrestrial fauna species; and
- Discussion of the proposed vegetation clearing in relation to the Ten Clearing Principles.

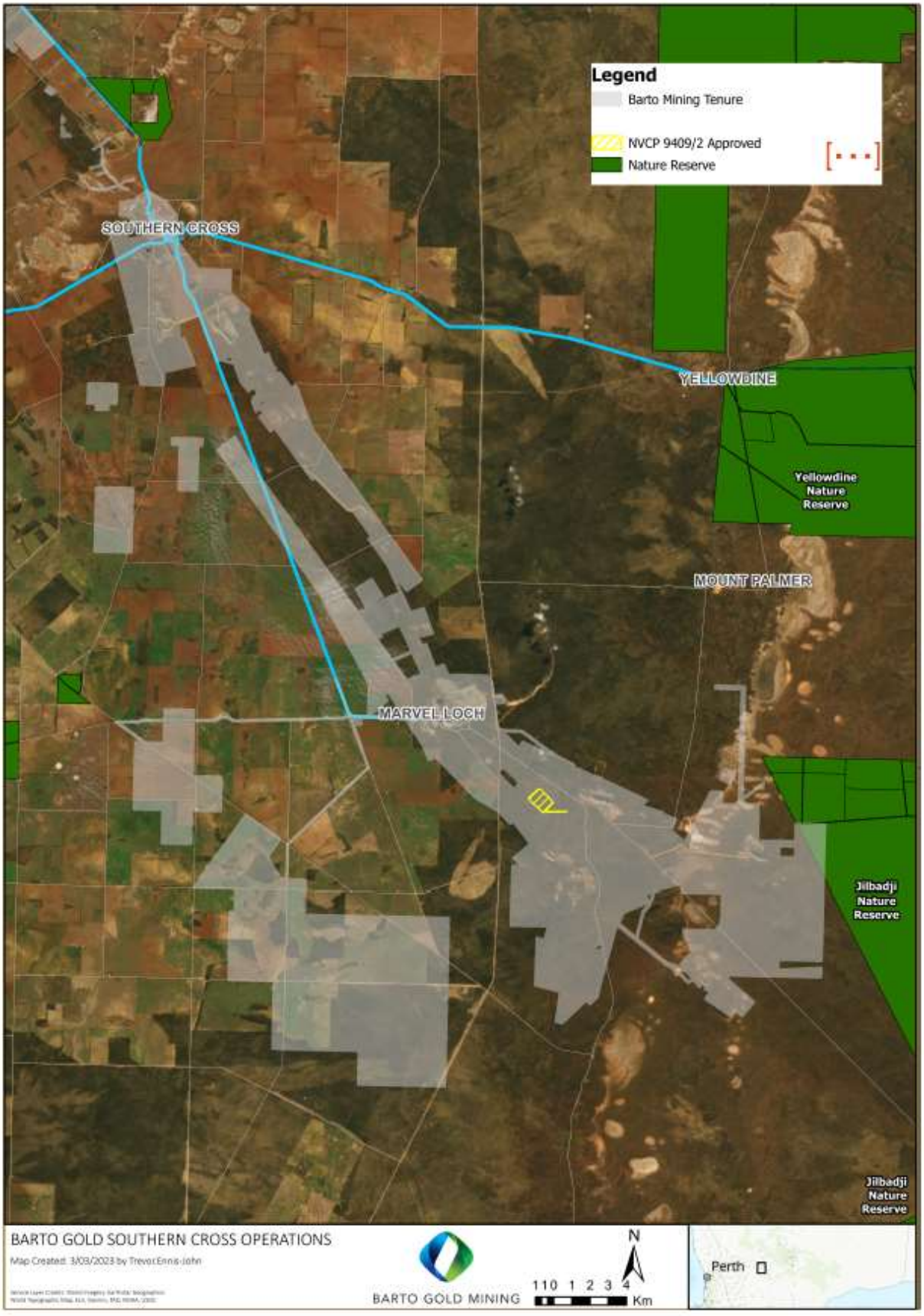


Figure 1: Barto Gold SXO Regional Location

Figure 2: Current Windmills location showing approved CP 9409/2 purpose permit area & REGID:115104

1.2. NVCP SCOPE

The application for the proposed NVCP (Purpose Permit) is based primarily on the findings from the Windmills Flora, Vegetation and Fauna Survey work (Stantec, 2021)(Error! Reference source not found.), which focused on a survey area of 874.75 hectares (herein referred to as the Survey Area- Figure 3). Additional targeted Chuditch Survey work was conducted between June-July 2021, with the camera locations and results provided in **Appendix B.**

In addition to the above, the proposed Purpose Permit amendment Area lies within broader biological study areas that have been regularly surveyed for flora, vegetation, and fauna. The information in the supporting documentation has been primarily sourced from the below documents:

- Stantec (2021) Windmills Flora, Vegetation and Fauna Survey (Error! Reference source not found.);
- Stantec (2021) Barto Targeted Chuditch Survey (**Appendix B**):

Figure 3: Windmills Survey Area by STANTEC 2021

1.3. PROJECT LOCATION, TENURE AND SITE LAYOUT

The projects tenements relevant to this amendment application are shown in **Error! Reference source not found.**. All tenements are held by Barto.

Historic disturbance is evident across the proposed Purpose Permit Area, with numerous drill lines and early settlement features still present. Recent disturbance is predominantly from mining exploration activities, with numerous tracks for drilling access and the main access track forming most of the disturbance. Recent surveys have assessed the vegetation condition within the proposed Purpose Permit Area as 'Degraded' through to 'Excellent' condition (Stantec, 2021b).

Table 1 : Project tenure

Tenement	Holder	Tenement Area (Ha)	Granted	Expiry date
M77/775	Barto Gold Mining Pty Ltd	396.7	27/11/2003	01/12/2024
M77/790	Barto Gold Mining Pty Ltd	917.85	23/12/2003	07/01/2025
M77/791	Barto Gold Mining Pty Ltd	997.8	05/11/2003	04/11/2024
Total Area		**2312.35**		

1.4. CONTACT DETAILS

Company Details:

- Name: Max Ji (CEO), Barto Gold Mining Pty Ltd
- Trading Name: Barto Gold Mining Pty Ltd
- ABN/ACN: 13 161 566 490 / 161 566 490
- Postal Address: Level 3, 66 Kings Park Road, West Perth WA 6872

All compliance and regulatory correspondence should be forwarded by post or email to the following.

Table 2: Contact details for Barto

Contact		Email	Phone
Authorised Persons & Contact Persons	Trevor Ennis-John (Environment Manager)	trevor.ennis-john@minjargold.com.au	0421 078 917
	Jack Harma (Senior Environmental Advisor)	jack.harma@minjargold.com.au	0428 820 494

2. PROPOSED ACTIVITIES

2.1. DESCRIPTION OF PROPOSED ACTIVITIES:

Existing approved activities under CPS 9409/2 include the development of a small scall open pit mine (Windmills open pit), an associated waste rock landform (WRL), a haul road and other supporting mining infrastructure.

On the 18th of January 2023, an extension of the Windmills project was granted by DMIRS under Mining Proposal REGID 115104, which authorised the development of the Red Ox open pit, the Rhapsody open pit and a short haul road connecting Windmills and Rhapsody. Clearing of these areas were approved under exemption in the *Environmental Protection (Clearing of Native Vegetation) Regulations* 2004, specifically clause 2(2) of Schedule 1 which allows clearing of up to 10 hectares per tenement per financial year for clearing authorised under the Mining Act 1978.

This NVCP application seeks approval for the following activities:

- Development of the Rhapsody waste rock landform
- Development of the Rhapsody Run of Mine (ROM) pad
- Incorporation of activities already approved under the aforementioned clearing exemption (Red Ox and Rhapsody open pits and haul road)

A site layout of the proposed activities is provided as Figure 4.

2.2. ESTIMATED VEGETATION DISTURBANCE REQUIREMENTS

This proposed NVCP application seeks a clearing footprint of up to 40 ha within a Purpose Permit Area of 70.86 ha.

The current site layout, Indicative new site layout, tenure and proposed purpose permit area is shown in Figure 4 below.

Barto will ensure that clearing is minimised as much as practicable and is maintained within the boundaries of the proposed Purpose Permit Area, which has been designed to avoid and minimise impacts to the *Rinzia fimbriolata* (P1) and *Stenanthemum bremerense* (P4) to the east of the Survey Area and the *Hakea pendens* (P3) population located on the western boundary of the proposed Purpose Permit Area.

Figure 4: Proposed new site layout at Windmills with new purpose permit area

2.3. INDICATIVE TIME

Subject to approval, Barto proposes to commence vegetation clearing in Q3 2023 with vegetation clearing being implemented over the now longer life of mine.

2.4. METHOD OF VEGETATION CLEARING

Barto will ensure all clearing and ground disturbance is carried out in accordance with the Barto Site Disturbance Permit and Clearing Procedure (SX-EN-PRO-001). Noting this, the following methods of vegetation clearing will be implemented during the construction phase of the Project:

- Prior to clearing, a specific internal Surface Disturbance Permit (SDP) (SX-EN-FO-0030) will be completed and signed off by the Environmental Department;
- Clearing areas will be delineated in accordance with the project specific internal SDP, the clearing boundary will be surveyed and demarcated with survey pegs and flagging tape;
- Vegetation will be removed prior to topsoil stripping. Vegetation will generally be cleared 'blade up' with bulldozers or graders within the proposed Purpose Permit Area. Diggers and loaders may be used around drainage lines as required;
- Vegetation will typically be stripped and stored to the side of each disturbed area for use in rehabilitation works. Areas with thicker vegetation may need to have the vegetation pushed into piles and mulched;
- The upper 0.2 m (topsoil) of the soil profile within the proposed disturbance areas is stripped (where possible) and placed in stockpiles (paddock dumped not greater than 2m in height with adequate distance between them to create a series of mounds and troughs);
- Any rock fragments and surface litter present within the soil profiles will be collected and stockpiled with the topsoil;
- Machinery operators will aim to minimise the frequency and intensity of disturbance, so they do not compromise the structural integrity of the material. Handling of topsoil will be minimised as much as possible, particularly when wet;
- Soil stripping is planned to occur as close as possible to the time when the proposed disturbance is scheduled to commence.

2.5. REHABILITATION AND MAINTENANCE

Barto and its contractors will complete a Weed, Seed, and Hygiene Certificate (SX-EN-FO-0031) prior to vehicles arrival upon site and adhere to hygiene procedures to minimise the risk of spreading or introducing weeds within the proposed Purpose Permit Area.

In areas where topsoil has been disturbed it will be spread back over the area and rehabilitated according to the commitments of the approved Mine Closure Plan (Reg ID 84650) (MCP) and seeded with local native species.

Rehabilitation monitoring will be undertaken on all substantial rehabilitation areas within set timeframes specified in the MCP to determine whether germination and establishment has been successful. Ongoing monitoring will determine if further management activities are required, including re-seeding or other interventions (for example, to remediate eroded areas) will be undertaken.

3. SITE OVERVIEW

3.1. BIOGEOGRAPHIC REGION

The proposed Purpose Permit Area lies within the Southern Cross (COO2) subregion of the Coolgardie bioregion (COO) (Cowan, 2001)(**Figure 5**). The Southern Cross (COO2) subregion is described as having subdued relief, comprising gently undulating uplands dissected by broad valleys with bands of low greenstone hills. The valleys include chains of saline playa-lakes. Diverse Eucalyptus Woodlands (*Eucalyptus salmonophloia, Eucalyptus salubris, Eucalyptus transcontinentalis* and *Eucalyptus longicornis)* rich in endemic eucalypts occur around these salt lakes, as well as on the low greenstone hills, valley alluvials and broad plains of calcareous earths (Cowan, 2001).

The subregion supports a high diversity of vertebrate fauna, many of which are considered significant such as the Chuditch (*Dasyurus geoffroii*), Slender-Billed Thornbill (*Acanthiza iredalei*), Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Red-Tailed Black Cockatoo (*Calyptorhynchus banksii*) Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Malleefowl (*Leipoa ocellata*), and Carpet Python (*Morelia spilota imbricata*).

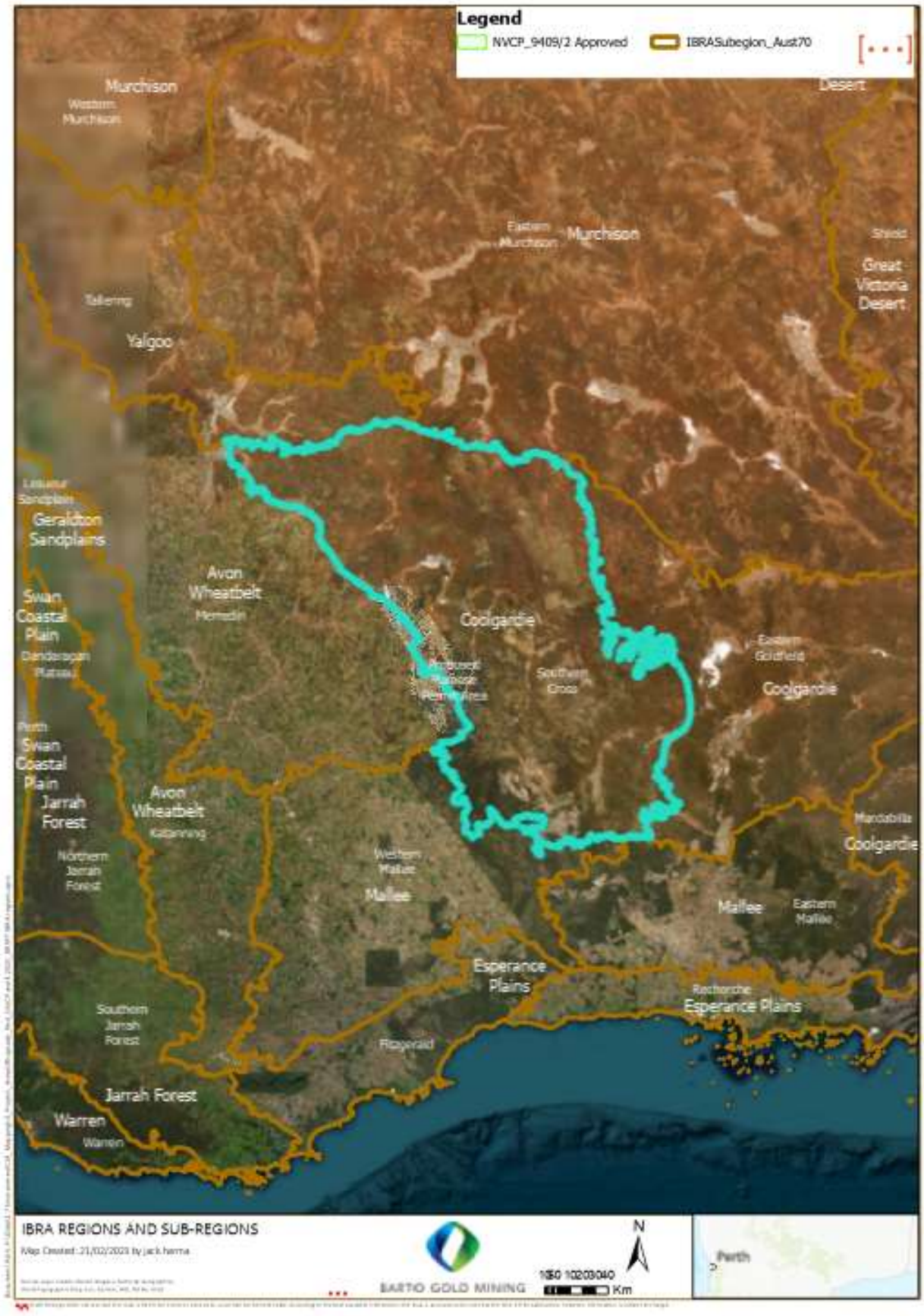


Figure 5: IBRA regions and the Southern Cross (COO2) subregion highlighted.

3.2. CLIMATE

The Coolgardie Botanical District of Western Australia has a semi-arid climate, characterised by hot summers and cool winters (Beard, 1990a). Long-term climate data (1996-2022) was obtained from the Bureau of Meteorology (BoM) weather station at Southern Cross Airfield (Station 12320), located approximately 35 km north-west of the Project Area. Most of the region's annual average rainfall is received during January to March and from June to August. The project area has an average annual rainfall of about 325 millimetres (mm). Relatively higher annual average rainfalls, 350 mm or higher, to the south and north-east are likely related to topographic influences. Large rainfall events can occur in the summer months; these are generally triggered by cyclonic weather events in the north or are local thunderstorms. Mean monthly 'Class A pan' evaporation exceeds mean monthly rainfall for all months and by an order of magnitude over the summer months. As annual rainfall only accounts for 10% of the annual potential evaporation, perennial surface water bodies in the area are uncommon. Intermittent, and generally short duration, surface runoff flows can be expected to occur following large rainfall events. The high rate of evaporation plays a major role in the formation of salt lakes and saline groundwater within the wider area (EMM, 2022).

The hottest months of the year are the summer months (December to February, with daily maximum temperatures regularly exceeding 30 degrees Celsius (°C)) and the coolest months occur between June and August, with minimum temperatures frequently falling below 5°C (**Figure 6**).

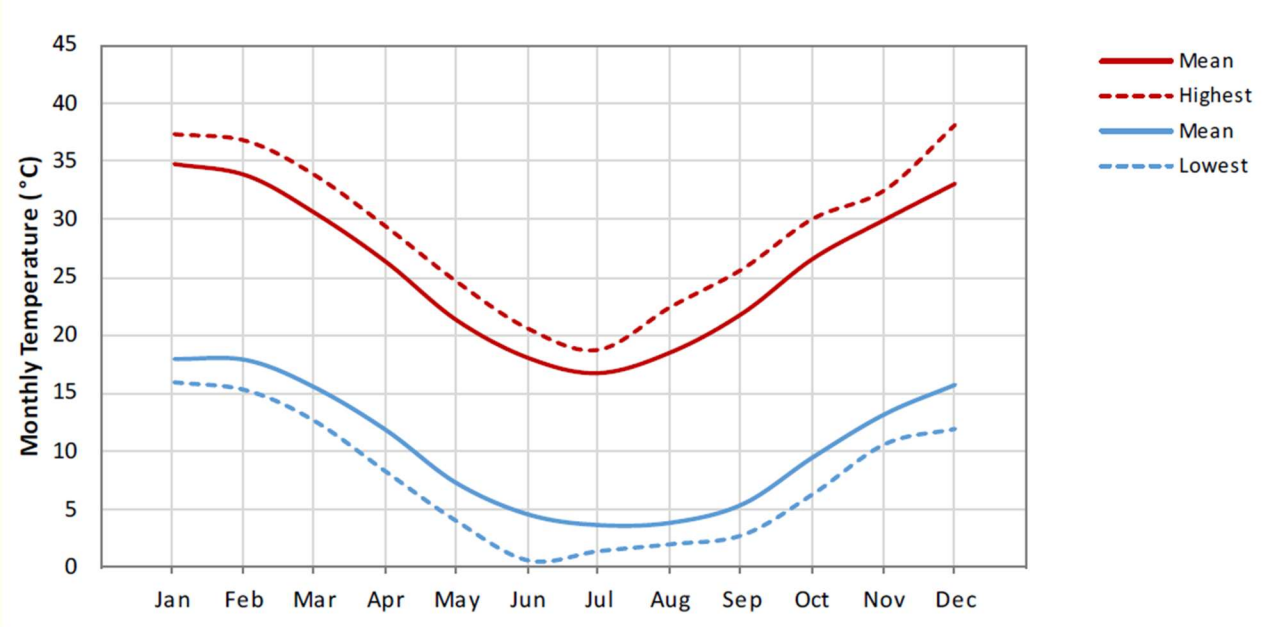


Figure 6: Monthly climate data for Southern Cross weather station (012074) 1996 – 2022 (BoM)

Predominant wind directions vary according to the time of day and year. Winds originating from the south-easterly sectors occur most frequently during summer, autumn, and spring. Winds from the north-easterly sectors are dominant during winter.

3.3. LAND USE

Land use in the area is predominantly for agriculture purposes such as cropping and grazing (Cowan, 2001). Crown Reserves and mining are also other dominant land uses in the areas surrounding Southern Cross with numerous small and abandoned mines and open shafts dotted across the Yilgarn landscape. The proposed Purpose Permit Area has been subject to previous mining exploration activity and historical settlement.

3.4. CONSERVATION RESERVES AND ENVIRONMENTALLY SENSITIVE AREAS

The proposed Purpose Permit Area amendment is located entirely within the Great Western Woodlands (GWW), situated on the western edge of the GWW Boundary. The GWW spans a 16 million ha area extending from the wheatbelt to the edge of the deserts and is the largest intact area of Mediterranean Woodland on earth. The GWW include open eucalypt woodlands (63%), mallee eucalypt woodlands, shrublands and grasslands (Bishop et al., 2013). Less common habitats within the GWW include granite outcrops, banded ironstone formations, salt lakes and freshwater wetlands (Fox and Douglas, 2016). The relative intactness of the GWW is a key value (Fox and Douglas, 2016) in that it provides habitat for many birds that are locally extinct or have reduced populations in the adjacent and substantially cleared Wheatbelt.

The proposed Purpose Permit Area does not overlap with conservation reserves or environmentally sensitive areas (ESA). Jilbadji Nature Reserve and Yellowdine Nature Reserve are the nearest conservation reserves, located approximately 10.5 km to the east and 16 km to the north-east, respectively. Boorabin National Park is located approximately 48 km to the north-east.

The Jilbadji Nature Reserve is over 200,000 ha and considered a significant area for maintaining existing ecosystem processes at a regional scale (Department of the Environment and Energy, 2021a). This reserve is substantially larger than the average reserve in the Wheatbelt region and has the potential to serve has an important refuge for many species. The reserve supports a very high diversity of reptiles and native mammal species; 38 and 15 species respectively, as well as 26 plant species endemic to the Wheatbelt region of Western Australia (Department of the Environment and Energy, 2021a). Yellowdine Nature Reserve lies in the transition zone between the Eremeaen and South-west botanical provinces, supporting a rich a diverse flora community with many species of flora and fauna persisting on the extremities of their distributions (Department of the Environment and Energy, 2021b).

Database search results identified one State-listed P3 PEC, Parker Range vegetation complexes, had a buffer that was mapped across the Survey Area (DBCA, 2019a). Vegetation analogous with this PEC has also been identified during previous surveys which intersect the Survey Area (Stantec, 2020b) or have been conducted in the vicinity of the Survey Area (Botanica, 2016, Gibson and Lyons, 1998, Recon Environmental, 2008a, Recon Environmental, 2008b).

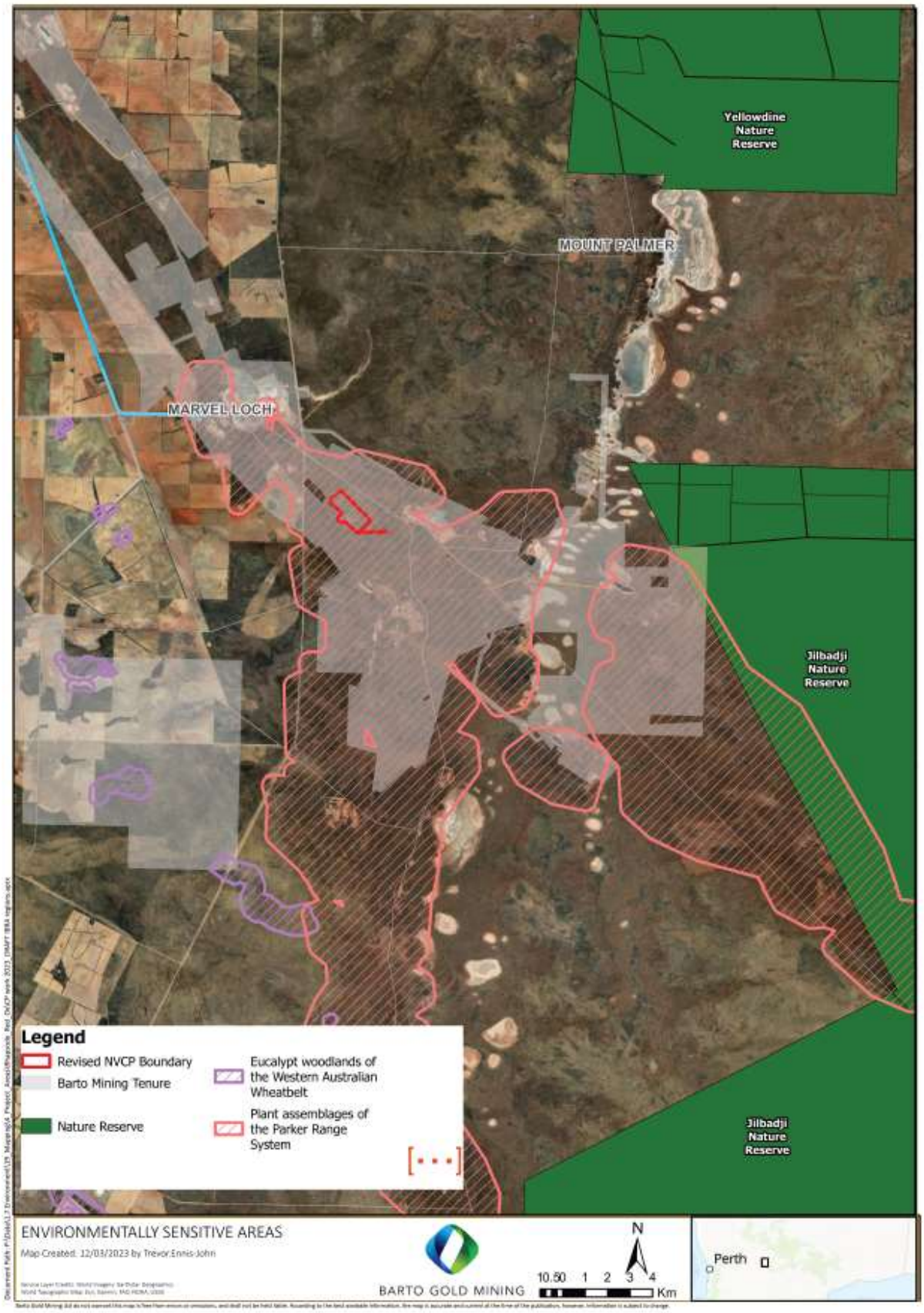


Figure 7: Environmentally Sensitive Areas within the region

3.5. LAND SYSTEMS AND SOILS

Land systems are defined as an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation (Tille, 2006). An assessment of land systems provides an indication of the occurrence and distribution of vegetation types within and surrounding the proposed Purpose Permit Area (Purdie et al., 2004). Land systems across the Goldfields and Wheatbelt have been mapped by the Natural Resources Assessment Group of the Department of Primary Industries and Regional Development (DPIRD), providing a comprehensive description of biophysical resources (Purdie et al., 2004). The proposed Purpose Permit Area occurs predominantly within the DD15. (**Table 3 ;Figure 8**).

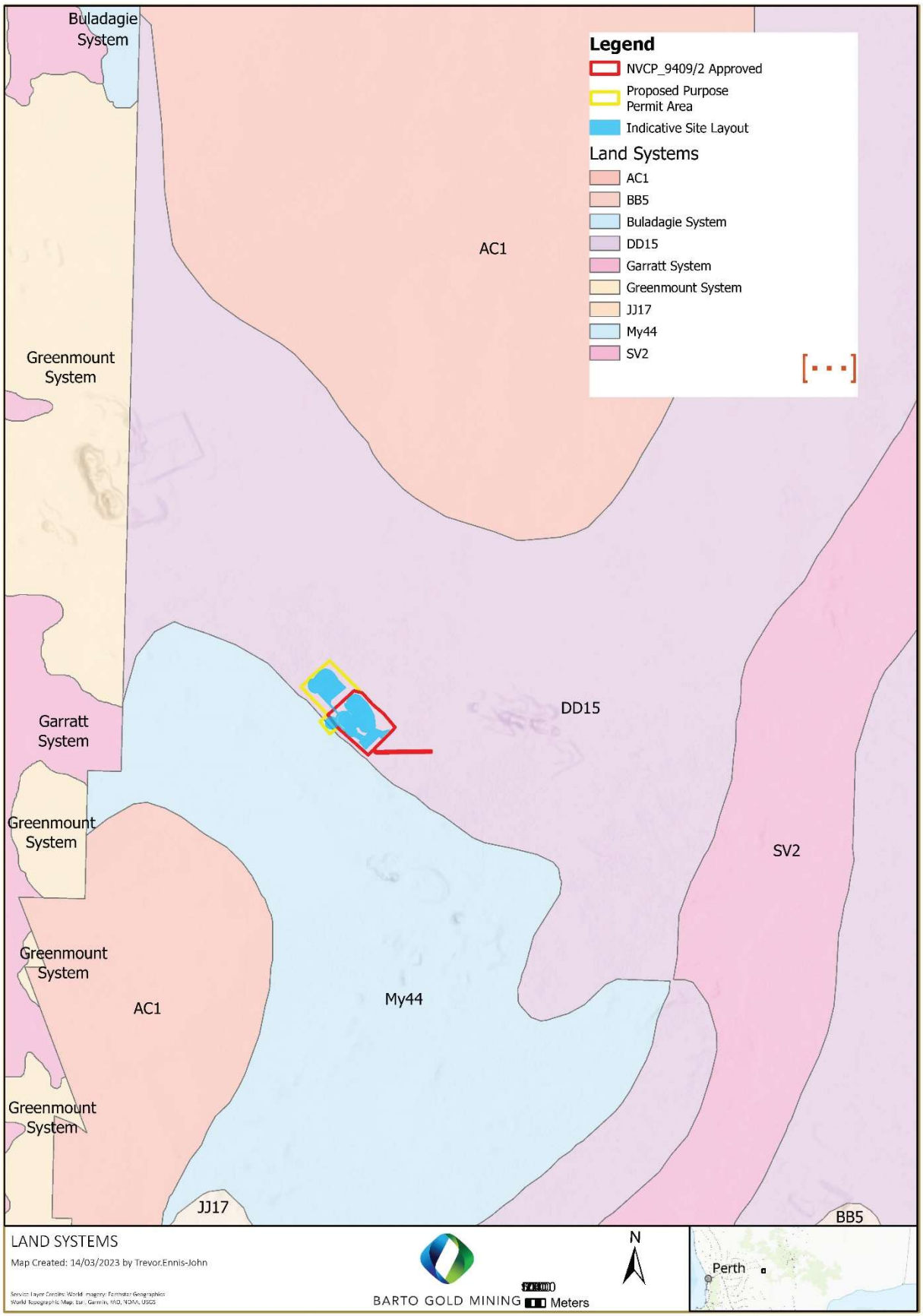


Figure 8 DPIRD Land Systems of the Windmills Area

Table 3: Extent of Land System within the proposed new Purpose Permit Area

Land System	Description	Proposed new Purpose Permit Area	
		Area (Ha)	Proportion (%)
DD15	Undulating plains with some low dunes, seasonal lakes and clay pans	67.68 Ha	95.51%
My44	Undulating ridge and low hilly terrain with some mesas and buttes and small valley plains	3.18 Ha	4.49%

3.5.1. SOIL CHARACTERISTICS

Soils in the region are mainly shallow, fertile red brown sandy clays with a pH that ranges from 5.5 to 8.5. These soils are typically associated with agricultural land uses that dominate the landscape to the north and west of Marvel Loch although can be saline and dispersive. Outcropping the landscape are skeletal soils dominated by basement highs that have either resisted weathering or structures that have later intruded the landscape or the presence of lateralised ridges (Barto Gold, 2020).

The proposed Purpose Permit Area is as soil landscape zone 261 – Southern Cross in the Kalgoorlie Province (Tille, 2006). The Southern Cross soil unit, covering some 8,550 square km is described as undulating plains and uplands, with some salt lakes and low hills, on deeply weathered mantle, colluvium and alluvium over greenstone and granite rocks of the Yilgarn Craton (Tille, 2006). Soils of this unit are varied and consist of calcareous loamy earth, red and yellow loamy earths, and alkaline deep and shallow sandy duplexes with some yellow sandy earths, salt like soils, yellow deep sand and red shallow loamy duplexes (Tille, 2006). DPIRD has further grouped these soil types and the proposed Purpose Permit Area is classed as predominantly Calcareous loamy earth as per Figure 9.

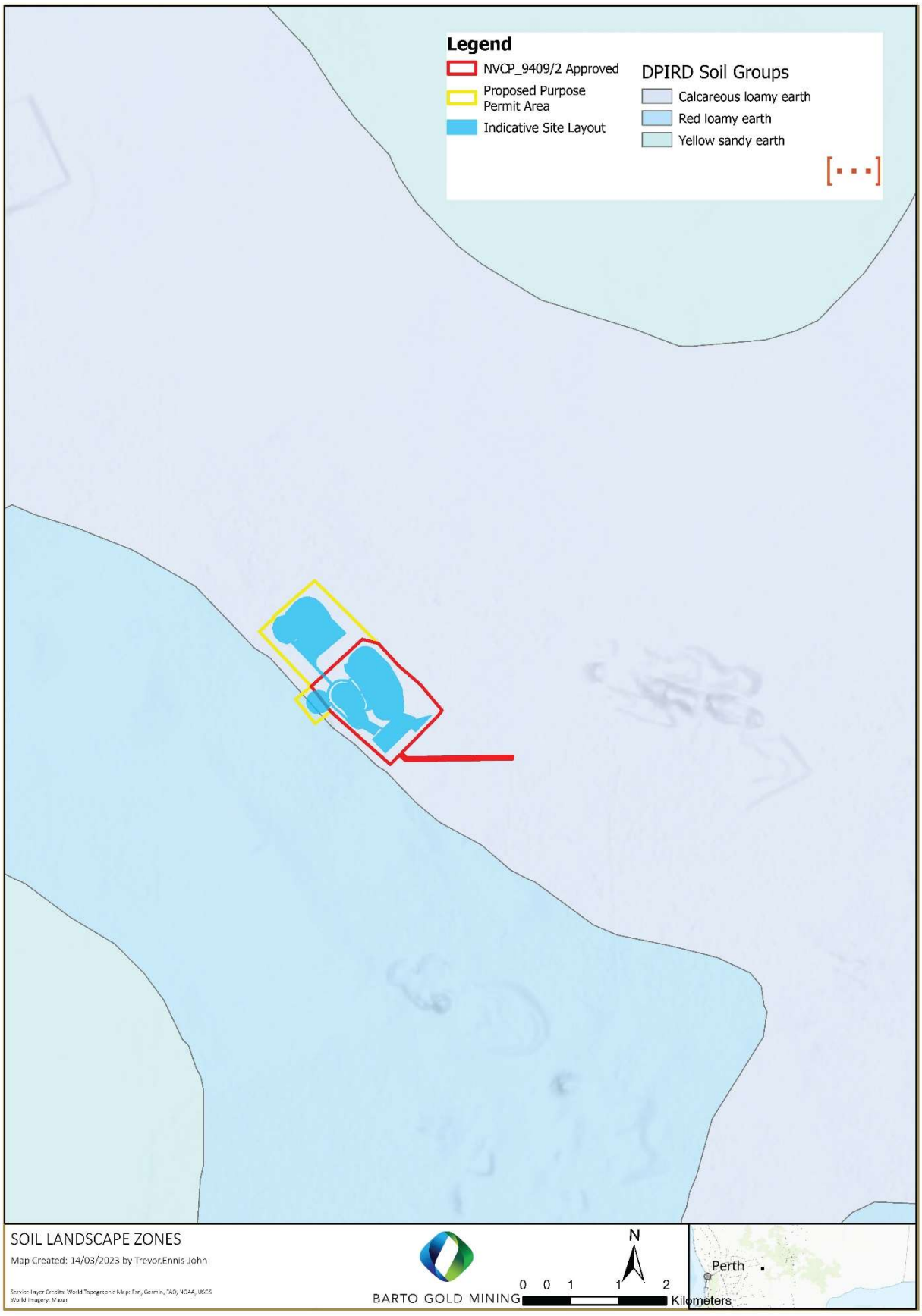


Figure 9: DPIRD Soil Types of the Windmills Area

3.5.1.1. LAND DEGRADATION SUMMARY

Land degradation includes any alteration to land capability, soil erosion, salinity, nutrient export, acidification, waterlogging and flooding that affects the present or future use of land.

A review of the grade of soil erosion for the Yilgarn Plateau Province of Australia (Geoscience Australia, 2021) indicated the proposed Purpose Permit Area lies within an area graded as 'Poor' owing to the province being vulnerable to wind erosion due to low ground cover and erodible soils. Poor soil erosion grading of the province is likely attributed to agriculture and grazing activities that dominate the region. The proposed Purpose Permit Area does not occur within a known acid sulphate risk area.

3.6. GEOLOGY

3.6.1. REGIONAL GEOLOGY

The Survey Area encompasses six geological units (Error! Reference source not found.), with the majority underlain with unit 74240.

3.6.2. LOCAL GEOLOGY

The proposed Purpose Permit Area intersects three geological units (**Table 4, Figure 10**), predominantly and 38491 colluvium (50.56 ha).

Table 4: Geological features within the proposed permit area

Geological Unit	Description	Proposed Purpose Permit Area (Ha)
Asy: Pelitic and psammitic sedimentary rocks 74240	Conglomerate, chert, small amounts felsic volcaniclastic rocks, sandstone, quartzite, siltstone, phyllite, schist, pelite, shale. Includes the former Hatfield Formation.	15.63 ha
Awy Volcanic and sedimentary rocks 74483	Rhyodacitic porphyry, volcaniclastic rocks, tuff, para-amphibolite, quartzite, mafic schist, amphibolite, felsic volcanic rocks, mafic volcanic rocks, banded iron formation, siliciclastic rocks, ultramafic rocks, chert	4.67 ha
Qrc: Colluvium 38491	Colluvium and-or residual deposits, sheetwash, talus, scree; boulder, gravel sand; may include minor alluvial or sand plain deposits, local calcrete and reworked laterite.	50.56 ha
Total		70.86 ha

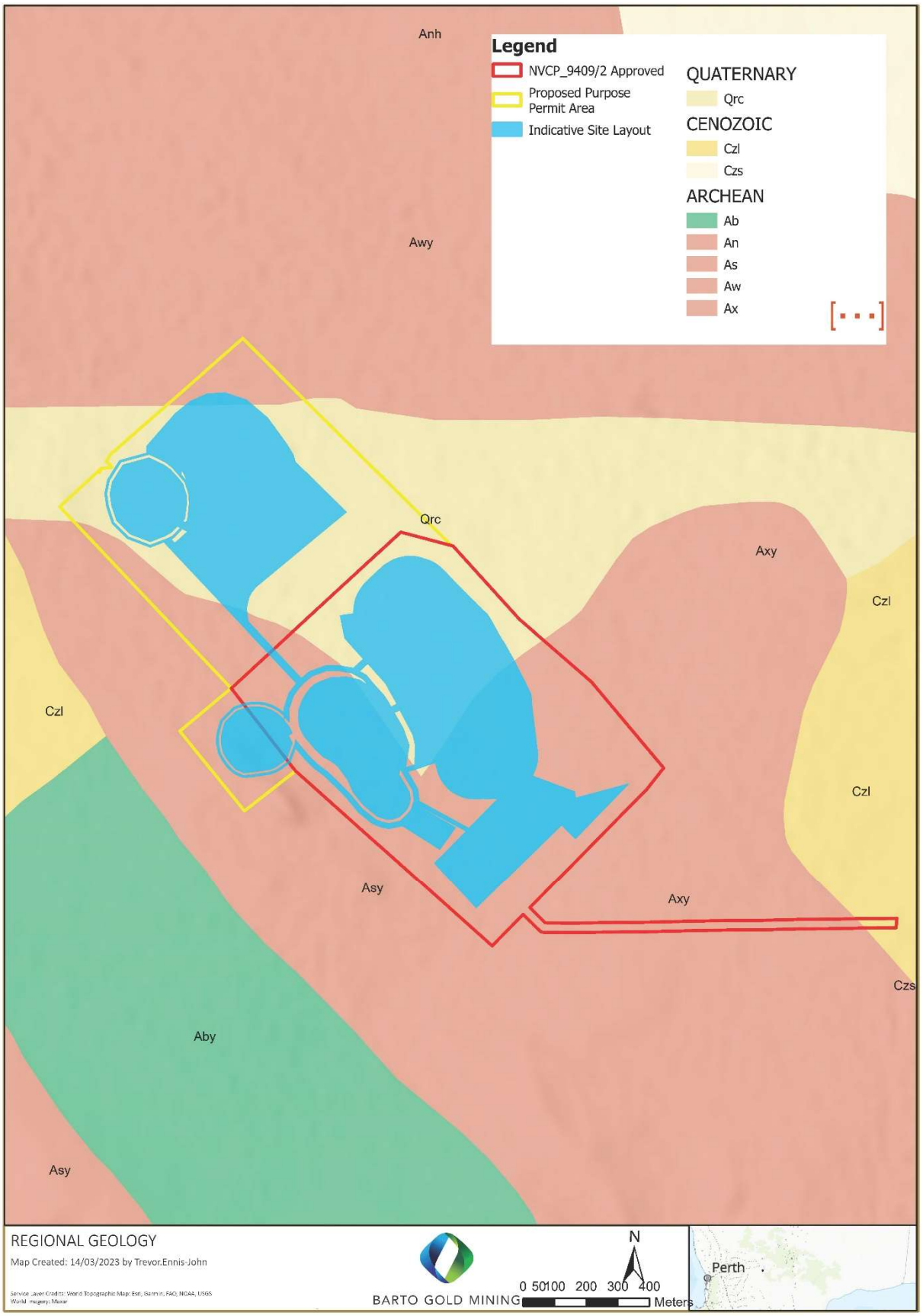


Figure 10: Surface Geology of the Windmills Area

3.7. SURFACE WATER AND HYDROLOGY

The Southern Cross (COO2) subregion has occluded drainage with any excess surface water after heavy rainfall draining into salt lakes (BoM 2012, Cowan et al. 2001). The proposed Purpose Permit Area occurs within the Lake Julia Sub-catchment of the Swan-Avon River catchment (State of Western Australia, 2021)(**Figure 11**). Drainage systems in the area are characterised by extensive paleo-alluvium and chains of playa lakes, with numerous ephemeral watercourses within proximity to the proposed Purpose Permit Area, however, none of these intersect the proposed Indicative Development Footprint. A chain of ephemeral lakes occurs approximately six kms east of the proposed Purpose Permit Area.

The proposed Purpose Permit Area is not located within a Public Drinking Water Source Area (PDWSA). The closest PDWSA is associated with the Broad Arrow Dam Catchment Area, located over 200 km northeast of the proposed Purpose Permit Area.

There are no surface water bodies or water courses that intersect the proposed Purpose Permit Area. Clearing is not likely to impact on any drainage or surface water quality in the area.

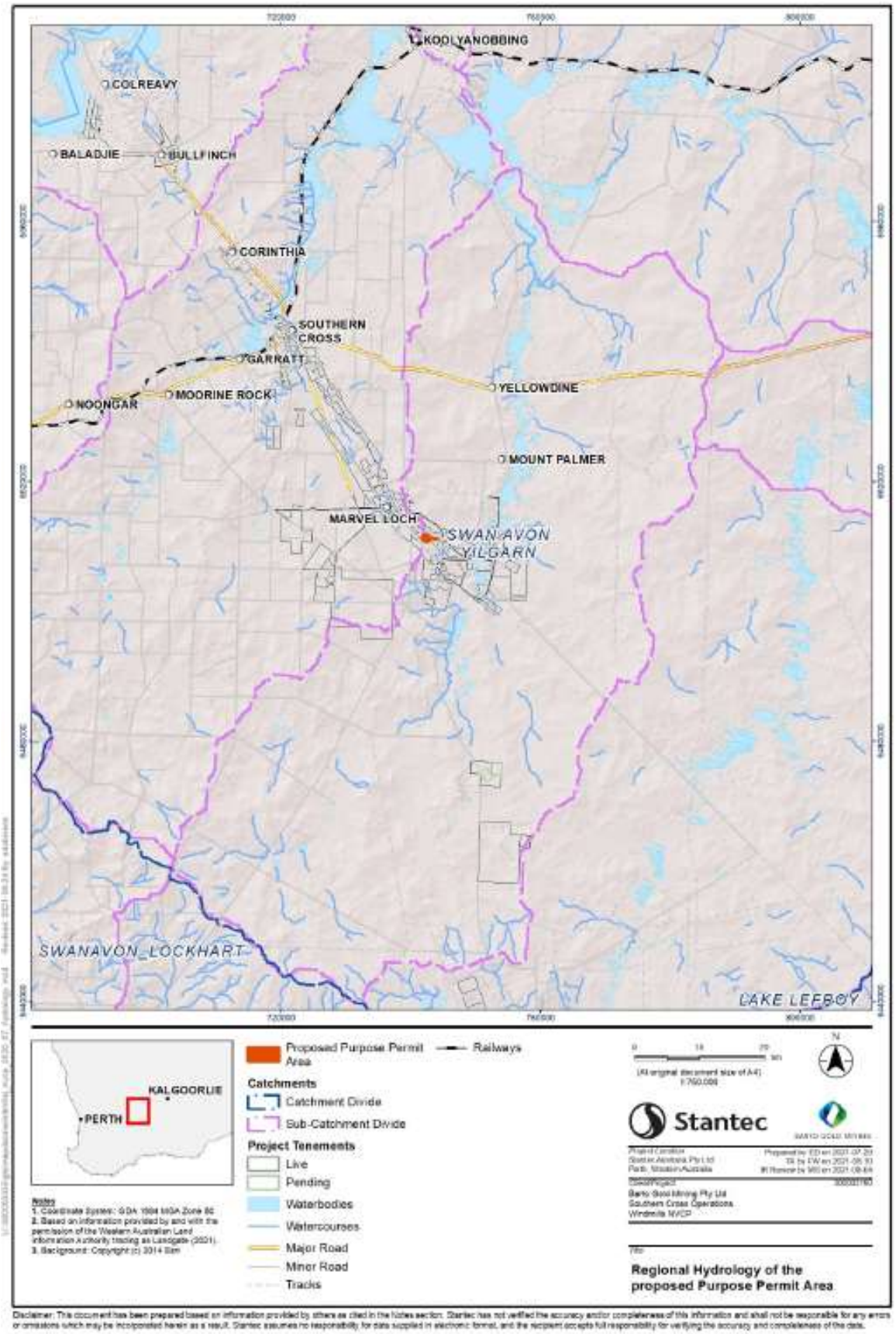


Figure 11: Regional Surface Hydrology

3.8. HYDROGEOLOGY

The Southern Cross Operations are located within the Yilgarn Craton, an area dominated by Archaean Greenstones with significant granitic and gneiss inliers. The Greenstones within the area can be significantly metamorphosed. The Archaean units are generally considered to be a poor groundwater source; however some quartzite rocks, together with shear zones, can offer potential groundwater resources (Barto Gold, 2020).

The aquifer units found with the Southern Cross area comprise superficial, paleochannel and bedrock aquifers (Barto Gold, 2020). Groundwater recharge in the area is generally restricted to the southern margins of the Ghooli Dome, where lower salinity groundwater has been located within fractured rocks and alluvium (Barto Gold, 2020).

The groundwater flows are generally towards the north, and the chains of Lakes (such as Seabrook, Polaris, Koorkoordine and Deborah). The regional groundwater table is 5 to 45 m deep, with groundwater flowing in a north-westerly direction, towards the paleodrainages (Barto Gold, 2020)

Groundwater is hypersaline and has no near-by users or value to vegetation. Groundwater salinities are generally in the range of 10,000 and 180,000 mg/L Total Dissolved Solids (TDS), but more typically between 20,000 and 110,000 mg/L TDS (Barto Gold, 2020).

The proposed NVCP is located within the Goldfields Groundwater Area Proclaimed under the *Rights in water Irrigation Act 1914*, meaning a licence is required for the abstraction of groundwater or the construction of bores (DWER 2020). Clearing is highly unlikely to impact on groundwater quality provided that appropriate management practices are followed to reduce the likelihood of spills and contamination of groundwater.

4. ENVIRONMENTAL VALUES

This section contains information about the environmental characteristics of the proposed Purpose Permit Area (within the context of the region), specifically relating to flora, vegetation and terrestrial fauna values, that may be relevant to this NVCP application. The assessment against the 10 clearing principles has also taken into regard the geological, soil characterisits and hydrogology to inform the impact predictions.

4.1. FLORA

4.1.1. SURVEY OBJECTIVES AND METHODS

A combined Flora, Vegetation and Fauna Survey was conducted by Stantec in April and September 2020, as well as an opportunistic botanical survey in April 2021 (Stantec, 2021), as well as recent targeted survey work for Chuditch (*Dasyurus geoffroii*) (Stantec Unpublished Data, 2021a). The Survey Area encompassed and extended beyond the proposed NVCP Area (Figure 12).

The objective of the 2020 and 2021 survey work was to understand the flora and vegetation values of the Survey Area, including characterising the flora, delineating vegetation units and providing an assessment of the conservation significance of the flora and vegetation.

The Environmental Protection Authority (EPA) recommends that flora and vegetation surveys be undertaken following the season of highest rainfall to optimise the likelihood of encountering flowering and fruiting taxa and capturing ephemeral species. The recommended survey timing for the South-Western Interzone Province is during spring (September to November). The survey was undertaken in accordance with the EPA's technical Guidance: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016).

4.1.1.1. DESKTOP ASSESSMENT

A desktop assessment, comprising database searches and a literature review, was undertaken prior to the field survey to gather contextual information on the Survey Area and to inform a likelihood of occurrence for significant flora and vegetation to occur within the Survey Area. Database searches were completed to generate a list of vascular flora and vegetation communities previously recorded within, and in the vicinity of, the Survey Area, with an emphasis on species and communities of conservation significance and introduced species.

Background information relating to the Survey Area and surrounds was compiled prior to conducting the field work for the Survey. Historic vegetation mapping (Beard, 1972, Shepherd et al., 2002c), soil and land system mapping and characteristics (Cowan, 2001, Tille, 2006), and the IBRA classification system information (Thackway, 1995) were reviewed to provide broad contextual information. The literature review also considered 13 publicly available survey reports of relevance to the Survey Area, comprising eight flora and vegetation surveys.

4.1.1.2. FIELD SURVEY

Two field surveys were completed in April and September 2020, followed by an opportunistic survey April 2021 following a significant rainfall event. The survey methods comprised the establishment of quadrats, habitat assessments, mapping notes, targeted searches, opportunistic collections of flora and opportunistic recordings of fauna. Survey effort consisted of 12 combined quadrats and habitat assessments and one relevé. Targeted searches were conducted for significant flora identified during the desktop assessment.

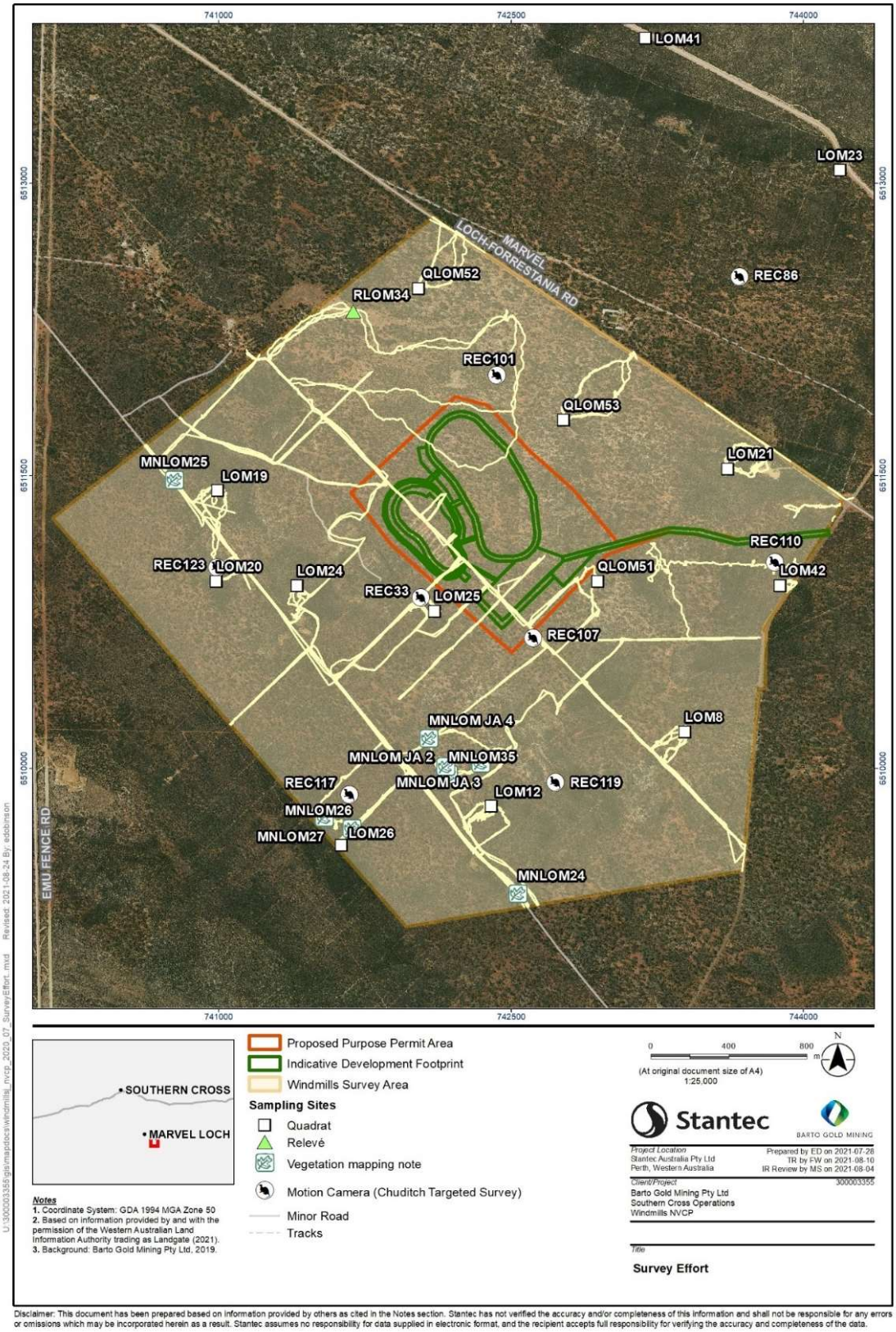


Figure 12: Field Survey Effort

4.1.2. FLORA

A total of 103 vascular flora taxa, representing 31 families and 65 genera, were recorded during the field assessments (Error! Reference source not found.). Of these 20 specimens were unable to be confidently identified beyond family or genus level due to lack of diagnostic characteristics and are likely to represent additional species; additional species are unlikely to represent significant flora. None of the 20 specimens possessed characteristics analogous with those of species of significance. The dominant plant family was Myrtaceae, with 28 confirmed species, while *Acacia* was the most frequently recorded genus (Error! Reference source not found.). Floristic diversity and composition were considered typical of the COO2 subregion (Cowan, 2001) and also showed similarities to the nearby Avon Wheatbelt (AW1) subregion, with the presence of eucalyptus and *Eucalyptus loxophleba* subsp. *lissophloia* woodland. Diversity was largely consistent with previous surveys undertaken within and in close proximity to Survey Area (Botanica, 2016, GHD, 2016, Gibson and Lyons, 1998, MWH Australia, 2014, Recon Environmental, 2008a, Recon Environmental, 2008b, Spectrum Ecology, 2020, Stantec, 2020b).

A full list of flora species identified during the Flora, Vegetation and Fauna Survey is provided in the Survey Report (Error! Reference source not found.).

4.1.3. FLORA OF SIGNIFICANCE

No Commonwealth or State-listed threatened flora were recorded within the Survey Area. Three State-listed priority flora species, *Rinzia fimbriolata* (P1), *Hakea pendens* (P3) and *Stenanthemum bremerense* (P4), were recorded during the field assessments. These three species have been recorded within five kilometres of the Survey Area, either from database search results or previous surveys (DBCA, 2020a, DBCA, 2020c, Recon Environmental, 2008a, Stantec, 2020b).

Rinzia fimbriolata (P1) was recorded at 23 locations within the Survey Area (Stantec, 2021)(**Figure 13**), with an estimated total of 431 individuals occurring within this area. This species usually favours open mallee *Eucalypt* woodland with an understorey dominated by Melaleuca and Acacia shrubs in brownish sandy loam soil. A further three records of *Rinzia fimbriolata* (P1) are held by the Western Australian Herbarium, with records identified up to 50 km north-west of the Survey Area (WAH, 2021a). To date, 2291 individuals of *Rinzia fimbriolata* have been recorded regionally by Stantec. Therefore, Stantec do not considered this species to be restricted to this Survey Area and is widespread though the surrounding environment. The population located with the Windmills Survey Area represents 18.7% of the regionally known population (Stantec, 2020b, Stantec, 2020a). Due to avoidance measures involving the realignment of the haul road, no individuals were located or disturbed within the proposed Purpose Permit Area and a 50 m buffer from the nearest individual will be maintained during construction and operations of the new activities.

Hakea pendens (P3) is restricted to the Parker Range System (which consists of Parker Range, Toomey Hill and Harris Find) (Beard, 1972, Beard, 1976), in ironstone or stony ridges in stony loam of mixed scrub (Beard, 1990b). Within the Survey Area, this species was recorded within tall open scrub dominated by *Allocasuarina campestris*. It was recorded from 49 locations (**Figure 13**), with 247 individuals estimated in total. According to the Western Australian Herbarium (WAH), only 23 records of *Hakea pendens* (P3) are currently listed (WAH, 2021b). The restriction of *Hakea pendens* (P3) to the Parker Range System is of regional and local significance. Stantec botanists have recorded 212 other *Hakea pendens* individuals (totalling 482) regionally, while the proportion within the Survey Area represents over half known records (51%), the species is not considered restricted to the Survey Area (Stantec, 2021) and the proposed Purpose Permit Area would only impact a small proportion (<2%).

Stenanthemum bremerense (P4) was recorded at 13 locations within the Survey Area (**Figure 13**), with an estimated abundance of 135 individuals. Currently there are 33 records of *Stenanthemum bremerense* (P4) held by WAH, with records identified up to 160 km south-east of the Survey Area (WAH, 2021b). Outside the Survey Area, Stantec botanists have identified 991 individuals of this species (Stantec, 2020a, Stantec, 2020b), and as such, this species is not restricted to the Survey Area and represents only 11.8% of the regional population. No individuals have been recorded from within the proposed Purpose Permit Area.

Database search results (DBCA, 2020a, DBCA, 2020c) indicate that *Calamphoreous inflatus* (P4) has been previously recorded at two locations within the Survey Area (Stantec, 2021), with at least 11 individuals noted. During the survey, searches for this species were conducted within the locality of the provided waypoint locations, however the species was not detected. Given that the known flowering time for this species is October to December and February to March, it is possible that it was not flowering at the time of the surveys and therefore not easily detectable. No individuals have been recorded from within the proposed Purpose Permit Area.

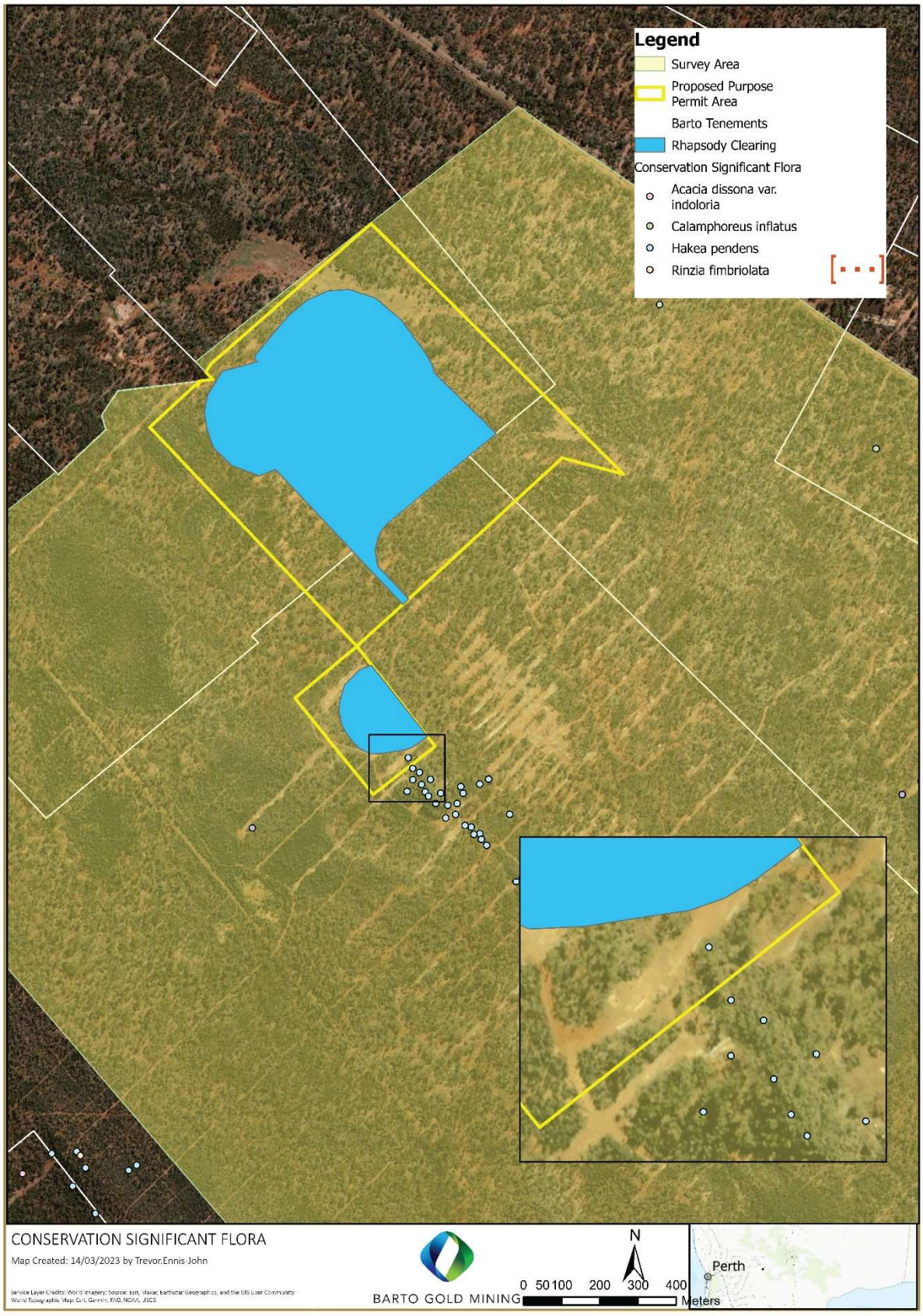


Figure 13: Conservation Significant Flora

4.1.4. INTRODUCED FLORA

Seven introduced flora (weed) species were recorded within the Survey Area (Stantec, 2021). None of these species represents a declared pest under Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) or are listed as a Weed of National Significance (WoNS)(Commonwealth of Australia 2020a). Cover and abundance for each of the introduced species was low and generally recorded in small patches within previously disturbed areas. (Table 5 below)

Table 5: Introduced flora tax identified in the Survey Area

Taxon	Common Name	Ecological Impact & Invasiveness (DBCA)
Erodium cicutarium	Common Storksbill	Low; Medium
Lysimachia arvensis	Pimpernel	Unknown; Rapid
Medicago minima	Small Burr Medic	Unknown; Unknown
Pentameris airoides	False Hairgrass	Unknown; Unknown
Pentameris airoides* subsp. *airoides	-	N/A
Rostraria pumila	-	Unknown; Unknown
***Sonchus* sp. Indet.**	Sowthistle	Unknown; Rapid

4.2. VEGETATION

4.2.1. VEGETATION TYPE

Six vegetation types were described, delineated and mapped across the Survey Area (Stantec, 2021), five of which are intersected by the proposed Purpose Permit Area at Windmills (**Figure 14**).Vegetation types were broadly represented by mid height to tall *Eucalyptus* Woodlands, *Acacia* and *Melaleuca* shrublands on a low Chenopod shrubland. *Eucalyptus* woodlands comprised the majority of the Survey Area (approximately 823 ha or 94%) and consisted of the following vegetation types: EllMhBe, EcAcGooHeEm and EsEsuElMpEaSaHe (Stantec, 2021). Within the proposed Purpose Permit Area vegetation comprises: EsEsuElMpEaSaHe, EcAcGooHeEm, EllMhBe, AvTpttpTpepeEt, ErAaaAbMhTkBeLfEm and cleared land (Table 6). These patterns of vegetation are considered typical of the South-Western Interzone (Gibson and Lyons, 1998, Gibson and Lyons, 2001, Recon Environmental, 2008a, Recon Environmental, 2008b).

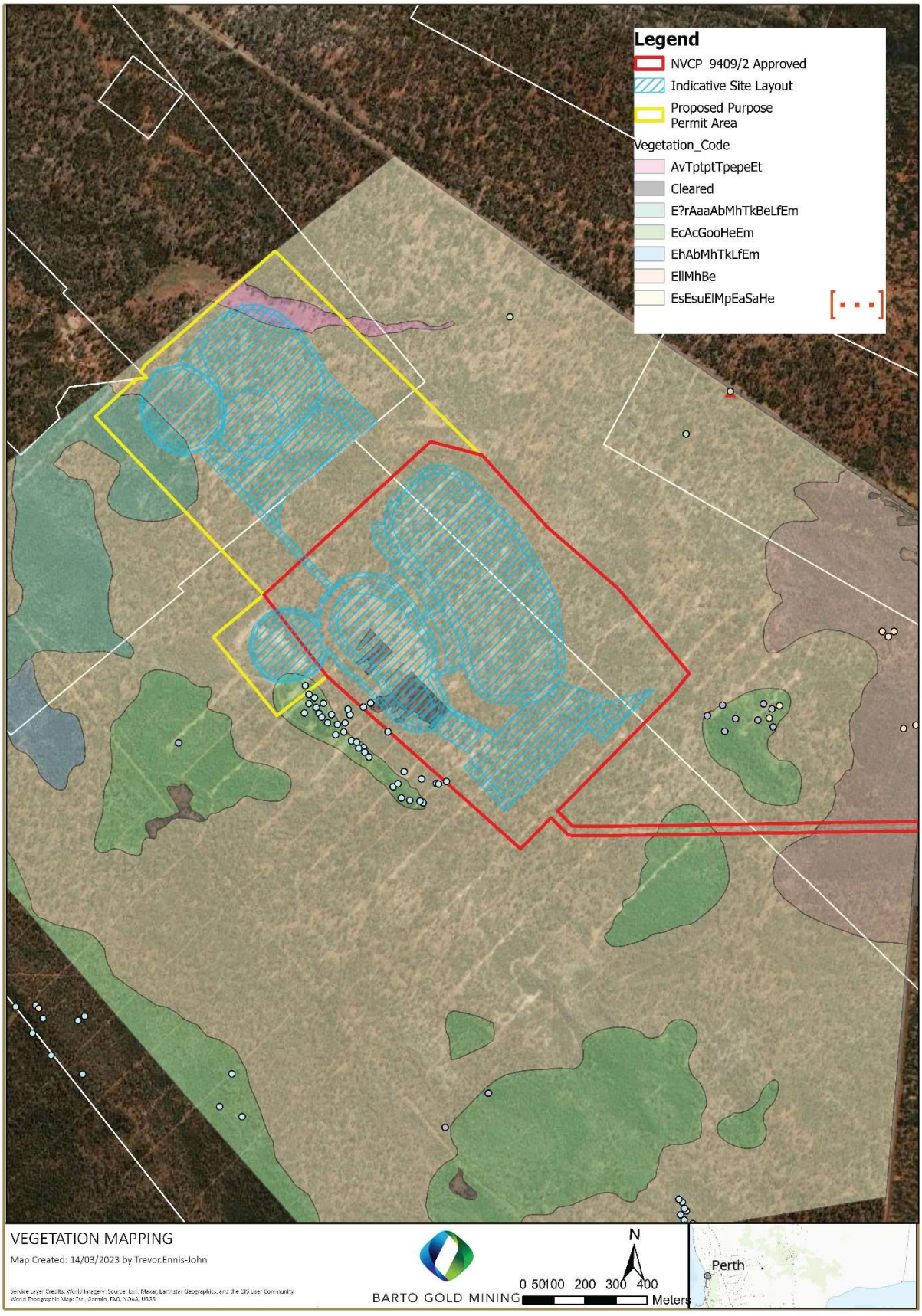


Figure 14: Vegetation Type Mapping of the Survey Area 2021

Table 6: Vegetation Types recorded within the Survey Area and Proposed Permit Area

Vegetation Type	Extent Within Survey Area		Proposed Purpose Permit Area (Ha)	
	Hectares (Ha)	Proportion (%)	Hectares (Ha)	Proportion (%)
EsEsuElMpEaSaHe Eucalyptus salmonophloia, E. salubris and E. longicornis woodland over Melaleuca pauperiflora, Exocarpos aphyllus and Santalum acuminatum tall shrubland over Hibbertia eatoniae low open shrubland.	649.19	74.20	65.33	92.19
EcAcGooHeEm Eucalyptus capillosa low open woodland over Allocasuarina campestris tall shrubland over Grevillea obliquistigma subsp. Obliquistigma scattered shrubs over Hibbertia eatoniae, Euryomyrtus maidenii low shrubland	106.79	12.20	1.05	1.48
AvTptptTpepeEt Atriplex vesicaria, Tecticornia pterygosperma subsp. pterygosperma, Tecticornia pergranulata subsp. pergranulata and Enchylaena tomentosa low open shrubland	4.27	0.49	3.10	4.37
E?rAaaAbMhTkBeLfEm Eucalyptus rigidula scattered low trees over Acacia assimilis subsp. Assimilis, Acacia beauverdiana, Melaleuca hamata tall shrubland over Thryptomene kochii, Baeckea elderiana, Leptospermum fastigiatum shrubland over Euryomyrtus maidenii low open shrubland	31.46	3.6	1.38	1.94
Totals	868.82	99.32	70.86	100

4.2.2. VEGETATION OF SIGNIFICANCE

No Commonwealth or State-listed Threatened Ecological Communities (TECs) are known to occur within or immediately adjacent to the proposed Purpose Permit Area (DBCA, 2019b). The closest mapped TEC to the proposed Purpose Permit Area is the *Eucalypt Woodlands of the Western Australian Wheatbelt* (Wheatbelt Woodlands) (CR)(**Table 7**), which is located approximately 8 km to the west and is restricted to the Avon Wheatbelt region.

Table 7: Summary of Threatened Ecological Communities mapped within 10km of the Survey Area

Ecological Community Overview	Proximity to proposed Purpose Permit Area
Eucallypt Woodlands of the Western Australian Wheatbelt (Wheatbelt Woodlands) **Critically Endangered TEC (EPBC Act)**	
Eucalypt-dominated woodlands in the Western Australian Wheatbelt region as defined by the IBRA Avon Wheatbelt 1 and 2 and Western Mallee subregions with the specific exceptions of: woodlands and forests dominated by Jarrah (*E. marginata*) or Marri (*Corymbia calophylla*) where they occur without York Gum present; and non-woodland communities dominated by eucalypts, specifically those dominated by eucalypts with a mallee growth form. Community is defined primarily by its structure as a woodland. The presence in the canopy layer of eucalypt trees - most commonly salmon gum (*Eucalyptus salmonophloia*), York gum (*Eucalyptus loxophleba*), red morrel (*Eucalyptus longicornis*) or gimlet (*Eucalyptus salubris*) defines the Wheatbelt woodlands. Several of the other emergent eucalypt species which may be present as a defining species (e.g. Kondinin blackbutt (*E. kondininensis*), *E. myriadena*, salt river gum (*E. sargentii*), silver mallet (*E. ornata*) and mallet (*E. singularis*) are found only in the Western Australian Wheatbelt.	8km West

Database search results identified one State-listed P3 PEC, Parker Range vegetation complexes, had a buffer that was mapped across the Survey Area (DBCA, 2019a). Vegetation analogous with this PEC has also been identified during previous surveys which intersect the Survey Area (Stantec, 2020b) or have been conducted in the vicinity of the Survey Area (Botanica, 2016, Gibson and Lyons, 1998, Recon Environmental, 2008a, Recon Environmental, 2008b).

Vegetation unit EsEsuElMpEaSaHe covered an area of 649.19 ha, representing almost 75% of the Survey Area (Stantec, 2021). A total of 65.33 ha has been mapped in the proposed Purpose Permit Area (7.5% of the Survey Area)(Stantec, 2021). The Parker Range PEC spans an area of 39,548 ha and all plant vegetation types within the extent of this broad PEC are considered representative of the PEC, the proposed Purpose Permit Area would seek to clear a maximum of 0.10%. No new occurrences of TEC or PECs were identified in the Survey Area.

Table 8: Extent of Vegetation type representing the Parker Range vegetation complexes PEC within the Survey Area, proposed Purpose Permit Area and Indicative Disturbance Footprint.

Vegetation Type description	Parker Range vegetation community type	Parker Range PEC Area (Ha)	Proposed Purpose Permit Area (Ha)		
			Hectares	Clearing (Ha)	Proportion (%)
EsEsuElMpEaSaHe Eucalyptus salmonophloia, E. salubris and E. longicornis woodland over Melaleuca pauperiflora, Exocarpos aphyllus and Santalum acuminatum tall shrubland over Hibbertia eatoniae low open shrubland.	Community Type 3	39,548	65.33	40	0.10

4.2.3. VEGETATION CONDITION

Vegetation condition within the Survey Area ranged from 'excellent' to 'completely degraded', with the majority (approximately 96%) in 'excellent' condition (Stantec, 2021). Within the proposed Purpose Permit Area, in 2020 vegetation ranged from 'degraded' to 'excellent' with 65.81 ha (92.8%) rated as 'excellent'. Keighery (1994) and Trudgen (1988) define 'Excellent' condition as vegetation with the structure still intact, however, with some weed species and disturbances evident. Disturbances were minor and included access tracking, clearing for exploration activities and settlement remnants.

It should be noted that since this survey was completed, further exploration activities have occurred within the proposed Purpose Permit extended area, and the Rhapsody and Red Ox pit areas can now be considered 'degraded'.

Seven weed (introduced flora) species were recorded during the 2020 and 2021 assessments (Stantec 2021) (see section Error! Reference source not found.**,** Error! Reference source not found.). None of these species represent a declared pest under Section 22 of the *Biodiversity and Agriculture Management Act 2007* (BAM Act) or are listed as Weed of National Significance (WoNS)(Commonwealth of Australia, 2021). Cover and abundance for each of the introduced species was low and generally recorded in small patches within previously disturbed areas.

Table 9: Vegetation Condition recorded in the Survey Area and proposed Purpose Permit Area

Vegetation Condition	Extent within Survey Area		Proposed Purpose Permit Area		
	Hectares (ha)	Proportion (%)	Hectares (ha)	Clearing (ha)	Proportion (%)
Excellent	836.04	95.57	65.81	38.69	96.7
Very Good	10.61	1.21	4.87	1.31	3.3
Good	18.39	2.11	0.18	0	-
Degraded	3.9	0.45	-	-	-
Completely degraded (cleared)	5.81	0.66	-	-	-
Total	**874.75**	**100**	**70.86**	**40**	**100**

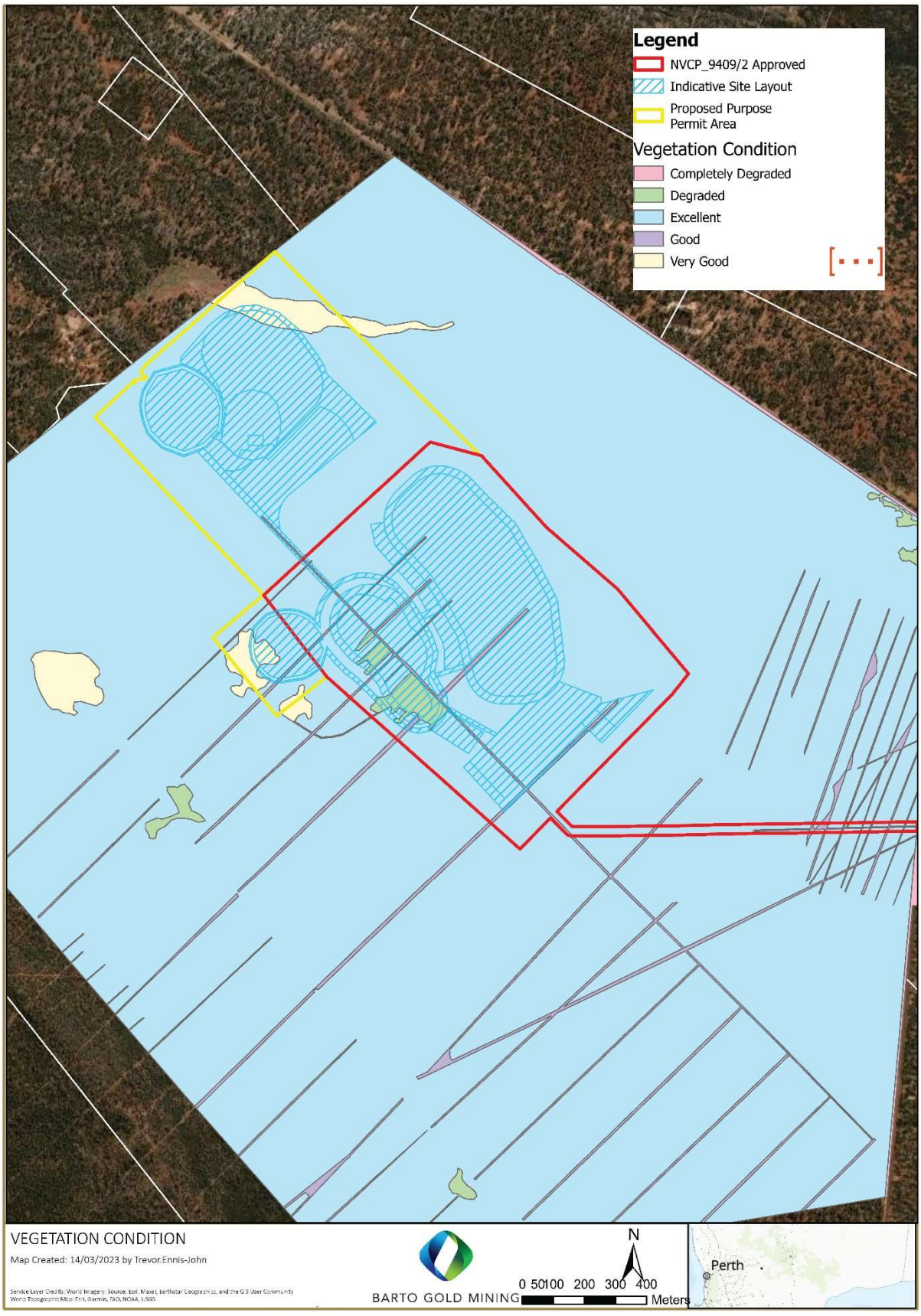


Figure 15: Vegetation Condition of the survey area as described by Stantec 2021

4.2.4. PRE-EUROPEAN VEGETATION

The vegetation of Western Australia was mapped on a broad scale (1:1,000,000 and 1:250,000) by Beard (1975)), who characterised and described a state-wide mapping and vegetation classification system based on geographic, geological, soil, climate, structure, life form and vegetation characteristics. These vegetation associations were re-assessed by Shepherd et al. (2002a), to account for clearing in the intensive land use zone, and to divide some larger vegetation units into smaller units. Additionally, Shepherd et al. (2002a) developed a series of systems to assist in the removal of mosaics; however, some mosaics still occur.

The proposed Purpose Permit Area intersects one pre-European vegetation extent: 1068 (**Table 10**, Figure **17**) (Shepherd et al., 2002b, Shepherd et al., 2002c). The significance of clearing a particular vegetation association can be determined by comparing current and pre-European extents (Error! Reference source not found.). A 30% threshold level of the pre-European extent of a vegetation is designated by the EPA's position statement No. 2 (EPA, 2000), as a required retention threshold; below which clearing is considered to compromise species diversity at an ecosystem level.

Over time, extensive clearing and land disturbance for mining activities as agriculture have resulted in a decline to as low as 53% existing for pre-European vegetation across the four scales of assessment (State, bioregion, subregion and LGA)(**Table 10**), with between one percent and 26% protected within Reserves (Government of Western Australia 2018). The proposed Purpose Permit Area will result in clearing up to 40 ha (0.020%) of regional native vegetation (**Table 11**), this is small scale and temporary disturbance will not significantly reduce the pre-European vegetation extent.

Table 10: Extent of pre-European vegetation associations remaining across four scales (State, Bioregion, Subregion and Local Government Area) (Government of Western Australia 2018)

Vegetation Association	Scale	Pre-European extent (ha)	Current extent (ha)	Proportion remaining (%)
1068	State-wide	268,900	142,088	53
	Bioregion (COO)	193,988	104,804	54
	Subregion (COO2)	193,988	104,804	54
	LGA (Yilgarn)	268,900	142,088	53

Table 11: Proportion of pre-European Vegetation within the proposed Purpose Permit Area

Vegetation Association	Bioregion (COO) Extent Ha	Proposed Purpose Permit Area (ha)	Proportion (%)
1068 Medium woodland; salmon gum, morrel, gimlet and *Eucalyptus sheathiana*	**193,988**	**70.86**	**0.020**
Total		**70.86**	**0.020**

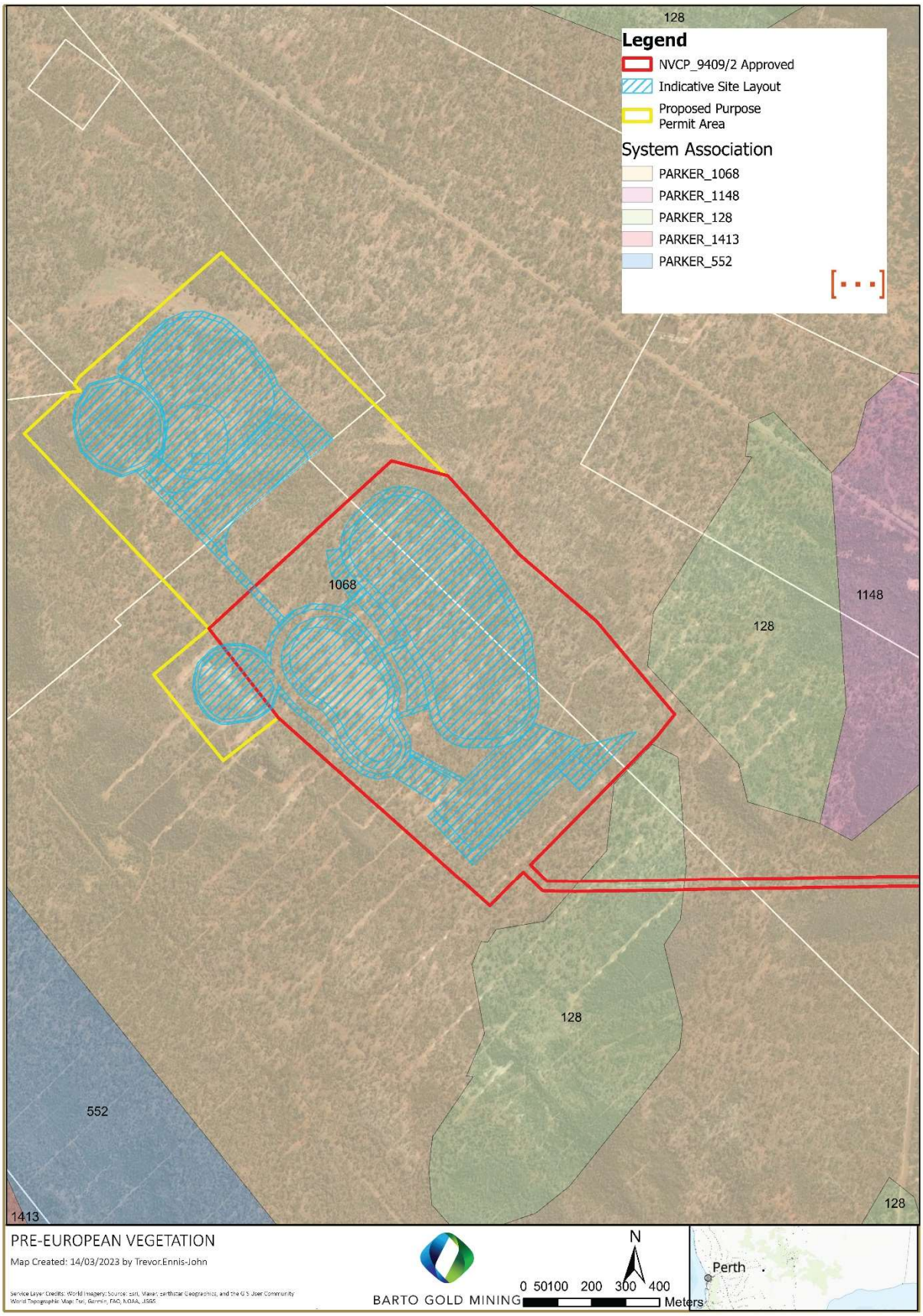


Figure 16: Pre-European Vegetation Associations of the Survey area

4.3. TERRESTRIAL FAUNA

As detailed in **Section** Error! Reference source not found.**,** the Fauna Survey was combined with the Flora and Vegetation Survey and conducted by Stantec in April and September 2020 (Error! Reference source not found.), and a targeted Chuditch Survey was undertaken in June-July 2021 (Stantec, 2021a). The Survey Area encompasses and extends beyond the proposed Purpose Permit Area (Stantec, 2021).

4.3.1. SURVEY OBJECTIVES AND METHODS

The objective of the Survey was to assess the fauna values of the Survey Area, including fauna of significance and significant fauna habitat.

The recommended timing for fauna surveys to be undertaken in the South-Western Interzone is between October-December (Primary survey) and February-March (Secondary survey) for reptiles; May-June, July-August and November-December for amphibians; September-December and November-March for birds and September-December for mammals (EPA 2020).

4.3.1.1. DESKTOP ASSESSMENT

Database searches were completed to generate a list of terrestrial fauna previously recorded within, and in the vicinity of, the Survey Area, with an emphasis on species and communities of conservation significance and introduced species.

A literature review considered four publicly available survey reports of relevance to the Survey Area, comprising two flora and fauna, one biodiversity and one fauna survey.

4.3.1.2. FIELD SURVEY

Field surveys were undertaken by Stantec in April and September 2020 (Stantec, 2021), and a survey targeting Chuditch was undertaken during June-July 2021 (Stantec, 2021a). The objectives were to verify the accuracy of the desktop study, document specific fauna assemblages and species of conservation significance within the Survey Area and characterise the fauna habitats present.

A targeted Malleefowl survey was undertaken (April and September 2020). Any evidence of Malleefowl presence was recorded, with reference to methodology from the National Manual for the Malleefowl Monitoring System (National Heritage Trust, 2007), and the National Malleefowl Monitoring Manual: Standards, Protocols and Monitoring Procedures Edition 2016-1 (National Malleefowl Recovery Team, 2016) The presence of Malleefowl was determined based on the classification of mounds (Active, Inactive and Extinct) found within the Survey Area.

Within the Study Area nine motion-sensing cameras were deployed between June-July 2021 (31 nights) to record fauna species considered or known to occupy the region. This timeframe is considered effective at capturing the presence of native mammal taxa within the area (Stantec, 2021b). Cameras were baited and placed in areas likely to support fauna of significance and in areas displaying fauna activity e.g. burrows, mounds and foraging evidence.

4.3.2. FAUNA HABITATS

Four broad fauna habitats were identified and delineated from fauna habitat assessments across the Survey Area (**Figure 18**). These comprised:

- *Eucalyptus* Woodlands;
- Saline Depressions and Claypans

- Shrubland; and
- Shrubland Stony Rise.

A description of each of these fauna habitats and the characterisation of each, in terms of distribution and significance is provided in Error! Reference source not found..

All fauna habitats were identified as important for species of significance. The *Eucalyptus* Woodland habitat was the most extensive, encompassing almost 75% (649.11 ha)(Error! Reference source not found.) of the Survey Area. The large hollowing bearing trees provide important habitat for the Western Rosella (*Platycercus icterotis xanthogenys*) (inland pop.) (P4) and the Peregrine Falcon (*Falco peregrinus*) (OS). Additionally, the thick vegetation at some sites may also serve as suitable foraging habitat for the Western Rosella. *Eucalyptus* Woodland is also known to support Chuditch (*Dasyurus geoffroii*)(Vu, Vu) for denning (logs, hollows, rabbit warrens etc.), while Shrubland habitat is known to be used as foraging habitat. Unvegetated (cleared) areas, which did not represent habitat of significance, accounted for 9.72 ha of the Survey Area.

The proposed Purpose Permit Area intersects the four fauna habitats which is predominately *Eucalyptus* Woodland (**Table 12**)

Table 12: Fauna Habitats within the Survey Area and Permit Area

Fauna habitats	Survey Area	Proposed Purpose Permit Area (ha)	Clearing (ha)	Proportion (%)
Eucalyptus Woodland	649.11	60.98	38.06	95.1
Saline depressions & claypans	4.27	3.14	0.76	1.9
Shrublands	146.5	5.70	1.06	2.6
Shrubland stony rise	65.15	1.04	0.12	0.4
Cleared	9.72	-	-	-
Total	**874.75**	**70.86**	**40**	**100**

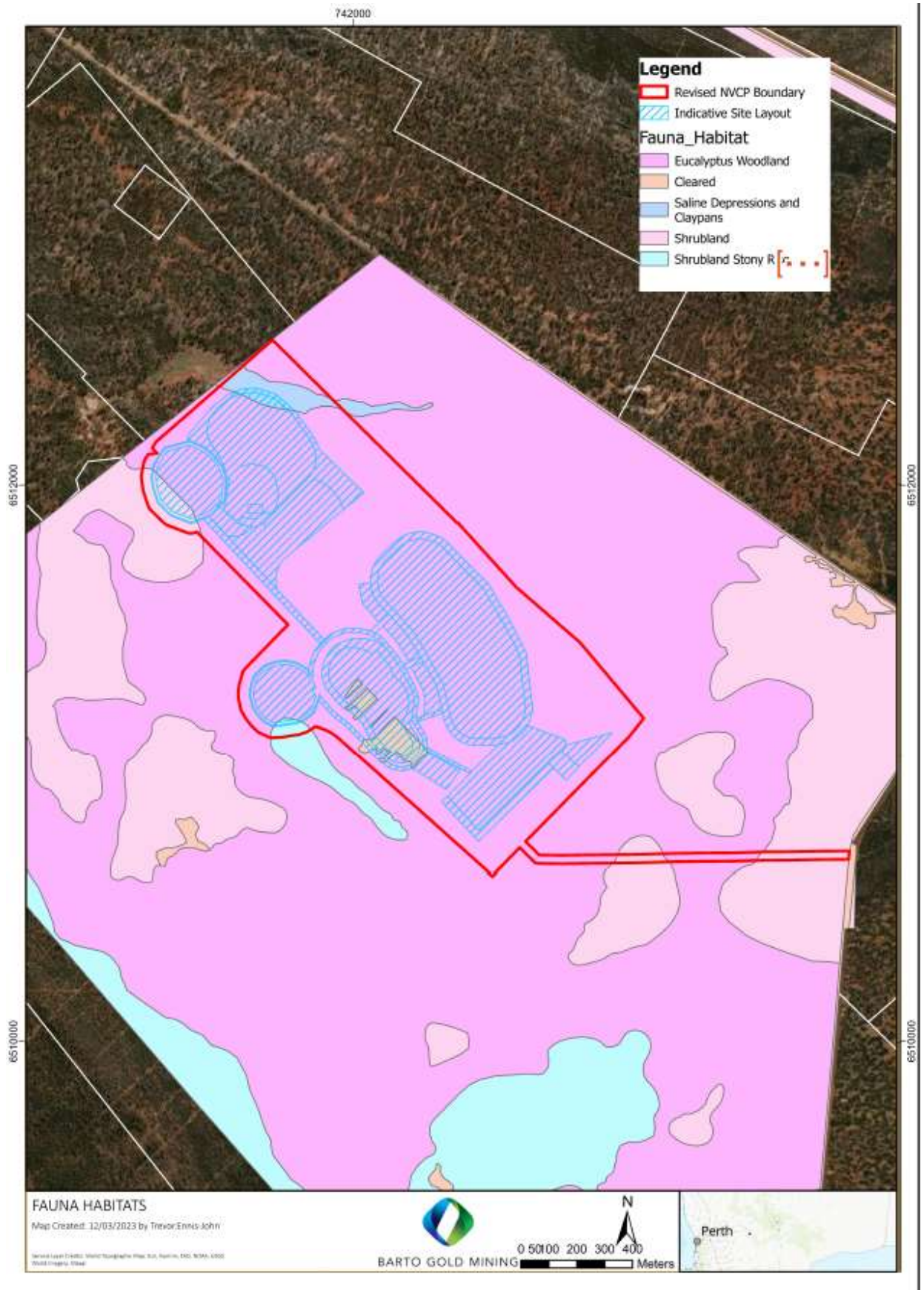


Figure 17: Fauna Habitats of the Survey Area

4.3.3. FAUNA ASSEMBLAGE

The desktop study identified a 249 species of vertebrate fauna, which have been recorded and/or have the potential to occur within the Survey Area. Of these, 20 are listed as being of significance, comprising six mammals, 12 birds, and two reptile(Stantec, 2021). There are 20 state (BC Act) and 14 Commonwealth (EPBC Act) listed fauna that may occur in the Survey Area. A full list of all vertebrate fauna is provided in Error! Reference source not found..

Many of these species are considered as 'unlikely to occur', as these records have been collected from a large area encompassing a wide range of habitats, many of which do not occur within the Survey Area. Furthermore, some small, common, ground-dwelling reptile and mammal species tend to be patchily distributed even where appropriate habitats are present, and many species of bird can occur as regular migrants, occasion visitors or vagrants.

Eleven fauna species were opportunistically recorded within the vicinity of the Survey Area during the two field assessments, one of which was an introduced species; the Rabbit (*Oryctolagus cuniculus*) (**Table 13**). Chuditch (*Dasyurus geoffroii*)(Vu, Vu) was later recorded from the June-July 2021 targeted survey. Of the 12 fauna species recorded from the Survey Area, only the Chuditch is listed as a threatened species under State and Commonwealth legislation. All fauna species recorded during the field survey were identified as having the potential to occur during the desktop assessment.

Table 13: Vertebrate fauna species recorded from the Survey Area

Species	Common Name	Method
Aves		
Barnardius zonarius	Australian Ringneck	*In-situ* observations
Cacatua roseicapilla	Galah	
Corvus coronoides	Australian Raven	
Oreoica gutturalis	Crested Bellbird	
Ocyphaps lophotes	Crested Pigeon	
Pachycephala occidentalis	Western Whistler	
Rhipidura leucophrys	Willie Wagtail	
Strepera graculina	Pied Currawong	
Mammalia		
Dasyurus geoffroii	Chuditch	Motion camera detection
Oryctolagus cuniculus	Rabbit	*In-situ* observations
Reptilia		
Tiliqua occipitalis	Blue-Tongued Lizard	*In-situ* observations
Ctenophorus cristatus	Bicycle Lizard	

4.3.4. FAUNA OF SIGNIFICANCE

Of the 249 species of vertebrate recorded during the desktop study, 20 species are listed as being of significance, comprising six mammals, 12 birds and two reptiles (Error! Reference source not found.). Of these:

- seven are listed as Threatened under the EPBC Act and/or BC Act;

- five are recognised by DBCA as priority fauna, DBCA recognises several species that are not listed under the BC Act or the EPBC Act, but for which there is some conservation concern, and has produced a supplementary list of priority fauna) (Error! Reference source not found.);
- one species, the Peregrine Falcon (*Falco peregrinus*) is recognised by the State (BC Act), as being in need of special protection;
- one species, the Red-tailed Phascogale (*Phascogale calura*), is recognised by the State (BC Act) to be conservation dependent;
- seven species are listed as Migratory under the EPBC Act or under the BC Act; and
- one species, the Bilby (*Macrotis lagotis*), is considered to be extinct in the Coolgardie and Avon Wheatbelt bioregions (Woinarski et al., 2014) and are therefore unlikely to occur within the Survey Area.

Additionally, three invertebrates of significance have been recorded as potentially occurring within the Survey Area. Some of the species, listed as threatened, migratory and/or priority fauna, may be included within multiple groups.

Eight species were likely to occur (Stantec, 2021) including the Chuditch (*Dasyurus geoffroii*) (Vu, Vu), Western Brush Wallaby (*Notamacropus 48rma*) (P4), Malleefowl (*Leipoa ocellata*), Western Rosella (*Platycercus icterotis xanthogenys*) (P4), Peregrine Falcon (*Falco peregrinus*) (OS), Common Greenshank (*Tringa nebularia)* (Mi, Mi), Woma Python (southwest pop) (*Aspidites ramsayi*) (P1) and the Tree-stem trapdoor spider (*Aganippe castellum*) (P4). Two species of significance were recorded within the Survey Area, the Malleefowl (*Leipoa ocellata*)(Vu, Vu)(Stantec, 2021) and Chuditch (*Dasyurus geoffroii*) (Stantec Unpublished Data, 2021a) was confirmed in the Survey Area. Two species, the Lake Cronin Snake (*Paroplocephalus atriceps*) (P3) and Common Sandpiper (*Tringa hypoleucos*) (Mi, Mi), were considered to possibly occur. The remaining 10 species were considered 'Unlikely' to occur within the Survey Area based on a lack of recent records, unsuitable habitat and/or the Survey Area occurring outside the known species range, with specific details presented in Error! Reference source not found..

4.3.4.1. MALLEFOWL (LEIPOA OCELLATA)

The Malleefowl (*Leipoa ocellata*) (Vu, Vu) has previously been confirmed in the Survey Area, from the presence of both active and inactive mounds, recorded by Barto (Stantec, 2021). Targeted Malleefowl searches were conducted in areas of suitable habitat within the Survey Area by Stantec, however no mounds or observations of Malleefowl individuals were recorded. The previous records of the active and inactive mounds within the Survey Area were recorded in shrubland habitat, which provides suitable dense shrub cover and leaf litter on substrates suitable for mound building (Stantec, 2021).

Malleefowl were recorded recently in the surrounds on numerous occasions. This includes an active mound <200m from the Survey Area boundary (located by Barto), one active and one inactive mound approximately from 288 m of the proposed haul road (Error! Reference source not found.), furthermore two inactive and one active mounds have been recorded ~4.5 km southeast of the Survey Area and six sightings within 4 km of the Survey Area ranging from 2001 – 2005 (DBCA, 2020b). Botanica (2016) also recorded seven extinct Malleefowl mounds, one individual and one set of tracks within different areas, though predominantly in the Sandplain Shrublands (recorded approximately 35 km from the current Survey Area). In March 2021 a targeted Malleefowl survey was conducted at Phoenix, Bronco Brumby and Zeus (approximately ~4 km south) and recorded 10 Malleefowl mounds. Five were active, two were inactive and 3 mounds were extinct.

4.3.4.2. CHUDITCH (DASYURUS GEOFFROII)

Deployment of motion cameras identified the presence of Chuditch (Dasyurus geoffroii) at 784 from the proposed Purpose Permit Area (~896 m from the proposed pit outline), where a single individual was recorded on one occasion (Error! Reference source not found.) (Stantec Unpublished Data, 2021a). In contrast, Chuditch were recorded over several nights and early mornings on motion cameras outside the Windmills area, approximately 3 km from the proposed Purpose Permit Area. As there was only a single isolated record of Chuditch within the Survey Area, it is considered that foraging was occurring, and it is not considered likely that the immediate area was used by the individual for denning. However, the Survey Area is dominated by *Eucalypt* Woodlands, recently assessed as in 'excellent' condition, which is the preferred habitat for Chuditch denning and shrublands for foraging (DEC, 2012).

Male Chuditch are understood to have a roaming range of approximately 15 km while females have a much smaller range only three to four kilometres (Woinarski et al., 2014). While it is not possible to discern gender from the imagery, there have been records from both four kilometres south and over two kilometres to the north from Survey Area (Stantec Unpublished Data, 2021b, Stantec Unpublished Data, 2021a), which fit within the range of both the female and male ranges.

The size of the Chuditch population in the Wheatbelt is unknown, however the species has been recorded in low abundances during 2019 and 2020 (Phoenix, 2021), with additional records of multiple individuals recorded more recently in 2021 (Stantec Unpublished Data, 2021b). The individuals recorded in 2019 and 2020, were considered to represent the far north-eastern extent of the species current range, were recorded up to approximately ~70 km north of the individuals recorded during recent surveys (Phoenix, 2021, Stantec Unpublished Data, 2021a).

5. ENVIRONMENTAL MANAGEMENT MEASURES AND REHABILITATION

5.1. APPROVED POLICIES AND PLANNING INSTRUMENTS

The clearing of native vegetation in Western Australia is regulated under Part V of the EP Act and *the Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (Clearing Regulations).

In addition to the matters considered in accordance with section 51O of the EP Act, Barto has also had regard for the below statutes, polices and guidelines:

Other Legislation of relevance for assessment of native vegetation clearing:

- *Biodiversity Conservation Act 2016 (WA) (BC Act);*
- *Conservation and Land Management Act 1984 (WA) (CALM Act);*
- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act);
- *Soil and Land Conservation Act* 1945 (WA);
- *Rights in Water and Irrigation Act* 1914; and
- *Aboriginal Heritage Act* 1972 (WA).

Other Relevant policies and guidance documents:

- Environmental Offsets Policy (Government of Western Australia, 2011);
- A guide to the assessment of applications to clear native vegetation (DEC, December 2014);
- Procedure: Native vegetation clearing permits (DWER, October 2019);
- Technical guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016);
- Technical guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020); and
- Approved Recovery Plans for threatened species.

5.2. AVOIDANCE MEASURES – MODIFICATIONS OF DESIGN TO AVOID IMPACTS TO PRIORITY SPECIES

Barto is committed to appropriately managing its activities and ensuring any potential impacts to the environment are managed appropriately.

Biological surveys identified several priority flora species clustered within the Survey Area and original alignment of the Project's indicative footprint of the mining infrastructure, of particular concern being impacts to *Rinzia fimbriolata* (P1) and *Hakea pendens* (P3). The recording of these priority species resulted in Barto implementing several proponent-led avoidance measures to avoid and minimise impacts to significant flora species. These measures included:

- Modification of the Project's original haul road design to avoid all occurrences of *R. fimbriolata* so that no direct impacts will occur. The Windmills haul road has been designed to avoid any direct impact to *R. fimbriolata* (Figure 14). No road widening will be permitted which means that *R. fimbriolata* would not be subjected to any additional disturbance as a result of clearing native vegetation for the development of the Project.

- The proponent will take additional measures to avoid impacts to *R. fimbiolata* through dust management and minimalization, prohibit any unauthorised entry and undertake surveys of vegetation health.
- The southwestern boundary of the proposed Purpose Permit Area has been adjusted to minimise the interactions with *H. pendens* population associated with a stoney rise feature in the landscape.

Furthermore, Barto are commitment to undertaking all compliance functions stipulated by applicable laws and regulations, and the operation will require all employees to exercise appropriate environmental practices. Environmental management includes, but is not limited to:

- identifying risk and hazards;
- operational environmental management plans;
- training and competencies;
- monitoring programs;
- auditing and inspections;
- incident investigation; and
- reporting requirements.

5.3. MEASURES TO MINIMISE AND MANAGE

5.3.1. LAND CLEARING AND FLORA MANAGEMENT

Barto will ensure all clearing and ground disturbance is carried out in accordance with the Barto Surface Disturbance and Clearing Procedure. Noting this, the following methods of vegetation clearing will be implemented during the construction phase of the Project. The following actions will be implemented to minimise and manage land disturbance impacts:

- Prior to clearing, an internal Surface Disturbance Permit (SDP) will be completed and signed off by the Environment Department;
- The disturbance permit will identify any conditions that apply to the clearing area (including any protected areas / species to be avoided where practicable)
- Delineating the clearing area will be walked and marked with survey pegs and flagging tape to ensure only the surveyed area is cleared;
- Clearing will not be undertaken until construction is imminent, thus minimising erosion and dust risks;
- Environmental awareness training is completed by personnel involved in clearing activities (including identification of flora of conservation significance);
- Use of a spotter during clearing of external boundaries to ensure clearing remains within surveyed area;
- Implementation of fire management practices;
- No burning of vegetation spoil will occur on site; and

- All cleared vegetation will be stockpiled for later use in rehabilitation activities.

5.3.2. WEED MANAGEMENT

Barto will aim to prevent the introduction of weeds and limit the spread of weeds in the proposed Purpose Permit Area as far as practicable. The following management actions will be implemented to minimise the risk of introduced flora within the Project area:

- Weed, Seed and Hygiene Certificates (Doc No. SX-EN-FO-0031) will be presented as verification prior to mobilisation;
- all vehicles and equipment will be cleaned before mobilisation to the proposed Purpose Permit Area, to remove all dirt and vegetative materials;
- vehicle and equipment washdown will only occur at an appropriate facility;
- off-road vehicle use will be strictly controlled with no driving permitted off designated roads; and
- any new weed outbreaks will be recorded in the operation's Incident Reporting system and managed in accordance with site environmental procedures.

5.3.3. FAUNA

Barto will aim to ensure fauna species are not adversely affected, via either direct impacts or impacts to habitat as far as practicable. The following management actions will be implemented to minimise the potential impacts on fauna:

- Pre-clearance surveys within areas designated to be cleared will be undertaken in the morning of clearing to search for the presence of significant fauna species within the specified clearing areas;
- Fauna Spotter to be present during clearing activities to ensure the site is clear of significant fauna species and stop work orders will be implemented if significant fauna species are spotted within 50 m of an active site. Work will only commence 15 minutes after the significant fauna species has been determined to have exited the area;
- No clearing between 6pm and 6am to avoid nocturnal species;
- Awareness training will outline the appropriate behaviour and responses in the event of contact with native fauna;
- Native fauna will not be captured, fed, harmed, or disturbed. If relocation is required, the site Environmental Department will be contacted;
- All significant fauna deaths will be reported through the site Incident Reporting system;
- SDP will be required for all clearing, in accordance with **section** Error! Reference source not found.;
- Open excavations will be monitored regularly to ensure that any trapped fauna are rescued and released as quickly as possible;
- Water holding infrastructure, including the turkey's nests will be fenced to exclude fauna, and have fauna egress matting installed as required;
- Rehabilitation will be conducted progressively where possible;

- No pets or other animals will be brought to the Project site; and
- All bores will be capped.

5.3.4. DUST DEPOSITION ON VEGETATION

Barto will aim to minimise the fugitive dust emissions and other air quality issues created during construction and operation of the site, by:

- Use of water to suppress dust emissions from unsealed roads, stockpiles and work areas as required;
- Reducing vehicle speeds as appropriate, if dust emissions from roads are visually excessive;
- Where possible, schedule operational activities to avoid activities that may generate excessive dust during high winds;
- Ensure dust suppression activities keep saline water spray within the haul road and infrastructure footprints;
- Implement water truck operating procedures and train water cart operators of the potential impacts of saline water on vegetation;
- Construct and / or maintain roadside drainage so that water run-off from the haul road will be contained during rainfall events;
- Not use saline water for dust suppression during topsoil / subsoil harvesting or rehandling;
- Report any community complaints regarding dust levels or any dust levels that are deemed as excessive as an incident; and
- Not burn any materials on site, unless specifically authorised by the General Manager.

5.3.5. SOIL AND TOPSOIL MANAGEMENT

Topsoil is an important resource for rehabilitation of disturbed sites, which need to be managed effectively. Incorrect management of topsoil can impact upon the soil structure and decrease its usefulness in rehabilitation. Topsoil will be managed by:

- Vegetation, topsoil and subsoil will be stockpiled as per the SDP plan;
- Topsoil will be stripped to required depth (maximum 200 mm);
- Topsoil not to be used for windows, separate or surface water management;
- Materials/equipment is not stored on topsoil stockpiles;
- Stockpiles to be marked out on maps/recorded on GIS with volumes; and
- Weed, seed and hygiene requirements will be met.

5.3.6. WATER MANAGEMENT

The proposed Purpose Permit Area is not located within any major drainage lines or watercourses; therefore, clearing is not expected to impact surface water flows. Additionally, the proposed clearing is not located in proximity to any Public Drinking water Source Areas.

Surface water management measures will be implemented if required to divert surface water flows from mining infrastructure.

Clearing is unlikely to impact on groundwater quality if groundwater contamination from use of hydrocarbons and chemicals is avoided, as per management actions detailed in **section** Error! Reference source not found..

Barto will aim to minimise impacts on the quality of surface water and avoid unnecessary disturbance to natural surface drainage. There is potential for the proposed development to affect local surface water systems, however, direct impacts on surface water features are limited. General recommendations for surface water management that will be considered for all mine infrastructure areas include:

- Diversions and drains – where there are potential risks of stormwater runoff impacts from upslope areas, i.e. excessive ponding or inundation to key infrastructure and operational areas and requirements to maintain flows to downstream areas;
- Erosion and sediment control measures – where there is a risk of discharge of mine affected or sediment laden runoff to downstream environments; and
- Culverts and road cross-drainage options – where there are risks of modification to downstream flow, particularly for linear infrastructure developments.

5.3.7. HYDROCARBON MANAGEMENT

Barto will actively manage the storage and use of hydrocarbon in clearing machinery and vehicles to minimise and contain spillages and uncontrolled releases from impacting on vegetation causing death or health decline, as result of soil or water contamination. Increased vehicle activity during construction and development may result in hydrocarbon spills, however Barto aims to minimise such impacts by:

- Ensuring hazardous materials are approved prior to site entry;
- Ensuring hydrocarbons and chemicals are safely stored;
- Ensuring that hydrocarbon and other hazardous wastes are collected, treated, transported and disposed of in an environmentally sound manner, in accordance with regulatory and legislative requirements;
- Ensuring that the risk of hydrocarbons and hazardous waste spills is minimised; and
- Making effective spill clean-up material readily available at each work site and on all mobile service trucks or vehicles, and where hydrocarbons and chemicals are stored and / or used.

5.4. REHABILITATION MANAGEMENT

A mining proposal has been prepared for the project amendments outlined within this document and mine closure activities were captured in a revision to the Southern Cross Operations Mine Closure Plan (MCP) submitted with the Mining Proposal. All clearing activities outlined in this NVCP Application will be addressed in the revised MCP**.**

Rehabilitation of the project area will be conducted at the end of the project life, due to the short duration of the project progressive rehabilitation is not appropriate. Ongoing monitoring will be implemented during and post the life of the Project to ensure legal obligations and closure objectives are met. Rehabilitation activities will aim to meet post closure land use objectives. Barto will:

- Continue to consult with key stakeholders throughout the life of the Project and at closure;
- Ensure the rehabilitated land surfaces are safe and stable; and
- Undertaken rehabilitation tasks detailed in the MCP.

6. ASSESSMENT AGAINST THE CLEARING PRINCIPLES

6.1. SCALE OF THE PROPOSED CLEARING

The proposed Purpose Permit Area covers an area of 70.86 ha, of which 92.8% (65.81 ha) is in 'excellent' condition, 6.87% (4.87 ha) is in very good condition, 0.25% (0.18 ha) is in good condition and 0% (0 ha) is degraded. The Project will require clearing of up to 40 ha, of which 38ha (95%) is within *Eucalyptus* Woodland of the Parker Range PEC.

It should be noted that since this survey was completed, further exploration activities have occurred within the proposed Purpose Permit extended area, and the Rhapsody and Red Ox pit areas can now be considered 'degraded'.

6.2. CLEARING PRINCIPLES

The proposed clearing works were assessed against the 10 Clearing Principles for native vegetation as listed in Schedule 5 of the *Environmental Protection Act* 1986 (**Table 14**).

The 10 Clearing Principles, listed under Schedule 5 of the *Environmental Protection Act 1986*, stipulate when native vegetation should not be cleared. The proposal to clear native vegetation for Barto's Windmills project area, located within their Southern Cross Operations, is considered in terms of these principles, in accordance with the Department of Environment Regulation (now Department of Water and Environment Regulation) assessment guidelines (DER 2014).

As detailed, design has progressed an indicative development footprint has been delineated to accommodate the mining infrastructure and is approximately 40 ha within the 70.86 ha proposed Purpose Permit Area (**Figure 4**).

The following sections address each of the Ten Clearing Principles as specified in Schedule 5 of the *Environmental Protection Act (1986)* (EP Act). These assessments have been made using the information obtained from the Flora, Vegetation and Fauna Survey (Stantec, 2021).

Table 14: Assessment of Proposed clearing of native vegetation within the proposed Purpose Permit Area against the 10 Clearing Principles

Clearing Principle	Justification of Variance	Reference	Variance
Principle (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	The Survey Area is 874.75 hectares (ha) in size, of which 865 ha (99%) contains remnant vegetation with the remainder cleared land. A total of 103 confirmed vascular flora taxa, representing 31 families and 65 genera were recorded during the field survey. No Commonwealth or State-listed threatened flora were recorded within the Survey Area. Three State-listed priority flora species were recorded during the survey, including: • *Rinzia fimbriolata* (P1) – 431 individuals within the Survey Area, none located within the proposed Purpose Permit Area; • *Hakea pendens* (P3) – 247 individuals within the Survey Area, 9 individuals within the proposed Purpose Permit Area (3 within 16 m of indicative disturbance footprint); and • *Stenanthemum bremerense* (P4) – 135 individuals within the Survey Area, none within the proposed Purpose Permit Area. All three Priority species have been recorded within five kilometres of the Survey Area, either from database search results or previous surveys. Database search results (DBCA 2020f, g) indicate that *Calamphoreus inflatus* (P4) has been previously recorded at two locations within the Survey Area, however, despite searches for this species during the field survey, it was not detected. No Threatened Ecological Communities (TECs) are known to occur within the proposed Purpose Permit Area or surrounding environment, however one Priority Ecological Community (PEC), the P3 Parker Range Vegetation Complexes, is mapped within the proposed Purpose Permit Area. One vegetation type, EsEsuElMpEaSaHe, was considered to represent Community 3 of this PEC, and accounted for 649.10ha, or 74.20% of the Survey Area, and 65.33 ha in the proposed Purpose Permit Area. The Parker Range Vegetation Complexes PEC has been identified outside of the Survey Area by previous surveys undertaken within 10 km. The clearing proposed of this vegetation type will result in a 0.1 % decline in regional extent (39,548), which is not considered a significant decline, and due to the small scall and temporary nature of the proposed clearing and rehabilitation proposed, the impacts can be minimized to acceptable levels. No significant residual impacts are considered to occur as a result of the proposed clearing. Two significant fauna species was recorded in the Survey Area; one Chuditch (*Dasyurus geoffroii*) (recorded 784 m from the proposed Purpose Permit Area) and two Malleefowl (*Leipoa ocellata*) (Vu, Vu) mounds (located 288 m from the proposed Purpose Permit Area), one active and one inactive, were recorded by Barto Gold Mining Pty Ltd. The desktop assessment identified seven terrestrial fauna species of significance as being 'likely' to occur within the Survey Area; Western Brush Wallaby (*Notamacropus irma*) (P4), Western Rosella (*Platycercus icterotis xanthogenys*) (P4), Peregrine Falcon (*Falco peregrinus*) (OS), Common Greenshank (*Tringa nebularia)* (Mi, Mi), Woma Python (southwest pop) (*Aspidites ramsayi*) (P1) and the Tree-stem trapdoor spider (*Aganippe castellum*)(P4). Four fauna habitats were described for the proposed Purpose Permit Area all of which are considered important for significant species: *Eucalyptus* woodland, saline depressions and claypans, shrublands and shrubland stony rise. Shrublands contain patches of dense vegetation cover, leaf litter and suitable substrates optimal for supporting Malleefowl mound building. *Eucalyptus* woodlands and areas of shrubland stony rise may also support the species. Eucalyptus woodlands and shrublands would also support a range of other significant species considered likely to occur in the Survey Area owing to the abundance of debris, shelter, and foraging suitability. *Eucalyptus* woodlands would also support nesting birds and denning Chuditch where hollows are present. Saline depressions and claypans may support migratory shorebirds when inundated. Based on the survey findings and the desktop assessment, the fauna habitat, biological diversity and occurrences of priority species within the proposed Purpose Permit Area are considered widespread throughout the surrounding regional environment and not considered restricted to the area of clearing.	DBCA (2019a) DBCA (2020f, 2020g) Commonwealth of Australia (2020a)DPIRD (2020) Cowan *et al.* (2001) Stantec (2019) Gibson and Lyons (1998) Recon Environmental (2008b)	Unlikely to be at variance

	Although clearing is in an area that supports a high biodiversity of flora and fauna, due to the small scale of the clearing, short duration of the project, proposed management controls and rehabilitation commitments, it can be concluded that the proposed clearing will not be at variance with this principle. **The proposed clearing is unlikely to be at variance with this Principle.**		
Principle (b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	The proposed Purpose Permit Area contains two broad fauna habitats: *Eucalyptus* Woodland and Shrublands. These habitats are considered typical of the Southern Cross subregion and were broadly represented outside of the Survey Area. A single Chuditch (*Dasyurus geoffroii*) was recorded within the 784 m west of the proposed Purpose Permit Area, within Shrubland habitat. An active and inactive Malleefowl mound were also recorded 288 m north of the proposed Purpose Permit Area. Both mounds were recorded in a shrubland habitat. The desktop assessment identified seven terrestrial fauna species of significance as being 'likely' to occur within the Survey Area; Chuditch (*Dasyurus geoffroii*) (Vu, Vu), Western Brush Wallaby (*Notamacropus irma*) (P4), Western Rosella (*Platycercus icterotis xanthogenys*) (P4), Peregrine Falcon (*Falco peregrinus*) (OS), Common Greenshank (*Tringa nebularia)* (Mi, Mi), Woma Python (southwest pop) (*Aspidites ramsayi*) (P1) and the Tree-stem trapdoor spider (*Aganippe castellum*) (P4). Based on the survey findings and the desktop assessment, significant fauna and their habitat are known to occur within the study area and across the surrounding environment and regional landscape and are not considered restricted to the area of proposed clearing. Development of the proposed Purpose Permit Area is highly unlikely to fragment, restrict or isolate any populations of conservation significant fauna species. Although clearing is proposed in an area that is known to support a foraging individual being the Chuditch, due to the small scale of clearing, short duration of the project, proposed management controls (including fauna spotters) and rehabilitation commitments, it can be concluded that the proposed clearing will not be at variance with this principle. **The proposed clearing is unlikely to be at variance with this Principle.**	Cowan *et al.* (2001) Stantec (2019) GHD (2016) Botanica (2016b)	Unlikely to be at variance
Principle (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No Commonwealth or State-listed threatened flora were recorded within the proposed Purpose Permit Area or were considered to have potential to occur. The potential to impact a small number (up to 9 individuals) of *Hakea pendens* (P3) will be avoided and minimised as far as practicable, but ultimately if lost, will not significantly impact the population, change its conservation status, or impact the species local viability in the region. **The proposed clearing is not at variance with this Principle.**	DBCA (2020f, 2020g) DoAWE (2020)	Not at variance
Principle (d) Native vegetation should not be cleared if it comprises the whole or a part of or is necessary for the maintenance of a Threatened ecological community.	No TECs listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Biodiversity Conservation Act 2016* (BC Act) are known to occur within or adjacent to the proposed Purpose Permit Area. The closest TEC to the Survey Area is the *Eucalypt Woodlands of the Western Australian Wheatbelt (Wheatbelt Woodlands)*, located approximately 8 km west of the Survey Area. This TEC is restricted to the Avon Wheatbelt region, outside of the Survey Area. **The proposed clearing is not at variance with this Principle.**	DBCA (2020d)	Not at variance

<table>
<tr>
<td>Principle (e)

Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</td>
<td>The Survey Area occurs within the Southern Cross subregion (COO2) of the Coolgardie (COO) IBRA bioregion and is under the jurisdiction of the Shire of Yilgarn. The proposed Purpose Permit Area occurs within one pre-European vegetation associations; 1068.

Table A outlines the pre-European vegetation extents (measured in 2018) remaining within the IBRA bioregion, subregion, and within the local government area (LGA). The remaining proportions of the vegetation associations for the Bioregion, Subregion and Yilgarn LGA are above the 30% threshold considered to be required for maintaining ecological viability. The area of native vegetation proposed for potential clearing within the Survey Area (861 ha) will not significantly reduce the pre-European vegetation extent. The proposed 40 ha of clearing would equate to a 0.087%, 0.014%, and 0.050% reduction in the Yilgarn LGA for Vegetation Associations 128, 1068, and 1148 respectively.

Table A: Extent of pre-European vegetation associations remaining across three scales (Bioregion, Subregion and Local Government Area).
<table>
<tr><th>Vegetation Association</th><th>Scale</th><th>Pre-European extent (ha)</th><th>Current extent (ha)</th><th>Proportion remaining (%)</th></tr>
<tr><td rowspan="3">1068</td><td>Bioregion (COO)</td><td>193,988</td><td>104,804</td><td>54</td></tr>
<tr><td>Subregion (COO2)</td><td>193,988</td><td>104,804</td><td>54</td></tr>
<tr><td>LGA (Yilgarn)</td><td>268,900</td><td>142,088</td><td>53</td></tr>
</table>
The proposed clearing not at variance with this Principle.</td>
<td>Shepherd et al. (2002b)

Government of Western Australia (2019)

Thackway and Cresswell (1995)

Cowan et al. (2001)</td>
<td>Not at variance</td>
</tr>
<tr>
<td>Principle (f)

Native vegetation should not be cleared ifit is growing in, or in association with, an environment associated with a watercourse or wetland.</td>
<td>No internationally or nationally significant wetlands are located within the proposed Purpose Permit Area. The nearest nationally important wetland is Lake Cronin, located 97 km south of the Survey Area within the sire of Kondinin. The nearest named water course to the Survey Area is Esdaile Creek, which is 88 km north-east of the Survey Area.

The proposed clearing is not at variance with this Principle.</td>
<td>State of Western Australia (2020)

Commonwealth of Australia (2020b)</td>
<td>Not at variance</td>
</tr>
<tr>
<td>Principle (g)

Native vegetation should not be cleared ifthe clearing of the vegetation is likely to cause appreciable land degradation.</td>
<td>Land degradation includes any alteration to land capability, soil erosion, salinity, nutrient export, acidification, waterlogging and flooding that affects the present or future use of land.

The Survey Area lies outside the soil landscape land quality mapping and assessment of land capability, which extends to the edge of the wheatbelt. The Survey Area occurs within two land systems.

The DD15 land system includes low lying areas identified within this report as Saline depressions and claypans (4.27 ha or 0.49% of the Survey Area). These areas may be prone to land degradation from clearing in the form of salinisation, water logging, soil erosion and acidity.

The My44 land system does not include wetlands, salt lakes, and is unlikely to comprise fine loose sands or calcareous loamy earth. Consequently, soils within the Survey Area are unlikely to be prone to erosion.

The proposed clearing is not at variance with this Principle.</td>
<td>State of Western Australia (2020)

(Purdie et al. 2004)

(van Gool et al. 2005)(Cowan

et al. 2001) (DPIRD 2015)</td>
<td>Not at variance</td>
</tr>
<tr>
<td>Principle (h)

Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.</td>
<td>The proposed Purpose Permit Area does not occur within, or adjacent to, a conservation area. The closest reserves to the Survey Areaare Jilbadji Nature Reserve and Yellowdine Nature Reserve, respectively located approximately 10.5 km to the east and 16 km to the north-east. Boorabbin National Park is located approximately 48 km north-east of the Survey Area.

The proposed clearing is not at variance with this Principle.</td>
<td>State of Western Australia (2020)</td>
<td>Not at variance</td>
</tr>
</table>

Principle (i) Native vegetation should not be cleared ifthe clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	The proposed Purpose Permit Area does not intersect any surface water bodies. The nearest nationally important wetland is Lake Cronin, located 97 km south of the Survey Area of Kondinin. The nearest named water course to the Survey Area is Esdaile Creek, which is 88 km north-east of the Survey Area. The closest Public Drinking Water Source Area is associated with the Broad Arrow Dam Catchment Area, located over 200 km northeast of the Survey Area. Additionally, the proposed clearing is not in any controlled catchments under the *Country Areas Water Supply Act 1947* (CAWS) where clearing controls are in place to prevent salinisation. The closest CAWS catchment to the Survey Area is the Mundaring Weir Catchment Area, located over 200 km west of the Survey Area. **The proposed clearing is not at variance with this Principle.**	Government of Western Australia (2020)	Not at variance
Principle (j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	The proposed native vegetation clearing is unlikely to alter the hydrological regime of the area leading to an increase in the frequency or intensity flooding. As the proposed Purpose Permit Area does not intersect any drainage areas or watercourses, clearing is unlikely to cause or exacerbate the incidence of flooding. **The proposed clearing is not at variance with this Principle.**	State of Western Australia (2020)	Not at variance

7. STAKEHOLDER CONSULTATION

Table 15: Details of consultation undertaken Windmills/Rhapsody Project

DMIRS **27/04/21**	Key discussion points/outcomes: • Project plan was discussed. DMIRS recommended targeted fauna survey work outside of the survey areas as possible with whatever available time allowed. • Barto presented its priorities for fieldwork are targeted surveys for 1) Glendower 2) PBBZ/Windmills (both same urgency).
Marvel Loch Community Forum **30/7/21**	Key discussion points/outcomes: • Barto provided a community update on the progress of the Windmills project located 11km south-east from Marvel Loch • Mine life (6-12) was discussed and avoidance and minimisation levels were presented. • No specific questions were asked regarding the proposed works.
Shire of Yilgarn Council Meeting – Update **19/08/21**	Key discussion points/outcomes: • Barto presented an update to the Council regarding their Life of Mine planning, including the proposed the Windmills project. • Barto presented the Windmills development envelope and avoidance measures implemented to avoid key priority flora species.
DMIRS **19/3/2022**	Discussed proposed amendment to haul road alignment. DMIRS agreed NVCP amendment was appropriate
DMIRS **14/02/2023**	Discussed proposed changes to Windmills/Rhapsody project. DMIRS advised that a separate clearing permit application was the appropriate path to progress approval, rather than amendment to Windmills NVCP 9409/2

8. CONCLUSION

Barto proposes to clear no more than 40 ha of native vegetation within a 70.86 ha NVCP (Purpose Permit) area as part of further development the Windmills Project. The proposed clearing is not at variance to principles (c), (d), (e), (f), (g), (h), (i) and (j). Clearing is unlikely to be at variance to principal (a) or (b) based on the small scale of clearing, short duration of the project, proposed management controls and rehabilitation commitments. While development of the Windmills Project will result in the loss of some terrestrial fauna habitat, the fauna habitat, biological diversity and occurrences of priority species within the proposed Purpose Permit Area are regionally widespread and are not considered restricted to the area proposed for clearing.

9. REFERENCES

BISHOP, C. L., BAYLISS, B., VAN LEEUWEN, S., ENNIS, A., FRENCH S. & GIOIA, P. 2013. Great Western Woodlands Map Project: Consolidation of existing fine-scale vegetation maps using the National Vegetation Information System (NVIS). Perth, Western Australia: Department of Environment and Conservation (Science Division).

Botanica, Botanica Consulting. (2016b) *Level 2 Flora & Fauna Survey: Redwing Project For Hanking Gold Mining Pty Ltd*, Unpublished report prepared for Hanking Gold Mining Pty Ltd.

Commonwealth of Australia. (2020a) *Australian Wetlands Database.* Department of the Environment and Energy. Available online at https://www.environment.gov.au/water/wetlands/australian-wetlands-database.

Commonwealth of Australia. (2020b) *Weeds of National Significance.* Department of Agricuture, Water and Environment. Available online at https://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html.

Cowan, M., Graham, G. and McKenzie, N. (2001) Coolgardie 2 (COO2 - Southern Cross subregion). In: *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Kensington, W.A., pp 143-155

EMM, 2022, *Water management options assessment, Southern Cross Operations site wide water balance*, June 2022.

GHD. (2016) *Yilgarn Star North Prospect Biological Assessment*.

Shepherd, D. P., Beeston, G. R. and Hopkins, A. J. M. (2002b) *Native Vegetation in Western Australia. Extent, Type and Status*, Department of Agriculture, Perth, Western Australia.

Stantec, Australia. (2019) *Parker Range PEC, Flora and Fauna Reconnaissance Survey and Priority Flora Search*, Perth, Western Australia.

STANTEC 2021. Windmills Flora, Vegetation and Fauna Survey. Perth, Western Australia: Stantec.

State of Western Australia. (2020) *Shared Location Information Platform (SLIP) Database.* Western Australia Land Information Authority (Landgate). Available online at https://maps.slip.wa.gov.au/landgate/locate/.

Thackway, R. and Cresswell, I. D. (1995) *An Interim Biogeographical Regionalisation for Australia.* Australian Nature Conservation Agency, Canberra, Australian Capital Territory.

van Gool, D., Tille, P. J. and Moore, G. A. (2005) *Land Evaluation Standards for Land Resource Mapping: Assessing Land Qualities and Determining Land Capability in South-western Australia*.

DBCA 2019a. 2018 Statewide Vegetation Statistics (formly the CAR Reserve Analysis): Full Report. *In:* DEPARTMENT OF BIODIVERSITY, C. A. A. (ed.). Perth, Western Australia.

DBCA 2019b. Threatened and Priority Ecological Communities Database (custom search). *In:* DEPARTMENT OF BIODIVERSITY, C. A. A. (ed.).

DBCA, Department of Biodiversity Conservation and Attractions (2019a) *Threatened and Priority Ecological Communities Database (custom search)*. Available online at http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities.

DBCA 2020a. NatureMap: Mapping Western Australia's Biodiversity (custom search). *In:* DEPARTMENT OF BIODIVERSITY, C. A. A. (ed.).

DBCA 2020b. Threatened and Priority Fauna Database (custom search). *In:* DEPARTMENT OF BIODIVERSITY, C. A. A. (ed.).

DBCA 2020c. Threatened and Priority Flora Database (custom search). *In:* DEPARTMENT OF BIODIVERSITY, C. A. A. (ed.).

DBCA, Department of Biodiversity Conservation and Attractions (2020d) *Western Australian Herbarium Specimen database (WAHerb) (custom search)*. Available online at https://florabase.dpaw.wa.gov.au/.

DBCA, Department of Biodiversity Conservation and Attractions, (2020f) *NatureMap: Mapping Western Australia's Biodiversity (custom search)*. Available online at http://naturemap.dec.wa.gov.au./default.aspx.

DBCA, Department of Biodiversity, Conservation and Attractions (2020g) *Threatened and Priority Flora Database (custom search)*. Available online at http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants.

DPIRD, Department of Primary Industries and Regional Development (2015) *MySoil: Sandy Earths (Central North)*. Available online at https://www.agric.wa.gov.au/mycrop/mysoil-sandy-earths-central-north.

DPIRD, Department of Primary Industries and Regional Development. (2020) *Western Australian Organism List (WAOL).* Government of Western Australia. Available online at https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol.

DoAWE, Department of Agriculture, Water and the Environment (2020) *Protected Matters Search Tool (custom search)*. Commonwealth of Australia. Available online at http://www.environment.gov.au/epbc/protected-matters-search-tool.

FOX, E. M., S., & DOUGLAS, T. 2016. Birds of the Great Western Woodlands. . *Report for the Nature Conservancy.* Melbourne: BirdLife Australia

Gibson, N. and Lyons, M. N. (1998) Flora and Vegetation of the Eastern Goldfields Ranges: Part 3. Parker Range. *Journal of the Royal Society of Western Australia* 81: 119-129.

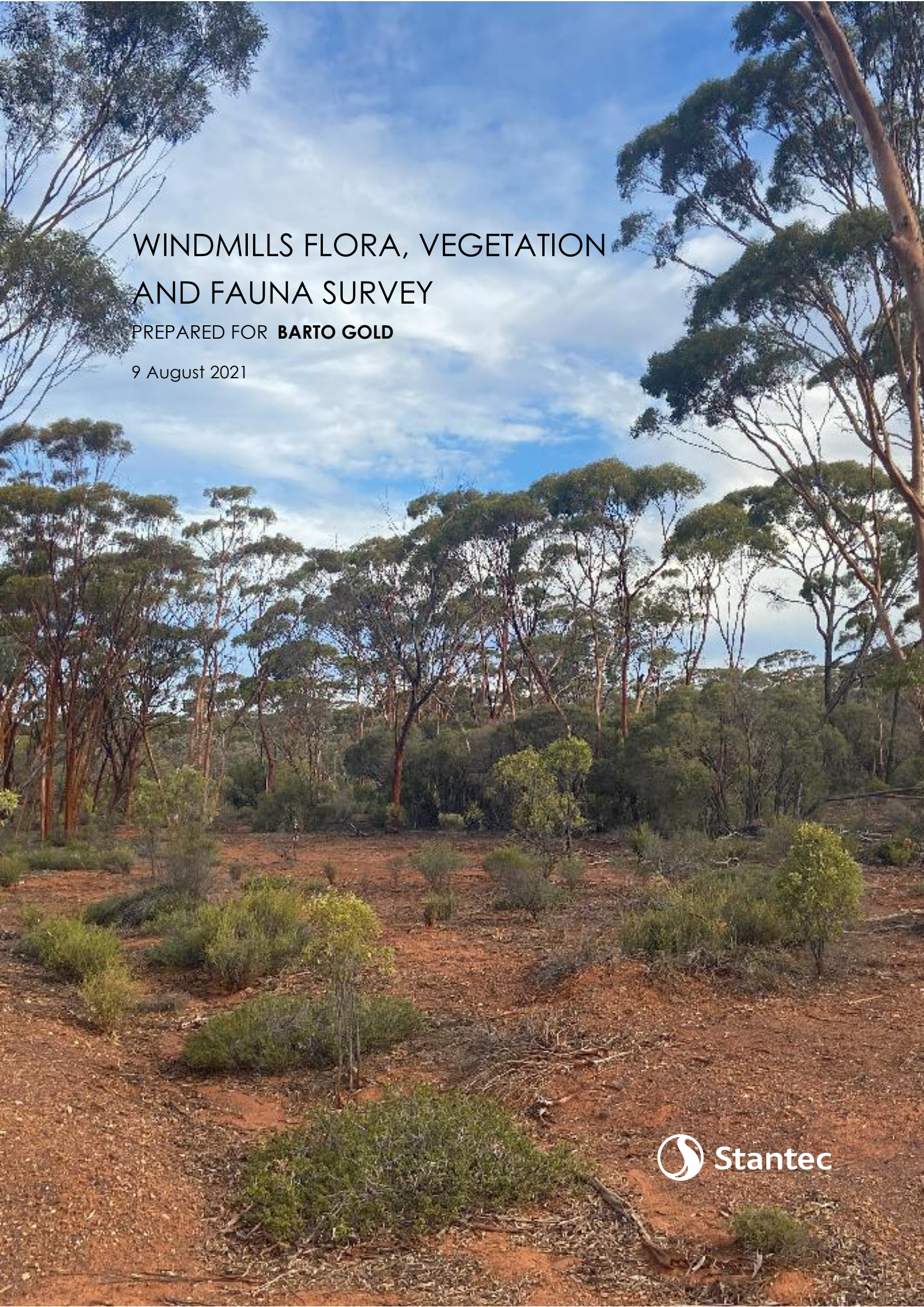
Government of Western Australia (2020) *Public Drinking Water Source Area online mapping tool*. Department of Water and Environmental Regulaiton. Available online at http://water.wa.gov.au/maps-and-data/maps/public-drinking-water-source-area-mapping-tool.

PURDIE, B. R., TILLE, P. J. & SCHOKNECHT, N. R. 2004. Soil-landscape mapping in south-Western Australia: an over of methodology and outputs. *Department of Agriculture and Food, Perth, Western Australia*.

Recon Environmental. (2008b) *Marvel Loch TSF Extension Vegetation Survey*.

TILLE, P. J. 2006. Soil-landscapes of Western Australia's Rangelands and Arid Interior. Perth, Western Australia: Department of Agriculture and Food Resource Management

10. APPENDICES



WINDMILLS FLORA, VEGETATION AND FAUNA SURVEY

PREPARED FOR **BARTO GOLD**

9 August 2021

Stantec

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
1.0	05/03/2021	Draft report for client review	SP, NC	DR	AB	PB
2.0	27/04/2021	Final report	CH			
3.0	09/07/2021	Amended final report	SP, JM	GF	AB	AB
3.1	27/07/2021	Client comments addressed	GF	SP	AB	AB
4.0	09/08/2021	Final report	GF	JM	AB	AB

Executive Summary

Barto Gold Mining Pty Ltd propose to develop the Windmills project area located within their Southern Cross Operations, as part of their Life of Mines project. The Survey Area is 874.75 hectares and is located approximately 35 kilometres south-east of Southern Cross in the Eastern Goldfields region of Western Australia. The majority (865 hectares) of the Survey Area contains native vegetation.

The objective of the Survey was to understand the flora, vegetation and fauna values of the Survey Area, to inform future environmental approvals. The field work for the Survey was undertaken in April and September 2020, as a component of the greater Life of Mines project, and comprised quadrat sampling, habitat assessments, targeted searches and opportunistic collections of flora and fauna. Survey effort consisted of 12 combined quadrats and habitat assessments, one relevé and eight mapping notes. Despite slightly below average rainfall in the three months prior to the phase 2 survey, seasonal conditions for all surveys were considered adequate to detect the majority of species with the potential to occur. A third additional targeted survey was completed in April 2021 encompassing a development envelope within the Windmills Survey Area. This was done five weeks after a heavy rainfall event in March.

Floristic diversity and composition were considered typical of the Southern Cross subregion and also showed similarities to the nearby Avon Wheatbelt 1 subregion. A total of 116 species from 31 families and 66 genera were recorded during the field surveys. Flora and vegetation was largely consistent with previous surveys undertaken within and in close proximity to the Survey Area. No threatened flora were recorded during the Survey, however, three priority flora species, *Rinzia fimbriolata* (P1), *Hakea pendens* (P3) and *Stenanthemum bremerense* (P4) were identified. *Calamphoreus inflatus* (P4) was previously recorded within the Survey Area at two locations, with one occurrence recorded in 1990 and the other in 1996.

Introduced flora diversity and density was considered low, given the level of previous disturbance from exploration drill lines within the Survey Area. Weed distribution was patchy and predominantly associated with previously disturbed areas. None of the weed species represents a declared pest under Section 22 of the *Biosecurity and Agriculture Management Act 2007* or a Weed of National Significance.

The vegetation recorded within the Suvey Area was representative of the South-Western Interzone and showed some similarities with the adjacent Avon Wheatbelt 1 subregion. Vegetation was comprised broadly of *Eucalyptus* Woodlands, *Acacia* and *Melaleuca* shrublands and a low Chenopod shrubland. *Eucalyptus* Woodlands comprised the majority of vegetation within the Survey Area. One vegetation type, EsEsuElMpEaSaHe, was considered to be analogous with vegetation described for Community 3 of the *Parker Range vegetation complexes* PEC. The presence of this ecological community is consistent with locations identified during previous surveys conducted within and in close proximity to the Survey Area.

Historic exploration activity is evident across the Survey Area, with a number of drill lines present. These drill lines, along with a main access track, form the majority of disturbance within the Survey Area. These areas were identified as being in 'Completely Degraded' through to 'Good' condition, and accounted for approximately 28 hectares, or 3.22%, of the Survey Area. The majority of the Survey Area (almost 96%) was considered to be in 'Excellent' condition.

Four broad fauna habitats were identified within the Survey Area, comprising *Eucalyptus* Woodland, Saline Depressions and Claypans, Shrubland, and Shrubland Stony Rise. The *Eucalyptus* Woodland habitat comprised the majority of the Survey Area, covering 649.11 ha (approximately 75%). All four habitats were identified as potentially providing habitat for significant fauna species, owing to the presence of shrub cover, woody debris, hollows, suitable substrates for Malleefowl mound-building and, when inundated, potential foraging for migratory birds in one or more of the habitats.

. No fauna of significance were recorded in the current survey, however one active and one inactive Malleefowl (*Leipoa ocellata*) (Vu, Vu) mound were recorded in the Survey Area by Barto Gold Mining Pty Ltd. Both mounds were recorded in shrubland habitat, which would provide suitable dense shrub cover and leaf litter on substrates for mound building.

Based on proximity of previous records and presence of preferential habitat, seven significant fauna species were considered 'likely' to occur. These were the Chuditch (*Dasyurus geoffroii*) (Vu, Vu), Western Brush Wallaby (*Notamacropus irma*) (P4), Western Rosella (*Platycercus icterotis xanthogenys*) (P4), Peregrine Falcon (*Falco peregrinus*) (OS), Common Greenshank (*Tringa nebularia)* (IA, Mi), Woma Python (southwest pop) (*Aspidites ramsayi*) (P1) and the Tree-stem trapdoor spider (*Aganippe castellum*) (P4). Two species, the Lake Cronin Snake (*Paroplocephalus atriceps*) (P3) and Common Sandpiper (*Tringa hypoleucos*), were considered to possibly occur.

Barto gold

Flora, Vegetation and Fauna Windmills Survey Report

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1. Introduction

1.1 Project Background and Location

The Barto Gold Mining Pty Ltd (Barto) Life of Mines project (the Project) encompasses a number of potential project areas within Barto's Southern Cross Operations, located in the Eastern Goldfields region of Western Australia (**Figure 1-1**). As part of the planning process for the Project, Barto are currently assessing the Windmills project area (Survey Area), which is located approximately 35 kilometres south-east of Southern Cross (**Figure 1-2**). Stantec Australia Pty Ltd (Stantec) was commissioned by Barto to undertake a flora, vegetation and fauna survey with targeted significant flora and fauna searches for the Project, of which the Survey Area is a component, to inform future approvals for the Project. The Survey Area is 874.75 hectares (ha) in size, with the majority (865 ha) retaining native vegetation.

1.2 Scope and Objectives

The objective was to assess the flora, vegetation and fauna values of the Survey Area through a desktop assessment and field survey. The scope of works was to:

- conduct a desktop assessment prior to the survey, including database searches and literature review of available contextual and project related resources;
- undertake a dual season flora and vegetation survey/basic fauna survey to:
- describe and map vegetation communities, vegetation condition and fauna habitat types; and
- develop a list of flora and fauna species recorded within the Survey Area.
- conduct targeted searches for flora, vegetation communities and fauna of significance, including species and communities of local and regional significance that may not be listed on government databases.
- assess the survey findings in a local and regional context, by comparing the results with available data from other localities within the bioregion; and
- assess the project against the Department of Environment Regulation (now Department of Water and Environment Regulation) Native Vegetation Clearing Principles.

The objectives and methods adopted for these surveys are aligned with the following relevant State and Commonwealth guidance:

- EPA Technical Guide (2016), Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a);
- Environmental Protection Authority (EPA) (2016), Environmental Factor Guideline: Flora and Vegetation (EPA 2016c);
- EPA Technical Guide (2020), Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment(DotE 2020);
- EPA Factor Guideline (2016), Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d);
- EPA Factor Guideline (2016), Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016b); and
- Department of the Environment (2013), Matters of National Environmental Significance - significant impact guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (DotE 2013).

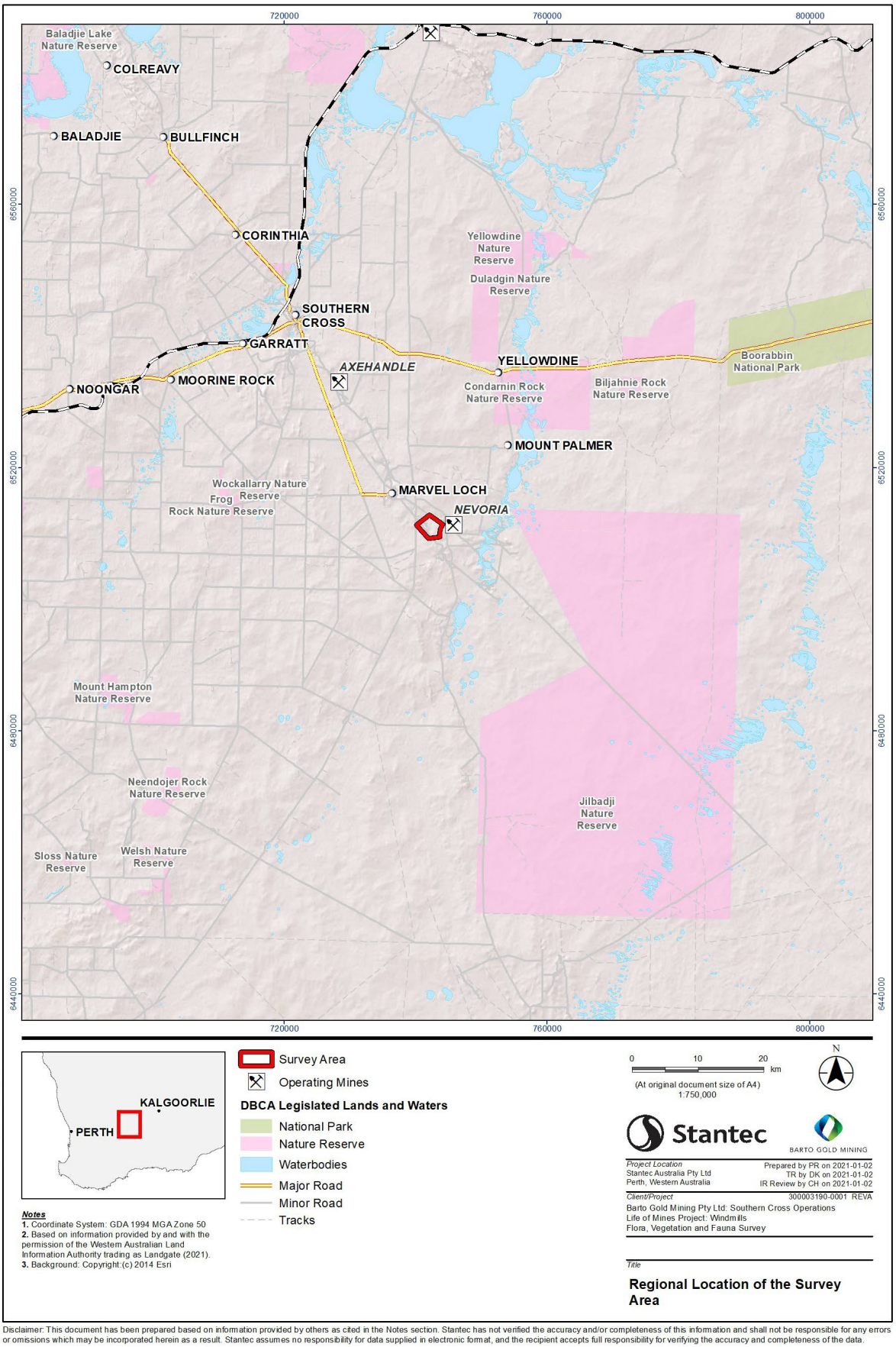

Figure 1-1: Regional location of the Survey Area.

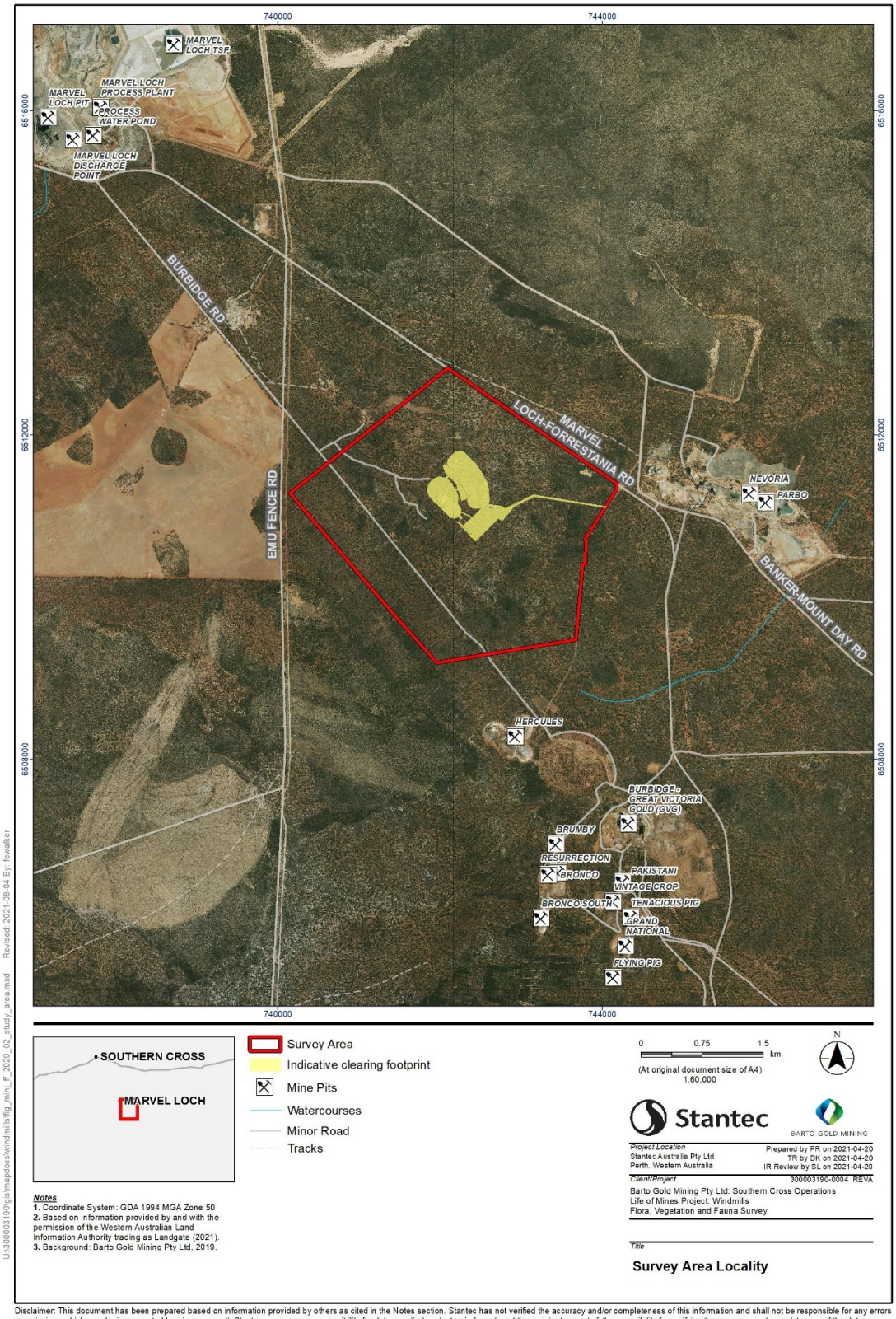

Figure 1-2: Survey Area locality.

2. Existing Environment

2.1 Biogeographic Location

The Interim Biogeographic Regionalisation for Australia (IBRA) is a bioregional framework that divides Australia into 89 biogeographic regions and 419 subregions on the basis of climate, geology, landforms, vegetation, and fauna (Thackway and Cresswell 1995). It was developed through collaboration between state and territory conservation agencies with coordination by the Commonwealth Department of the Environment, Water, Heritage and the Arts (now the Commonwealth Department of Agriculture, Water and the Environment (DoAWE)). The bioregions and subregions are the reporting unit for the systematic development of a comprehensive, adequate, and representative National Reserve System.

The Survey Area occurs entirely within the Southern Cross (COO2) subregion of the Coolgardie bioregion and borders the Avon Wheatbelt 1 (AW1) subregion (Cowan et al. 2001) (**Figure 2-1**). The Southern Cross (COO2) subregion is described as having subdued relief, comprising of gently undulating uplands dissected by broad valleys with bands of low greenstone hills. The valleys include chains of saline playa-lakes. Diverse *Eucalyptus* Woodlands (*Eucalyptus salmonophloia*, *E. salubris*, *E. transcontinentalis* and *E. longicornis*) rich in endemic eucalypts occur around these salt lakes, as well as on the low greenstone hills, valley alluvials and broad plains of calcareous earths (Cowan *et al.* 2001).

Dwarf shrublands of samphire are associated with salt lakes within the COO2 subregion. Granite basement outcrops occur at mid-levels in the landscape and support swards of *Borya constricta* with stands of *Acacia acuminata* and *Eucalyptus loxophleba*. The yellow sandplains, gravelly sandplains and lateritic breakaways of the uplands support mallees (*Eucalyptus leptopoda*, *E. platycorys* and *E. scyphocalyx*) and scrub-heaths (*Allocasuarina corniculata*, *Callitris preissii*, *Melaleuca uncinata* and *Acacia beauverdiana*) (Cowan *et al.* 2001).

Significant vertebrate species that may occur include species such as the Chuditch (*Dasyurus geoffroii*), Slender-Billed Thornbill (*Acanthiza iredalei*), Carnaby`s Cockatoo (*Calyptorhynchus latirostris*), Malleefowl (Leipoa ocellata), Carpet Python (*Morelia spilota imbricata*), Major Mitchell's Cockatoo (*Cacatua leadbeateri*), and Red-tailed Black Cockatoo (*Calyptorhynchus banksii*) (Cowan *et al.* 2001).

2.2 Land Systems

Land systems are defined as an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation (Tille 2006a). An assessment of land systems provides an indication of the occurrence and distribution of vegetation types within and surrounding the Survey Area (Purdie *et al.* 2004). Land systems across the Goldfields have been mapped by the Natural Resources Assessment Group of the Department of Primary Industries and Regional Development (formerly the Department of Agriculture and Food (DAFWA)), providing a comprehensive description of biophysical resources (Purdie *et al.* 2004). The Survey Area occurs within the My44 and DD15 systems, which are described in **Table 2-1** and presented in **Figure 2-2**.

Table 2-1: Extent of land systems within the Survey Area.

Land system	Description	Extent within Survey Area	
		Area (ha)	Proportion (%)
DD15	Undulating plains with some low dunes, seasonal lakes, and clay pans	489.60	55.97
My44	Undulating ridge and low hilly terrain with some mesas and buttes and small valley plains	385.15	44.03

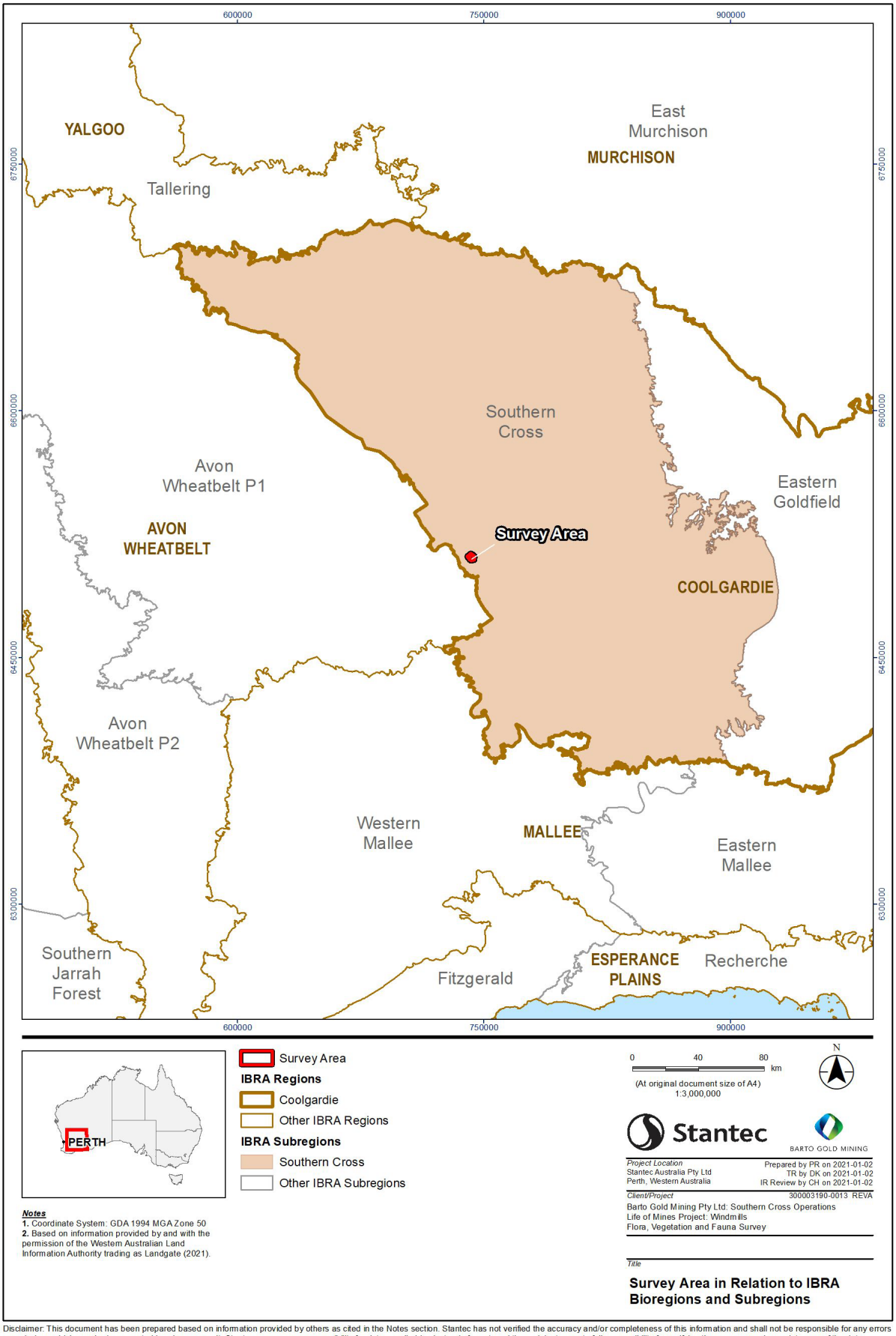

Figure 2-1: Survey Area in relation to IBRA bioregion and subregion.

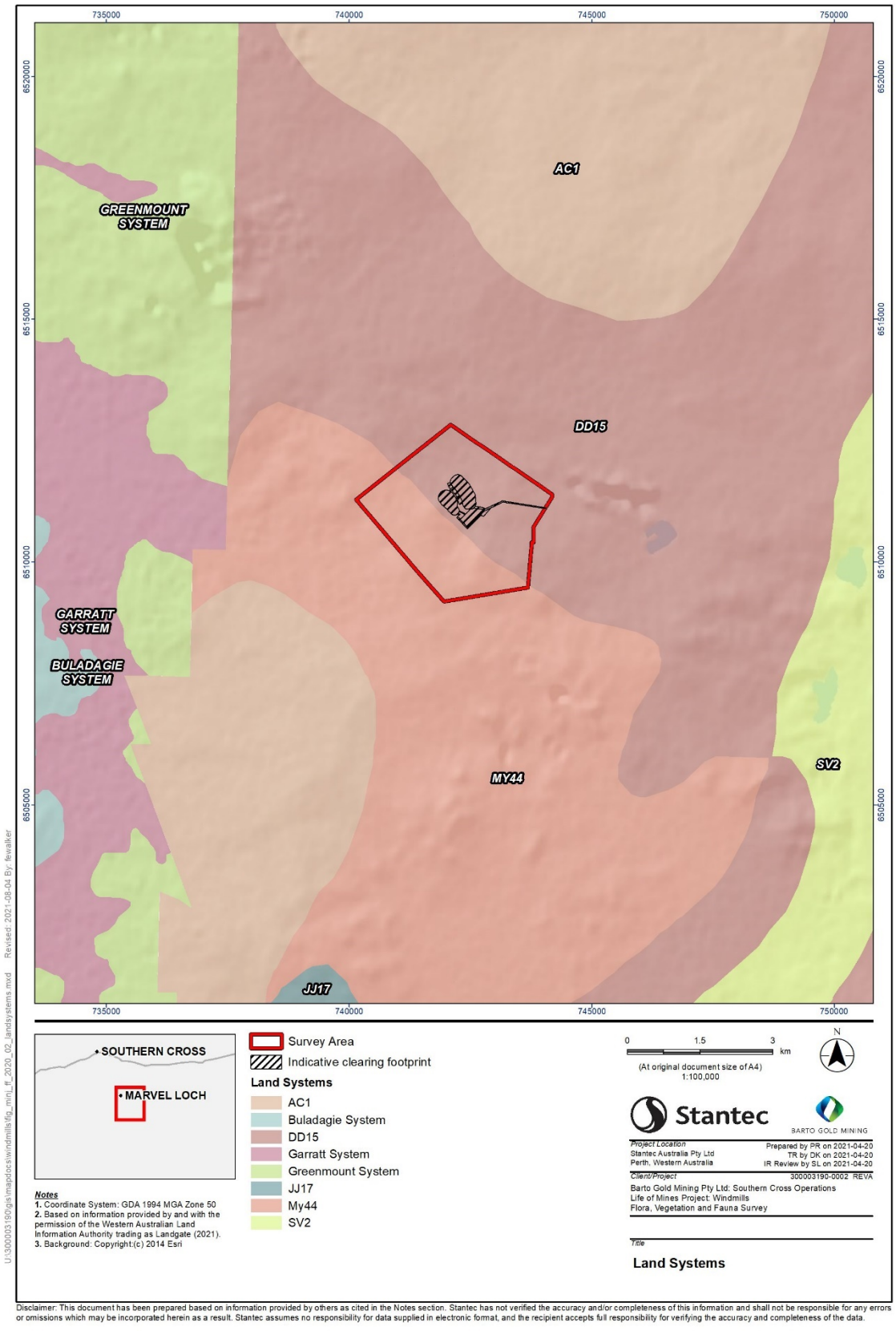

Figure 2-2: Land Systems of the Survey Area.

2.3 Pre-European Vegetation

The Survey Area occurs within the Coolgardie Botanical District of the South-Western Interzone Botanical Province (Beard 1990), which is the transition zone between the Eremaean and South-west botanical provinces (EPA 2016a). The Coolgardie Botanical District is described as predominantly Eucalypt woodlands, becoming open with a saltbush-bluebush (*Atriplex-Maireana*) understorey on the more calcareous soils. Patches of shrub steppe occur in areas adjoining the Great Victoria Desert and scrub-heath and *Casuarina* thickets on sandplains (Beard 1990).

Vegetation mapping of Western Australia was completed on a broad scale (1:1,000,000 and 1:250,000) by Beard (1975), classifying vegetation into broad vegetation associations. These vegetation associations were re-assessed by Shepherd *et al.* (2002a), to account for clearing in the intensive land use zone, and to divide some larger vegetation units into smaller units. Additionally, Shepherd *et al.* (2002a) developed a series of systems to assist in the removal of mosaics; however, some mosaics still occur.

The Survey Area falls within four Pre-European vegetation associations; 128, 552, 1068 and 1148 (**Table 2-2; Figure 2-3**) (Shepherd *et al.* 2002b). The significance of clearing a particular vegetation association can be determined by comparing current and pre-European extents. A 30% threshold level of the pre-European extent of a vegetation type is designated by the EPA's position statement No. 2 (EPA 2000), as a required retention threshold; below which clearing is considered to compromise species diversity at an ecosystem level.

The current extents for all pre-European vegetation associations within the Survey Area indicate that greater than 53% is remaining across the four scales of assessment (State, bioregion, subregion and Local Government Area (LGA)), with between one percent and 26% protected within Reserves (**Table 2-3**) (Government of Western Australia 2018).

Table 2-2: Pre-European vegetation associations within the Survey Area (Shepherd *et al.* 2002b).

Vegetation Association	Description	Extent within Survey Area (ha)
1068	Medium woodland; salmon gum, morrel, gimlet and *Eucalyptus sheathiana*	668.28
128	Bare areas; rock outcrops	104.86
552	Shrublands; *Casuarina acutivalvis* and *Calothamnus* (also *Melaleuca*) thicket on greenstone hills	66.67
1148	Shrublands; scrub-heath in the Coolgardie Region	33.93
Total		**874.75**

Table 2-3: Extent of pre-European vegetation associations remaining across four scales (State, Bioregion, Subregion and Local Government Area) (Government of Western Australia 2018).

Vegetation associations	Scale	Pre-European extent (ha)	Current extent (ha)	Proportion remaining (%)	Current extent within IUCN Class I-IV Reserves (ha)	Proportion of current extent protected within IUCN Class I-IV Reserves (%)[1]
128	State-wide	329,836	288,813	85	48,946	17
	Bioregion (COO)	184,550	183,891	99	21,673	12
	Subregion (COO2)	156,193	155,552	99	21,054	13
	LGA (Yilgarn)	45,797	41,452	90	5,806	14
552	State-wide	33,908	31,669	93	302	1
	Bioregion (COO)	6,173	5,897	96	-	-
	Subregion (COO2)	6,173	5,897	96	-	-
	LGA (Yilgarn)	12,510	12,167	97	-	-
1068	State-wide	268,900	142,088	53	16,761	12
	Bioregion (COO)	193,988	104,804	54	14,154	14
	Subregion (COO2)	193,988	104,804	54	14,154	14
	LGA (Yilgarn)	268,900	142,088	53	16,761	12
1148	State-wide	260,384	258,227	99	44,766	17
	Bioregion (COO)	254,932	252,776	99	42,791	17
	Subregion (COO2)	254,932	252,776	99	42,791	17
	LGA (Yilgarn)	79,301	77,149	97	20,190	26

[1]: includes existing National Parks, Nature Reserves, Conservation Parks, 5(g) Reserves (DBCA Conservation Reserves), DBCA conservation estate, Bush Forever on DBCA managed lands and Bush Forever in Regional Parks.
Note: Area values have been rounded to the nearest whole number.

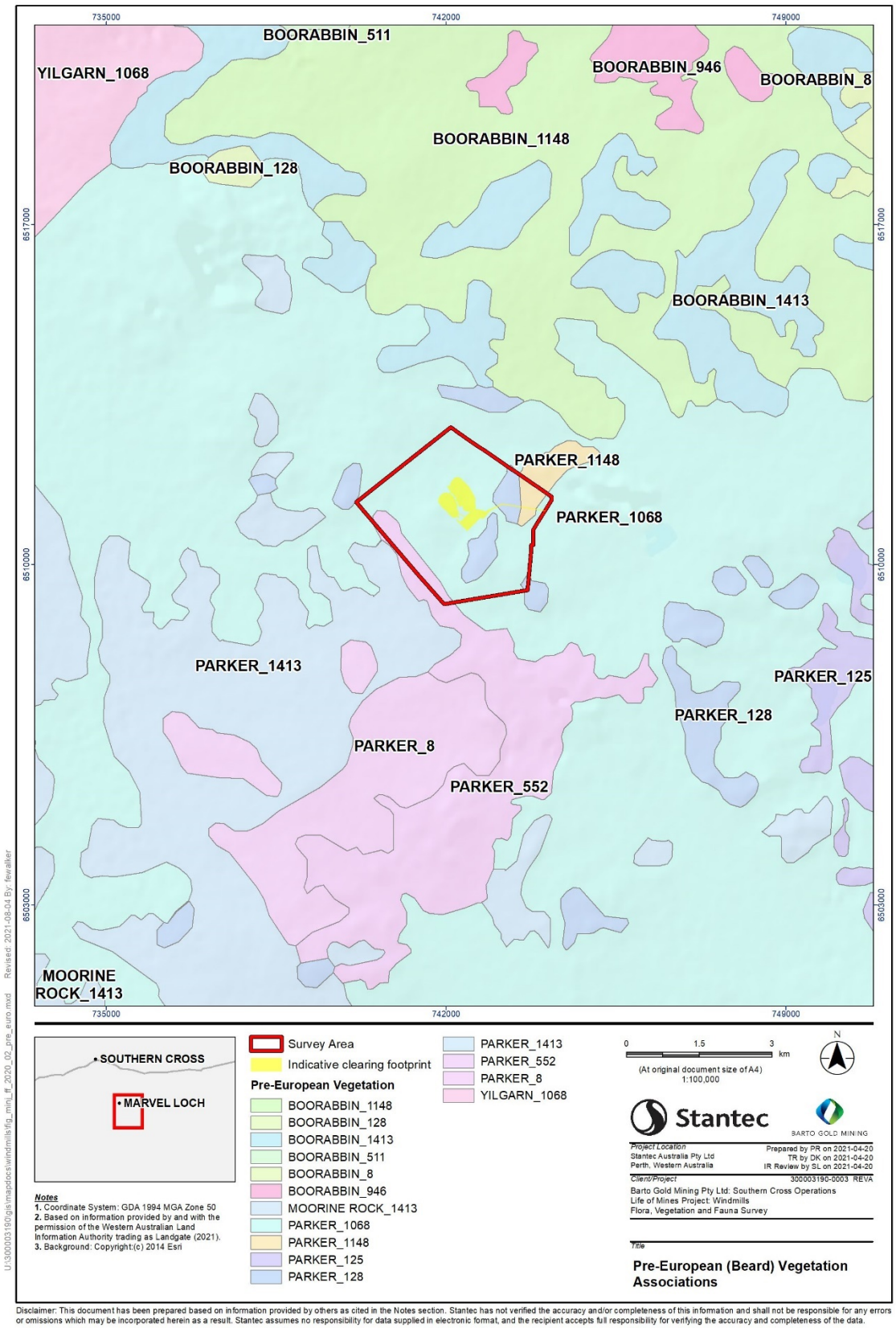

Figure 2-3: Pre-European vegetation associations mapped within the Survey Area.

2.4 Climate

The Survey Area is located within the Coolgardie Botanical District of Western Australia and has a semi-arid climate, characterised by hot summers and cool winters (Beard 1990). Annual total precipitation within this botanical district ranges from 200 millimetres (mm) to 300 mm (Beard 1981, Cowan *et al.* 2001).

Based on long-term climate data (1996 – 2020) from the nearest Bureau of Meteorology (BoM) weather station at Southern Cross Airfield (Station 12320), located approximately 12 km north west of the Survey Area, the mean annual rainfall is 305 mm (BoM 2020). The majority of this rainfall is received during the months of January, March, July and August (**Figure 2-4**). According to the long-term (1996-2020) temperature data, the hottest months of the year are between December and February, with mean maximum temperatures exceeding 30 degrees Celsius (°C). The coolest months occur between June and August (**Figure 2-4**).

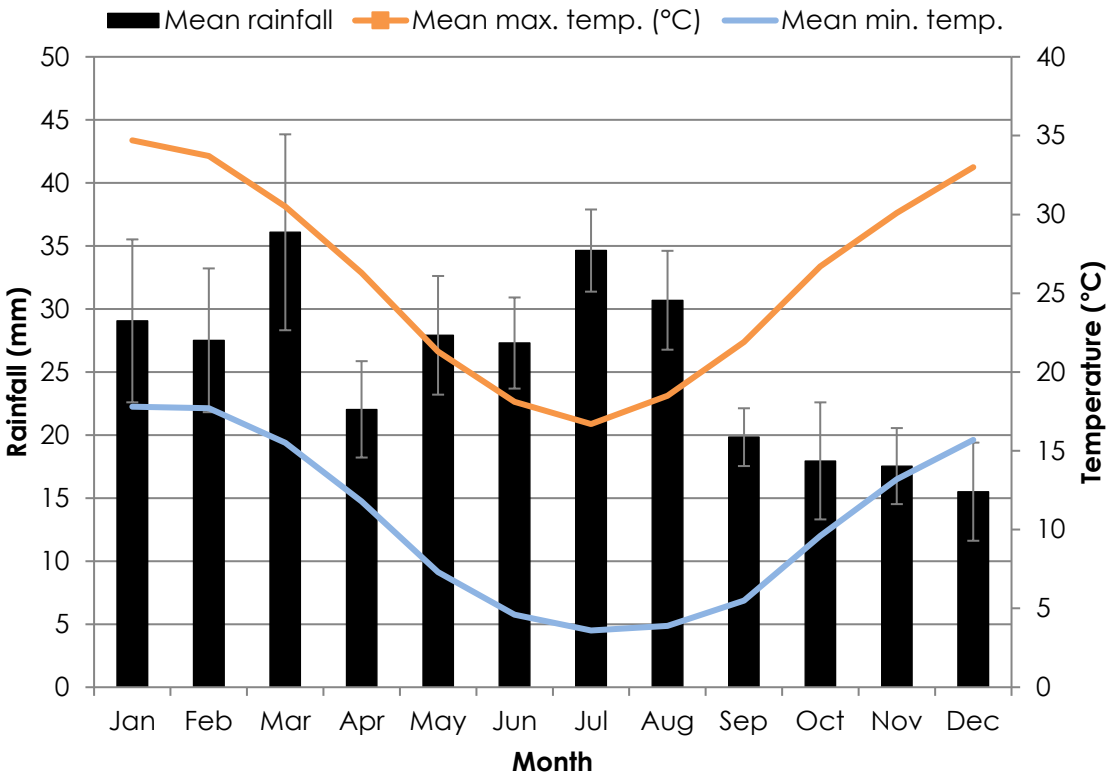

Figure 2-4: Long-term (1996 – 2020) rainfall (mm) and temperature (°C) data recorded at the Southern Cross Airfield weather station (station 12320) (BoM 2020).

2.5 Surface Geology and Soils

The Survey Area intersects six geological units, with the majority underlain with unit 74240 (**Table 2-4**). The Survey Area is mapped as soil landscape zone 261 – Southern Cross, in the Kalgoorlie Province (Tille 2006b). The Southern Cross soil unit is described as undulating plains and uplands, with some salt lakes and low hills, on deeply weathered mantle, colluvium and alluvium over greenstone and granite rocks of the Yilgarn Craton (Tille 2006b). Soils of this unit are varied and consist of calcareous loamy earths, red and yellow loamy earths, and alkaline deep and shallow sandy duplexes with some yellow sandy earths, salt lake soils, yellow deep sand and red shallow loamy duplexes (Tille 2006b).

Table 2-4: Surface geology associated with the Survey Area.

Geological unit	Description	Extent within Survey Area (ha)
Pelitic and psammitic sedimentary rocks 74240	Conglomerate, chert, small amounts felsic volcaniclastic rocks, sandstone, quartzite, siltstone, phyllite, schist, pelite, shale. Includes the former Hatfield Formation.	203.93
Undivided metamorphosed igneous and sedimentary rocks 74367	Komatiitic basalt, quartz-muscovite-andalusite schist, basalt, dacitic porphyry, granite with greenstone rafts, agglomerate, talc schist, banded gneiss, quartzite, amphibolite, schist, ultramafic rocks, banded iron formation, dolerite, granite.	196.49
Mafic extrusive rocks 74255	Metabasalt, high-Mg basalt, tholeiitic basalt, carbonated basalt, agglomerate, mafic schist, dolerite, amphibolite; porphyritic basalt and dolerite; komatiitic basalt; mafic pyroclastics; minor mafic schist with granite intercalations.	188.97
Colluvium 38491	Colluvium and-or residual deposits, sheetwash, talus, scree; boulder, gravel sand; may include minor alluvial or sand plain deposits, local calcrete and reworked laterite.	129.32
Ferruginous duricrust 38498	Regolith (lateritic duricrust) – Pisolitic, nodular or vuggy ferruginous laterite; some lateritic soils; may include massive to pisolitic ferruginous subsoil, mottled clays, magnesite, reworked products of ferruginous and siliceous duricrusts, calcrete, gossan; residual ferruginous saprolite.	116.62
Volcanic and sedimentary rocks 74483	Rhyodacitic porphyry, volcaniclastic rocks, tuff, para-amphibolite, quartzite, mafic schist, amphibolite, felsic volcanic rocks, mafic volcanic rocks, banded iron formation, siliciclastic rocks, ultramafic rocks, chert.	39.42
Total		**874.75**

2.6 Surface Water and Hydrology

The COO2 subregion has occluded drainage with any excess surface water following heavy rainfall draining into salt lakes (BoM 2012, Cowan *et al.* 2001). The Survey Area occurs within the Lake Julia sub-catchment of the Swan-Avon River catchment (State of Western Australia 2020). Numerous ephemeral watercourses and lakes occur within proximity to the Survey Area, however, none of these intersect the Survey Area. A band of lakes occurs approximately 6 km east of Survey Area.

The Survey Area does not fall within a Public Drinking Water Source Area (PDWSA). The closest PDWSA is associated with the Broad Arrow Dam Catchment Area, located over 200 km north east of the Survey Area (State of Western Australia 2020).

2.7 Conservation Reserves and Environmentally Sensitive Areas

The Survey Area does not occur within a conservation reserve. Jilbadji Nature Reserve and Yellowdine Nature Reserve are the nearest conservation reserves to the Survey Area, respectively located approximately 10.5 km to the east and 16 km to the north east. Boorabin National Park is located approximately 48 km to the north east of the Survey Area (State of Western Australia 2020).

Under Section 51B of the *Environmental Protection Act 1986* (EP Act), Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment(Government of Western Australia 2017). These areas aim to be protected from the degradation of environmental values such as declared rare flora, threatened ecological communities (TECs) or significant wetlands. The criteria for the declaration of ESAs do not include State-listed Priority Ecological Communities (PECs), which are protected under the *Biodiversity Conservation Act 2016* (BC Act).

The Survey Area does not occur within an ESA; the nearest ESA's to the Survey Area are located approximately 10.5 km to the east and 16 km to the north east, in association with Jilbadji Nature Reserve and Yellowdine Nature Reserve (State of Western Australia 2020). The Jilbadji Nature Reserve is over 200,000 ha and is considered a significant area for maintaining existing ecosystem processes at a regional scale (DotEE 2019a). The reserve is substantially larger than the average reserve (totalling 114 ha) in the wheatbelt region, and has the potential to be an important refuge for many species (DotEE 2019a). Jilbadji Nature reserve supports a very high diversity of reptiles and native mammal species; 38 and 15 species respectively, as well as 26 plant species endemic to the wheatbelt of Western Australia (DotEE 2019a). Yellowdine Nature Reserve lies in the transition zone between the Eremeaen and South-west botanical provinces, supporting a rich and diverse flora community with many species of plant and animal persisting on the extremities of their distributions (DotEE 2019b).

3. Desktop Assessment

A desktop assessment, comprising database searches and a literature review, was undertaken prior to the field survey to gather contextual information on the Survey Area and to inform a likelihood of occurrence for significant flora, vegetation and fauna to occur within the Survey Area. Significant species and rankings used under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), the BC Act, as well as the Department of Biodiversity, Conservation and Attractions (DBCA) priority list, are defined in **Appendix A**.

3.1 Methods

3.1.1 Database Searches

Database searches were completed to generate a list of vascular flora, vegetation communities and terrestrial fauna previously recorded within, and in the vicinity of, the Survey Area, with an emphasis on species and communities of significance. Six searches were conducted based on either the Survey Area polygon or a central Survey Area co-ordinate of 50J 729507.65 m E, 6530138.37 m S. Search buffers varied according to the technical capabilities of each database and the ecological features of the area (**Table 3-1**).

Table 3-1: Database searches conducted for the desktop assessment.

Custodian/Reference	Database name	Ecological focus group	Buffer (km)	Date of receipt
Department of Agriculture, Water and the Environment (DoAWE) DoAWE (2020)	Protected Matters Search Tool (PMST)	Flora and fauna	20	13/10/20
Department of Biodiversity, Conservation and Attractions (DBCA 2021)	Threatened Ecological Community (TEC) and Priority Ecological Community (PEC)	Vegetation communities of significance	20	05/08/19
Department of Biodiversity, Conservation and Attractions (DBCA 2020a)	NatureMap	Flora and fauna	20	13/10/20
Department of Biodiversity, Conservation and Attractions (DBCA 2020a, e)	Threatened and Priority Flora database (TPFL)	Threatened and Priority Flora	20	08/09/20
	Western Australian Herbarium Specimen database (WAHerb)	Threatened and Priority Flora	20	08/09/20
Department of Biodiversity, Conservation and Attractions (DBCA 2020b)	Threatened and Priority Fauna	Threatened and Priority Fauna	15	24/04/20
Birdlife Australia (Birdlife Australia 2019)	Birdlife Bird Data	Fauna	70	18/08/19

3.1.2 Literature Review

Background information relating to the Survey Area and surrounds was compiled prior to conducting the field work for the survey. Historic vegetation mapping (Beard 1972, Shepherd *et al.* 2002b), soil and land system mapping and characteristics (Cowan *et al.* 2001, Tille 2006b), and the IBRA classification system information (Thackway and Cresswell 1995) were reviewed to provide broad contextual information. Thirteen publicly available survey reports of relevance to the Survey Area were also reviewed, comprising eight flora and vegetation and five terrestrial fauna surveys (**Table 3-2** and **Table 3-3**).

Table 3-2: Summary of flora and vegetation surveys in the vicinity of the Survey Area.

Reference Survey	Survey Details	Proximity to the Survey Area	Survey Effort	Vegetation Types	Flora Recorded Vegetation Condition	Species and Communities of Conservation of Significance (species names and conservation status current at time of respective survey)
Stantec (2021)	**Location:** Yilgarn Star **Study Type:** Detailed flora, vegeataion and targeted fauna survey **Survey Date(s):** 21st and 22nd September 2019, 20th and 21st April 2020, 26th and 27th September 2020, 23rd – 25th March 2021	8.5km east of Survey Area	13 quadrats 1 relevé 3 mapping notes	**ElEsuMpEaEsAv** *Eucalyptus longicornis* and *Eucalyptus salubris* woodland over *Melaleuca pauperiflora* and *Exocarpus aphyllus* tall open shrubland over *Eremophila scoparia* scattered shrubs over *Atriplex vesicaria* low open shrubland. **EsuElEsMpSaEaAmAv** *Eucalyptus salubris*, *Eucalyptus longicornis* and *Eucalyptus salmonophloia* woodland over *Melaleuca pauperiflora* and *Santalum acuminatum* tall open shrubland over *Exocarpos aphyllus* and *Acacia merrallii* open shrubland over *Atriplex vesicaria* low open shrubland. **ElEcEyAmEiiAbEaDs** *Eucalyptus longicornis* woodland over *Eucalyptus corrugata* and *Eucalyptus yilgarnensis* low open woodland over *Acacia merrallii*, *Eremophila interstans* subsp. interstans and *Alyxia buxifolia* tall open shrubland over *Exocarpos aphyllus* and *Dodonaea stenozyga* open shrubland. **EcAaaEaMsAbAl.** *Eucalyptus capillosa* open woodland over *Allocasuarina acutivalvis* subsp. *acutivalvis* and *Exocarpos aphyllus* tall open shrubland over *Melaleuca scalena* open shrubland over *Alyxia buxifolia* and *Acrotriche lancifolia* scattered low shrubs.	**Flora:** • Families 29 • Genera 50 • Taxa 74 **Condition:** 'Excellent' to 'Completely Degraded', with the majority in 'Excellent' condition (approximately 76%).	• **TECs:** None • **PECs:** Parker Range vegetation complexes' Priority Ecological Community (Priority 3) Community Type 3 • **Threatened species:** None • **Priority species**:1 *Acacia asepala* (P2)
Spectrum Ecology (2020)	**Location**: Leviathan **Study Type:** Reconnaissance flora and vegetation, targeted fauna and targeted flora assessment **Survey Date(s)**: November 2019 **Size of Survey Area**: 195 ha	20 km north of Survey Area	7 relevés Traverses	**ElEs/Aa** *Eucalyptus lesouefii* and/or *E. sheathiana* (+/- *E. vittata*, *E. longicornis*) open woodland, over *Allocasuarina acutivalvis* subsp. *acutivalvis* and/or *A. helmsii* and *Acacia acuminata* shrubland. **Elo/Ele** *Eucalyptus longicornis* (+/- *E. oleosa* subsp. *oleosa*) open woodland, over *Eucalyptus leptopoda* subsp. *leptopoda* open mallee woodland, over *Melaleuca pauperiflora* subsp. *fastigiata* sparse tall shrubland, over *Atriplex vesicaria* sparse shrubland. **EloEs/Mp/Es** *Eucalyptus longicornis*, *E. salubris* open woodland over (+/-) *Melaleuca pauperiflora* subsp. *fastigiata* sparse tall shrubland, over *Eremophila scoparia* or *E. ionantha* and mixed *Atriplex* species shrubland.	**Flora:** • Families 25 • Genera 49 • Taxa 91 **Condition:** 'Excellent' **to** 'Completely Degraded' Majority excellent 94 ha (48.2%)	• **TECs:** None • **PECs:** None • **Threatened species:** None • **Priority species**: None
Stantec (2019)	**Location**: Parker range **Study Type:** Reconnaissance level vegetation and flora survey, and a level 1 fauna survey **Survey Date(s)**: 16 to 29 September 2019 **Size of Survey Area**: 16,429 ha	Intersects with Survey Area	35 relevés 76 mapping notes	**EoEpEsEsuEprMpSa MmEiDs** *Eucalyptus oleosa, E. polita, E. salmonophloia, E. salubris* and *E. prolixa* open forest over *Melaleuca pauperiflora* and *Santalum acuminatum* tall shrubland over *Microcybe multiflora* subsp. *multiflora, Eremophila interstans* subsp. *interstans* and *Dodonaea stenozyga* open shrubland. **EsuEsMpSaExOmAeTc** *Eucalyptus salubris* and *E. salmonophloia* open forest over *Melaleuca pauperiflora, Senna artemisioides* subsp. x *filifolia* and *Exocarpos aphyllus* tall open shrubland over *Olearia muelleri, Acacia erinacea* and *Templetonia ceracea* low open shrubland. **EsElEcMtSaEsEoMtEs** *Eucalyptus salmonophloia, E. loxophleba* and *E. corrugata* open woodland over *Melaleuca teuthidoides, Santalum acuminatum, Eremophila scoparia* and *E. oppositifolia* subsp. *angustifolia* open tall open scrub over *Maireana trichoptera* and *Eriochiton sclerolaenoides* scattered low shrubs. **HmAaTkGpPtGaAr** *Hakea multilineata, Allocasuarina acutivalvis* and *Thryptomene kochii* tall open shrubland over *Grevillea paradoxa* scattered shrubs over *Phebalium tuberculosum, Grevillea acacioides* and *Acacia resinimarginea* scattered low shrubs. **AcAaAhGoMcHe** *Allocasuarina corniculata, A. acutivalvis* and *Acacia hamata* tall open scrub over *Grevillea obliquistigma* subsp. *obliquistigma* and *Melaleuca cordata* open heath over *Hibbertia eatoniae* low open heath. **EsE?iMpEaAbTspTc** *Eucalyptus salmonophloia* tall open woodland over *E. ?incrassata* scattered low mallee trees over *Melaleuca pauperiflora, Exocarpos aphyllus* and *Alyxia buxifolia* open shrubland over *Tecticornia disarticulata* and *Templetonia ceracea* low shrubland. **EcAaAcDiPiHe** *Eucalyptus capillosa* scattered trees over *Allocasuarina acutivalvis, A. campestris* and *Dodonaea inaequifolia* tall shrubland over *Prostanthera incurvata, Hibbertia eatoniae* and scattered low shrubs. **ErCpSaHeGhG?eBs** *Eucalyptus rigidula* low mallee woodland over *Callitris preissii*, *Santalum acuminatum* and *Hakea erecta* tall shrubland over *Grevillea hookeriana, Grevillea ?excelsior* and *Banksia shanklandiorum* low shrubland.	**Flora:** • Families 43 • Genera 133 • Taxa 279 **Condition:** 'Pristine' to 'Completely Degraded' Majority = 'Excellent' 12,707.3 ha or 77.3%	• **TECs:** 1 Eucalypt Woodlands of the Western Australian Wheatbelt (Cr) • **PECs:** 2 Highclere Hills (Mayfield) vegetation complex (banded iron formation) (P3) and Parker Range vegetation complexes (P3) • **Threatened species:** None • **Priority species**: 17 *Cryptandra exserta* (P1) *Grevillea lissopleura* (P1) *Hysterobaeckea ochropetala* subsp. *ochropetala* (P1) *Lepidosperma* sp. Mt. Caudan (N. Gibson & M. Lyons 2081) (P1) *Rinzia fimbriolata* (P1) *Acacia asepala* (P2) *Acacia concolorans* (P2) *Baeckea grandibracteata* subsp. Parker Range (K. Newbey 9270) (P2) *Acacia crenulata* (P3) *Acacia dissona var. indoloria (P3)* *Hakea pendens* (P3) *Microseris walteri* (P3)

Reference Survey	Survey Details	Proximity to the Survey Area	Survey Effort	Vegetation Types	Flora Recorded Vegetation Condition	Species and Communities of Conservation of Significance (species names and conservation status current at time of respective survey)
				ElEtAc *Eucalyptus livida* and *E. tenera* low open mallee woodland over *Allocasuarina campestris* open heath to tall open scrub over mixed low shrubland. **ElEloMlMaA?aPcAhOp** *Eucalyptus loxophleba subsp. lissophloia* and *E. longicornis* open woodland over *Melaleuca lateriflora, M. acuminata* and *Acacia ?acuminata* tall open shrubland over *Phebalium canaliculatum, Acacia hemiteles* and *Olearia pimelioides* scattered low shrubs. **ErBgViGhLsDh** *Eucalyptus* sp. low mallee woodland over *Baeckea grandibractea* subsp. Parker Range (K. Newbey 9270), *Verticordia* sp. and *Grevillea hookeriana* subsp. *apiciloba* shrubland over *Isopogon scabriusculus* subsp. *stenophyllus* and *Drummondita hassellii* low open shrubland. **EsAbAdEmElPt** *Eucalyptus sheathiana* scattered low mallee trees over *Acacia beauverdiana* and *Acacia densiflora* tall shrubland over *Euryomyrtus maidenii, E. leptospermoides* and *Phebalium tuberculosum* low open heath. **EmEsuMpEaSaAaOm** *Eucalyptus myriadena* and *E. salubris* woodland over *Melaleuca pauperiflora, Exocarpos aphyllus* and *Santalum acuminatum* tall shrubland over *Acacia asepala* and *Olearia muelleri* low shrubland. **TsppAvFiDc** *Tecticornia disarticulata*, *Tecticornia indica* subsp. *bidens* and *Atriplex vesicaria* open shrubland over Frankenia *irregularis* and *Disphyma crassifolium* open herbland. **EsElAaMcPbBdAc** *Eucalyptus sheathiana* and *E. loxophleba* subsp. *supralaevis* woodland over *Allocasuarina acutivalvis* and *Melaleuca cordata* tall open shrubland over *Phebalium tuberculosum*, *Bertya dimerostigma* and *Acacia* sp. open shrubland. **EsuElMpEsEaEsEiSs** *Eucalyptus salubris* and *E. longicornis* woodland over *Melaleuca pauperiflora* subsp. *fastigiata*, *Eremophila scoparia* and *Exocarpos aphyllus* tall open shrubland over *Eremophila scoparia, E. ionantha* and *Scaevola spinescens* low shrubland. **EsuEsEaAcMt** *Eucalyptus salubris* low open woodland over *Eremophila scoparia* and *Eremophila alternifolia* scattered tall shrubs over *Atriplex codonocarpa* and *Maireana triptera* open shrubland. **CcEcMrAbPt** *Callitris canescens* and *Eremophila clarkei* tall open shrubland over *Micromyrtus racemosa, Alyxia buxifolia* and *Phebalium tuberculosum* open shrubland. **EtEsEcSaAtBsPs** *Eucalyptus transcontinentalis, E. sheathiana* and *E. capillosa* woodland over *Santalum acuminatum* scattered tall shrubs over *Acacia tetragonophylla* and *Beyeria sulcata* and *Philotheca* sp. scattered shrubs. **EcBsAaAhTmPi** *Eucalyptus corrugata* low mallee woodland over *Beyeria sulcata* and *Acacia acuminata* and *Allocasuarina helmsii* tall open scrub over *Trymalium myrtillus* subsp. *myrtillus* and *Prostanthera incurvata* open shrubland over *Trymalium myrtillus* subsp. *myrtillus* and *Prostanthera incurvata* low open shrubland **MlMpFi** *Melaleuca lateriflora, M. pauperiflora* subsp. *fastigiate* tall shrubland over *Frankenia irregularis* scattered low shrubs. **TspAvFspAe** *Tecticornia* spp., *Atriplex vesicaria* and *Frankenia irregularis* low shrubland over *Austrostipa elegantissima* scattered bunch grass. **EhHeAhMhTkRf** *Eucalyptus horistes* low mallee woodland over *Hakea erecta, Allocasuarina helmsii* and *Melaleuca hamata* tall open shrubland over *Thryptomene kochii* shrubland over *Rinzia fimbriolata* low shrubland. **EsE?cSaMtSaDsGp** *Eucalyptus salubris* and *Eucalyptus ?celastroides* low woodland over *Santalum acuminatum* and *Melaleuca teuthidoides* scattered tall shrubs over *Santalum acuminatum, Dodonaea stenozyga* and *Gastrolobium parviflorum* shrubland. **AtSsAaSsEcPbbWa** *Acacia tetragonophylla, Santalum spicatum, Acacia acuminata* tall shrubland over *Scaevola spinescens, Eremophila clarkei* and *Philotheca brucei* subsp. *brucei* over *Waitzia acuminata* scattered herbs. **EcE?sEeHmSaAcOm** *Eucalyptus calycogona* and *E. ?sheathiana* and *E eremophila* low mallee woodland over *Hakea meisneriana* and *Santalum acuminatum* scattered shrubs over *Acacia concolorans* and *Olearia muelleri* low open shrubland. **EsAaHf** *Eucalyptus sheathiana* low woodland over *Acacia acuminata* tall shrubland over *Hybanthus floribundus* subsp. *curvifolius* open low shrubland.		*Teucrium diabolicum* (R. Davis 8813) (P3) *Banksia shanklandiorum* (P4) *Calamphoreus inflatus* (P4) *Grevillea neodissecta* (P4) *Stenanthemum ?bremerense* (P4)

Reference Survey	Survey Details	Proximity to the Survey Area	Survey Effort	Vegetation Types	Flora Recorded Vegetation Condition	Species and Communities of Conservation of Significance (species names and conservation status current at time of respective survey)
GHD (2016)	**Location**: Yilgarn Star North Prospect **Study Type:** Desktop Assessment and Level 1 Flora and Fauna Survey **Survey Date(s)**: 20 and 21 of June 2016. **Size of Survey Area**: 180.76 ha	20 km south east of Survey Area	9 Relevés	**VA01**: Open forest of *Eucalyptus oleosa* subsp. *oleosa* and *E. salubris* with *E. myriadena* subsp. *myriadena*, *E. loxophleba* subsp. *lissophloia* and *Melaleuca sheathiana over* open shrubland of *Eremophila ionantha*, *E. scoparia*, *Exocarpos aphyllus* and *Santalum acuminatum* over sparse herbland of *Atriplex stipitata*, *Lycium australe*, *Olearia muelleri* and *Zygophyllum apiculatum*. **VA02**: Isolated chenopod shrubs of *Atriplex* spp., *Maireana* spp. and *Sclerolaena diacantha*.	**Flora:** • 17 families • 34 genera • 62 taxa **Condition:** From 2 to 7, mostly 3: Eremaean and Northern Botanical Provinces (EPA and DPaW 2015).	• **TECs:** None • **PECs:** None • **Threatened species:** None • **Priority species:** None
Botanica (2016a)	**Location**: Martin's Prospect **Study Type:** Reconnaissance Flora and Vegetation Survey **Survey Date(s)**: 2 April 2016 **Size of Survey Area**: 105.5 ha	10 km south of Survey Area	Survey effort not specified	**CLP/LS-EW1**: Low woodland of mixed *Eucalypts* over open scrub of *Exocarpos aphyllus/ Melaleuca pauperiflora* subsp. *pauperiflora/ Santalum acuminatum* and open dwarf scrub of *Acacia deficiens/ Scaevola spinescens* on clay- loam plain/ low slope **CLP/LS-EW2**: Low woodland of *Eucalyptus salubris* over scrub of *Melaleuca pauperiflora* subsp. *pauperiflora / M. pauperiflora* subsp. *fastigiata/ Santalum acuminatum* over open dwarf scrub *of Scaevola spinescens* on clay-loam plain/ low slope **CLP/LS-MWS1**: Tree mallee of *Eucalyptus gracilis* over heath of *Beyeria brevifolia* and open dwarf scrub of *Acacia erinacea/ A. merrallii* on clay-loam plain/ low slope. **RH-EW1**: Low woodland of *Eucalyptus vittata* over open low scrub of *Beyeria brevifolia/ Phebalium* spp. and open low sedge *of Lepidosperma sanguinolentum* on rocky hillslope **RH-MWS1**: Open tree mallee of *Eucalyptus loxophleba* subsp. *lissophloia* over scrub of *Melaleuca pauperiflora* subsp. *pauperiflora / M. pauperiflora* subsp. *fastigiata* and open dwarf scrub of *Westringia cephalantha* on rocky hillslope **CV**: Cleared/Disturbed Vegetation	• 23 families • 30 genera • 51 taxa C**ondition:** All vegetation communities had a '2' health rating	• **TECs:** None • **PECs:** 1 Parker Range Priority Ecological Community (P3). • **Threatened species:** None • **Priority species:** None
MWH (2014)	**Location**: Cheritons Find **Study type**: Level 1 Vegetation, Flora and Targeted Flora Survey. **Survey Date(s)**: 7-9 October 2014 **Size of Survey Area**: 504.6 ha (2 x 1.6 x 1.7 km)	10 km south east of Survey Area	16 Relevés 96 person hours	**VC 1**: Mid Open Mallee Woodland to Scattered Mallees of *Eucalyptus capillosa* subsp. *polyclada* (+/- scattered *E. ?eremophila*) over a Mid to Tall Open Shrubland of *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Santalum acuminatum* and *Acacia assimilis* subsp. *assimilis* over a Mid to Low Open Shrubland of *Isopogon gardneri* and *Melaleuca cordata* (+/- *Grevillea acacioides*, *Thryptomene kochii* and *Stenanthemum stipulosum*) occasionally over a sparse sedgeland of *Lepidosperma sanguinolentum* on low hills and minor laterite ridges. **VC 2 (R)**: Rehabilitated areas consisting of a Tall Shrubland to Open Shrubland of *Hakea francisiana*, *Acacia yorkrakinensis* subsp. *acrita* and *Allocasuarina campestris* over a Mid Sparse Shrubland of *Isopogon gardneri* and *Thryptomene kochii* over a Low Sparse Shrubland of *Westringia cephalantha* var. *cephalantha* and *Stenanthemum stipulosum* on low rocky hills. **VC 4**: Open Woodland of *Eucalyptus ? longicornis* over a Mid to Tall Sparse Shrubland of *Melaleuca pauperiflora* subsp. *fastigiata* with Scattered *Santalum acuminatum* over a Low Open Shrubland of *Daviesia argillacea*, *Acacia hemiteles* and *Exocarpos aphyllus* over isolated tussocks of *Austrostipa pycnostachya* on sandy loam flats. **VC 5**: Low to Mid Open Woodland to Woodland of *Eucalyptus ? eremophila* over a Mid Sparse Shrubland to Shrubland of *Melaleuca pauperiflora* subsp. fastigiata over a Mid to Low Shrubland to Sparse Shrubland of *Acacia merrallii*, *Dodonaea stenozyga* and *Daviesia argillacea* on loam flats and gentle slopes, many of which are in recovery from recent fire. **VC 5(Dr)**: Open Mallee Woodland of *Eucalyptus ? eremophila* over a Mid Open shrubland of *Melaleuca pauperiflora* subsp. fastigiata, Daviesia argillacea and *Acacia merrallii* over a Low Shrubland of *Acacia erinacea* and *Dodonaea stenozyga* in broad drainage lines. **VC 6**: Mid to Low Open Shrubland of *Acacia merrallii* and *Daviesia argillacea* over a Low Open Shrubland of *Exocarpos aphyllus*, *Eutaxia lasiocalyx* and *Sclerolaena diacantha* over a Sparse Forbland of *Angianthus tomentosus* and *Asteridea athrixioides* on gritty loam flats. **VC 7**: Open Woodland of *Eucalyptus urna* over a Mid Mallee Woodland of *Eucalyptus sheathiana* over a Mid Open Shrubland of *Daviesia argillacea* and *Acacia hemiteles* over a Sparse Low Shrubland of *Acacia merrallii* on low hills. **VC 8**: Mid Mallee Woodland of *Eucalyptus capillosa* subsp. *polyclada* over a Mid Sparse Shrubland of *Acacia steedmanii*, *Callitris ? canescens* and *Melaleuca hamata* over a Low Sparse Shrubland of *Westringia cephalantha* var. *cephalantha* and *Gastrolobium parviflorum* on gently sloping white sand plain.	• 22 families • 47 genera • 86 taxa **Condition:** From Cleared to Excellent	• **Priority species:** 4 *Euryomyrtus* sp. Parker Range (N. Gibson & M. Lyons 2269) (P1) (now *Rinzia medifila* (P1)) *Hemigenia* sp. Newdegate (E. Bishop 75) (P1) *Eutaxia lasiocalyx* (P2) *Calamphoreus inflatus* (P4)

Reference Survey	Survey Details	Proximity to the Survey Area	Survey Effort	Vegetation Types	Flora Recorded Vegetation Condition	Species and Communities of Conservation of Significance (species names and conservation status current at time of respective survey)
				VC 9: Mid Open Shrubland of *Acacia assimilis* subsp. *assimilis*, *Isopogon gardneri* and *Melaleuca cordata* over a Low Sparse Shrubland of mixed species including *Callitris ? canescens* and *Gastrolobium crassifolium* on sandy clay sloping plains **VC 10**: Scattered mallees of *Eucalyptus capillosa* subsp. *polyclada* and *Eucalyptus ? eremophila* over a Mid Sparse Shrubland of *Melaleuca hamata* and *Acacia acoma* over a Low Mixed Shrubland mostly dominated by *Grevillea obliquistigma* subsp. *obliquistigma*, *Acacia acanthaster* and *Stenanthemum stipulosum* over a Sparse Sedgeland of *Lepidosperma sanguinolentum* on low rocky hills. **VC 11**: Mid Open Mallee Woodland of *Eucalyptus capillosa* subsp. *polyclada* over a Mid Open Shrubland of *Acacia steedmanii* and *Acacia assimilis* subsp. *assimilis* over a Low Sparse Shrubland of *Grevillea paradoxa* on gravelly low hills.		
Recon Environmental (2008b)	**Location**: Marvel Loch TSF Extension **Study Type**: Vegetation Survey **Survey Date(s)**: 24 to 25 March 2008 **Size of Survey Area**: 75.7 ha	4.3 km north of Survey Area	Survey effort not specified	**ESSS**: *Eucalyptus* Shrubland on Sandy Soils occurring at the base of ridges and low rises; it can generally be summarised in the Marvel Loch TSF area as an open *Eucalyptus eremophila* shrubland. Type 1 (Gibson and Lyons 1995). **ELWF**: *E. longicornis* woodland with *Exocarpos aphyllus* and *Melaleuca pauperiflora* emerging over *Eremophila* species with *Olearia muelleri* and *Acacia merrallii*. In the small area ELWF was encountered in this survey this habitat was a regrowth woodland with a mid to low level understorey dominated by *Melaleuca pauperiflora* and *Templetonia sulcata*. Type 2 (Gibson and Lyons (1995, 1998)(Gibson and Lyons 1995, Gibson and Lyons 1998). **ESWF**: Open *Eucalyptus salubris* and *E. salmonophloia* woodland above *Melaleuca pauperiflora* with *Santalum acuminatum, Exocarpos aphyllus, Alyxia buxifolia, Eremophila oppositifolia* over *Acacia merrallii, Scaevola spinescens* and *Microcybe minutiflora*. Type 3 (Gibson and Lyons 1995, Gibson and Lyons 1998). **MASS**: Tall closed *Melaleuca* and *Acacia* shrubland generally on sandy soils. Type 4 (Gibson and Lyons 1995, Gibson and Lyons 1998). **STAM**: dense thickets of *Allocasuarina acutivalvis* frequently with *Allocasuarina campestris* and *Melaleuca uncinata* on sandy soils over laterite; in the survey area areas with scattered mallees are also common. Type 5 (Gibson and Lyons 1995, Gibson and Lyons 1998).	• 25 families • 51 genera • 101 taxa	• **TECs:** None • **PECs:** 1 Parker Range Priority Ecological Community (P3). • **Threatened species:** None • **Priority species:** 3 *Acacia crenulata* (P3) *Hakea pendens* (P3) *Stenanthemum bremerense* (P3)
Recon Environmental (2008a)	**Location:** Burbidge Rare Flora Distribution & Impact **Study Type:** Flora and Vegetation Survey **Survey Date(s):** August-September 2007 **Size of Survey Area:** 2,025 ha	Adjoining the Survey Area to the south east	16 days	**ESSS**: *Eucalyptus* Shrubland on Sandy Soils at the base of ridges/low rises: *Eucalyptus eremophila* shrubland **ELWF**: *Eucalyptus longicornis* Woodland on broad Flats: *E. longicornis* woodland with *Exocarpos aphyllus* and *Melaleuca pauperiflora* emerging over *Eremophila* species with *Olearia muelleri* and *Acacia merrallii.* **ESWF**: *Eucalyptus salubris* & *E. salmonophloia* Woodland on broad Flats: open *E. salubris* and *E. salmonophloia* woodland above *Melaleuca pauperiflora* with *Santalum acuminatum, Exocarpos aphyllus, Alyxia buxifolia, Eremophila oppositifolia* over *Acacia merrallii, Scaevola spinescens* and *Microcybe minutiflora.* **EWAC**: *Eucalyptus* woodland with *Melaleuca pauperiflora* subsp. *fastigiata* above *Acacia concolorans* (P2). **MASS**: *Melaleuca* & *Acacia* Shrubland on Sandy soils: tall closed *Melaleuca* and *Acacia* shrubland. **ASSS:** Allocasuarina Shrubland on Sandy Soils: *Allocasuarina corniculata* and *A. acutivalvis* with *Thryptomene kochii* dense shrubland. **MMSS**: Mallee above Mixed Shrublands on Sandy soils: mallee above mixed shrubs on yellow sands/sandy loams. **DMMA**: Drainage line Mallees above Mixed Shrubs: Drainage complex consisting of dense mallees (*Eucalyptus loxophleba* subsp. *lissophloia*) over *Alyxia buxifolia* and *Melaleuca*. **STAM**: Shrubland Thickets of *Allocasuarina* with *Melaleuca*: Dense thickets consisting of *Allocasuarina acutivalvis* frequently with *Allocasuarina campestris* and *Melaleuca uncinata.* **VSAM:** Varying Shrubland of *Allocasuarina* to Mallee: Varying community from *Allocasuarina* thickets with *Calothamnus* and *Melaleuca cordata* over *Hibbertia*; to a more open *Allocasuarina acutivalvis* and *Hakea pendens* shrubland with frequently emerging mallees. **CWRO**: *Callitris* Woodland on Rocky Outcrops: *Callitris columellaris* open woodland (sometimes with *Hakea pendens*) on rocky outcrops.	• 48 families • 224 taxa • 112 genera Condition: Not assessed	• **TECs:** None • **PECs:** 1 Parker Range Priority Ecological Community (P3) • **Threatened species:** None • **Priority species:** 5 *Goodenia heatheriana* (P1) *Acacia concolorans* (P2) *Acacia dissona* var. *indoloria* (P3) *Calamphoreus inflatus* (P4) *Eremophila caerulea* subsp. *merrallii* (P4)
Gibson and Lyons (1998)	**Location:** Parker Range **Study Type**: Flora and Vegetation Survey **Survey Date(s)**: Spring 1994	10 km south east of Survey Area	61 x 20 x 20 m quadrats	Sandy soils at base of ridges and low rises dominated by *Eucalyptus sheathiana* with *E. transcontinentalis* and/or *E. eremophila* as co-dominants. Typical understorey species were *Daviesia argillacea* and *Grevillea huegelii*. Broad flats dominated by *Eucalyptus longicornis* with co-dominants *E. corrugata* and *E. salubris*. One site was dominated by *E. myriadena*. Broad flats dominated by *Eucalyptus salmonophloia* and *E. salubris*. Typical understorey of *Eremophila oppositifolia*, *Acacia concolorans*, *Dodonaea stenozyga* and *Scaevola spinescens*.	• 253 taxa Myrtaceae (57 taxa), Asteraceae (23 taxa), Mimosaceae • (20 taxa), Proteaceae (17 taxa), Poaceae	• **TECs:** None • **PECs:** 1 Parker Range Priority Ecological Community (P3) • **Threatened species:** 1 *Isopogon robusta* T • **Priority species:** 8 *Hemigenia obovata* (P1) *Rinzia medifila* (P1)

Reference Survey	Survey Details	Proximity to the Survey Area	Survey Effort	Vegetation Types	Flora Recorded Vegetation Condition	Species and Communities of Conservation of Significance (species names and conservation status current at time of respective survey)
	Size of Survey Area: Not stated			Deeper sandy soils with *Allocasuarina acutivalvis* and *A. corniculata*. At some sites *Eucalyptus capillosa* subsp. polyclada and more typically *Baeckea elderiana* and *Thryptomene kochii*. *Allocasuarina* campestris and *A. acutivalvis* with *Eucalyptus capillosa* subsp. *polyclada* and/or *E. loxophleba* with *Hakea pendens, Phebalium tuberculosum* and *Westringia cephalantha* in the understorey. *Callitris columellaris* and *Isopogon robustus* on decomposing laterite and granite.	(15 taxa) and Chenopodiaceae (14 taxa)	*Drummondita wilsonii* (P1) *Grevillea phillipsiana* (P1) *Acacia asepala* (P2) *Acacia concolorans* (P2) *Hakea pendens* (P2) *Gnephosis intonsa* (P3) (now *Notisia intonsa* (P3))

Table 3-3: Summary of vertebrate fauna surveys in the vicinity of the Survey Area.

Reference Survey	Survey Details	Proximity to the Survey Area	Survey effort	Fauna habitats	Fauna assemblages recorded	Species of significance
Spectrum Ecology (2020)	**Location**: Leviathan **Study Type:** Reconnaissance Flora and Vegetation, Targeted Fauna and Targeted Flora Assessment **Survey Date(s)**: November 2019 **Size of Survey Area**: 195 ha	20 km north	Targeted fauna	**Semi-arid woodland and tall shrubland** **Semi-arid and arid habitats. Variety of Mallee woodlands and shrublands.**	Nil	Nil
(Stantec 2019)	**Location**: Parker range **Study Type:** Reconnaissance Level Vegetation and Flora Survey, and a Level 1 Fauna Survey **Survey Date(s)**: 16 to 29 September 2019 **Size of Survey Area**: 16,429 ha	Intersects with Survey Area	35 habitat assessments 76 mapping notes	***Eucalyptus* Woodlands** Gently undulating terrain, dominated by a woodland of *Eucalyptus salmonophloia* and *E. salubris* over *Melaleuca* sp., *Allocasuarina* sp., and *Acacia* sp. Shrubs. The habitat ranged from relatively open areas dominated by mature tall eucalypts to densely vegetated areas with immature eucalypts, regenerating after fire. Mallee forms of the eucalypts also occurred within the Eucalypt Woodland habitat. **Hills and Stony Rises** Sloped terrain on stony lateritic substrate, dominated by dense mid storey of *Allocasuarina acutivalvis* over dense *Grevillea* spp. and *Acacia* spp. shrubland. The habitat varied in the vegetation composition with patches of; *Callitris canescens* and *Eremophila clarkei* over *Phebalium* spp., and *Hakea multilineata* and *Thryptomene kochii* over *Grevillea* spp. and *Phebalium tuberculosum* within the habitat. Several patches of exposed bedrock were observed in the areas of the habitat. **Sandplain Shrublands** Relatively flat terrain on sandy substrate with mid to low dense shrub cover. The vegetation composition was dominated by *Eucalyptus capillosa* and *Eucalyptus sheathiana* over *Acacia* spp., and *Allocasuarina acutivalvis* on low shrubs. The lower shrubs varied in density from scattered to open. **Spinifex Shrublands** This habitat differed from other habitats primarily based on the presence of Spinifex. Broadly the habitat occurred on the sandplains dominated by *Eucalyptus rigidula* open mallee over *Callitris preissii* and *Santalum acuminatum* high shrubs on *Grevillea* spp., and *Banksia shanklandiorum* over *Triodia* sp. low shrubland. Substrate varied from stony to sandy loam, within the Survey Area. **Saline Lakes and Claypans** This habitat encompasses Saline Lakes and Claypans, along with their fringing vegetation. The habitat occurs low in the landscape where it may be inundated with water after heavy rainfall. The Saline Lakes and Claypans are dominated by *Tecticornia* spp., and *Frankenia* sp. The habitat ranges from more freshwater claypans with a *Melaleuca* spp. upper storey to salt lakes with gypsum crystals and tussock grass present. **Disturbed** Disturbance associated with infrastructure and clearing for exploration. Habitat considered of little to no value to fauna.	28 taxa: • 19 native bird species • 2 native mammal species • 3 reptile species • 3 introduced mammal species	• Malleefowl (Vu; VU) (*Leipoa ocellata*)
GHD (2016)	**Location:** North Yilgarn Star **Study Type:** Biological Assessment **Survey Date(s):** June 2016	20 km southeast	Traversed by foot, Opportunistic	**Mixed Eucalypt woodland:** *Eucalyptus* open forest **Highly modified areas:** Isolated Chenopod Shrubs (VA02) and Cleared/Highly Disturbed areas (HD)	19 taxa: • 14 native bird species • 2 native mammals • 3 introduced mammals	Nil

Reference Survey	Survey Details	Proximity to the Survey Area	Survey effort	Fauna habitats	Fauna assemblages recorded	Species of significance
Botanica (2016b)	**Location:** Redwing Project **Study type:** Level 2 Flora & Fauna Survey - Redwing Project **Survey Date(s):** 3 to 8 April	35 km south	2 person days	**Clay-Loam Plain** - Regrowth open low woodland of *Eucalyptus salmonophloia/ E. salubris/ E. urna* over scrub of *Melaleuca pauperiflora* and mixed low scrub on clay-loam plain. **Rocky Hillslope** - Low forest of *E. longicornis* over scrub of *M. pauperiflora* and mixed low scrub on rocky plain/ basalt rise or Open shrub Mallee of *E. livida/ E. tenera* over heath of *Allocasuarina campestris* and mixed low scrub on laterite rise **Rocky Plain/ Hillslope** - Very open shrub mallee of *E. livida/ E. cylindriflora* over heath of *A. acutivalvis/ A. corniculata/ Acacia yorkrakinensis* or very open shrub mallee of *E. livida/ E. cylindriflora* over heath of *A. acutivalvis/ A. corniculata/ A. yorkrakinensis;* over mixed low heath on rocky plain/ laterite rise **Existing Disturbed Areas** - Parts of the survey area have been subject to varying historical disturbances such as track construction for exploration drilling, wood cutting and low level mining operations (e.g. old shafts). These areas typically contain no vegetation or are in the early stages of natural regeneration.	44 taxa: • 32 birds • 11 mammals (including 6 bat species and 3 introduced species) • one reptile	• Malleefowl (Vu; VU) (*Leipoa ocellata*)
Western Wildlife (2008)	**Location:** Southern Cross Operations **Study type:** Baseline Fauna Survey (Level 2 fauna survey) **Survey Date(s):** Spring 2007 & Autumn 2008	31 km north	14 trapping grids established. Each grid consisted of 10 pitfall traps, five funnel traps, 10 Elliott traps and one or two cage traps. The traps were open for seven or eight nights on each survey 5419 trap-nights	Nil	123 taxa: • 71 birds • 15 mammals • 33 reptiles • 4 amphibians	• Western Rosella (P4) (*Platycercus icterotis xanthogenys*) • Peregrine Falcon (OS) (*Falco peregrinus*) • Malleefowl (Vu;VU) (*Leipoa ocellata*)

3.1.3 Likelihood of Occurrence of Significant Flora and Fauna

Prior to undertaking the field work for the survey, the significant species identified from the database searches and literature review were assessed for likelihood of occurrence within the Survey Area. This was based on interpretation of habitat types from aerial imagery, known preferred habitat and the nearest known location of each species. Each species of significant flora and vertebrate fauna was assessed and ranked for likelihood of occurrence in the Survey Area according to the criteria presented in **Table 3-4.**

Table 3-4: Criteria for assessing the likely presence of significant flora and fauna.

Likelihood: Confirmed
The species has been recorded unambiguously (i.e. during recent surveys of the Survey Area, from reliable records obtained via database searches or from current vouchered specimen at WA Herbarium) in the survey area.
Likelihood: Likely
There is a medium to high likelihood that the species occurs in the Survey Area as the Survey Area occurs within the known distribution of the species, contains suitable habitat and the species has been recorded recently nearby.
Likelihood: Possible
There is a potential for the species to occur in the Survey Area, as: • The species has not been recorded recently nearby, however; o the species may not have been detectable during current or previous surveys (e.g. rare, patchily distributed, non-optimal survey timing). o the species is known to be cryptic and may not have been detectable despite extensive surveys. • The species has been recorded recently nearby and species presence cannot be ruled out due to factors such as species ecology or distribution, however; o doubt remains over taxonomic identification. o the majority of habitat does not appear suitable. o coordinates are doubtful.
Likelihood: Unlikely
The species is unlikely to occur in the Survey Area as: • the species has not been recorded locally through DBCA database searches; • the Survey Area lacks potential habitat, having at best marginally suitable habitat, and/or being severely degraded; • it is only recorded from a few historic record/s and no other collections in the area; and • the species has not been recorded in the Survey Area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.

Following the field work for the survey, the significant flora and fauna species identified from the database searches, were re-assessed to determine their likelihood of occurrence within the survey area.

3.2 Results

3.2.1 Flora

The results of the desktop assessment identified 41 vascular flora taxa of significance potentially occurring within a 20 km search radius of the Survey Area (DBCA 2020a, e, DoAWE 2020). Eight species are listed as Threatened under the provisions of the EPBC Act and the BC Act, with the remaining 33 listed as priority by the DBCA. Of these, 14 are P1, four are P2, ten are P3 and five are P4.

The pre-survey likelihood of occurrence of these taxa within the Survey Area was assessed, with one significant species (*Calamphoreus inflatus* (P4)) previously recorded within the Survey Area in both 1990 and 1996 (DBCA 2020a, e). Thirteen species were considered 'likely' to occur, with the likelihood of a further 19 species considered 'possible' to occur. Eight species were assessed as 'unlikely' to occur in the Survey Area (**Appendix D**).

3.2.2 Vegetation

No Commonwealth or State-listed TECs are known to occur within or immediately adjacent to the Survey Area (DBCA 2019). The closest mapped TEC to the Survey Area is the *Eucalypt Woodlands of the Western Australian Wheatbelt (Wheatbelt Woodlands)* (CR), which is located approximately 8 km to the west, which is restricted to the Avon Wheatbelt region.

Database search results identified one State-listed PEC, *Parker Range vegetation complexes* P3, that is mapped across the Survey Area (DBCA 2019) (**Figure 5-3**). Vegetation analogous with this PEC has also been identified during previous surveys which intersect the Survey Area (Stantec 2019) or have been conducted in the vicinity of the Survey Area (Botanica 2016a, Gibson and Lyons 1998, Recon Environmental 2008a, b). These significant ecological communities are described in **Table 3-5.**

Table 3-5: Summary of Threatened and Priority Ecological Communities mapped within 20 km of the Survey Area.

Ecological community overview	Proximity to Survey Area
Eucalypt Woodlands of the Western Australian Wheatbelt (Wheatbelt Woodlands) - Critically Endangered TEC (*EPBC Act*)	
Eucalypt-dominated woodlands in the Western Australian Wheatbelt region as defined by the IBRA Avon Wheatbelt 1 and 2 and Western Mallee subregions with the specific exceptions of: woodlands and forests dominated by Jarrah (*E. marginata*) or Marri (*Corymbia calophylla*) where they occur without York Gum present; and non-woodland communities dominated by eucalypts, specifically those dominated by eucalypts with a mallee growth form. Community is defined primarily by its structure as a woodland. The presence in the canopy layer of eucalypt trees - most commonly salmon gum (*Eucalyptus salmonophloia*), York gum (*Eucalyptus loxophleba*), red morrel (*Eucalyptus longicornis*) or gimlet (*Eucalyptus salubris*) defines the Wheatbelt woodlands. Several of the other emergent eucalypt species which may be present as a defining species (e.g. Kondinin blackbutt (*E. kondininensis*), *E. myriadena*, salt river gum (*E. sargentii*), silver mallet (*E. ornata*) and mallet (*E. singularis*) are found only in the Western Australian Wheatbelt.	8 km west of Survey Area

Ecological community overview	Proximity to Survey Area
Parker Range vegetation complexes - Priority 3 (BC Act)	
Defined by six community types: **Community type 1:** occupies sandy soils at the base of ridges and low rises. It is generally dominated by *Eucalyptus sheathiana* with *E. transcontinentalis* and /or *E. eremophila* as co-dominants. Typical understorey species are *Daviesia argillacea, Grevillea huegelii.* **Community type 2:** generally dominated by *Eucalyptus longicornis*. Other eucalypts that occur as co-dominants included *E. corrugata* and *E. salubris* (occasionally dominated by *E. myriadena*). This community occupies the broad flats. **Community type 3:** occurs on the broad flats within the greenstone belt. Usually dominated by *Eucalyptus salmonophloia* and *E. salubris.* Typical understorey species include *Eremophila oppositifolia, Acacia concolorans* ms, *Dodonaea stenozyga* and *Scaevola spinescens.* **Community type 4:** generally dominated by *Allocasuarina acutivalvis* and *Allocasuarina corniculata*. *Eucalyptus capillosa* subsp. *polyclada* also occasionally occurred. Other species typical of this community type include *Baeckea elderiana* and *Thryptomene kochii,* further illustrating the sandy nature of these sites. **Community type 5:** almost totally lacks *Allocasuarina corniculata* (cf type 4), being replaced by *A. campestris,* while *Allocasuarina acutivalvis* is still a common element. *Eucalyptus capillosa* subsp. *polyclada* and /or *Eucalyptus loxophleba* tend to dominate these sites while *Hakea pendens* (P3), *Phebalium tuberculosum,* and *Westringia cephalantha* are common understorey elements. This community type is associated with laterites, breakaways and the massive gossanous caps of the Mt. Caudan area. **Community type 6:** restricted to a small area of a massive decomposing laterite and granite in the Parker Range. The area is dominated by low trees of *Callitris columellaris* and the previously unknown *Isopogon robustus* (T) ms. (Gibson and Lyons 1998).	Intersects the Survey Area

3.2.3 Terrestrial Fauna

The desktop assessment identified a total of 247 species of vertebrate fauna, which have been recorded and/or have the potential to occur within the Survey Area (**Appendix G**). This comprises 21 native mammal, 11 introduced mammal, 154 native bird, two introduced bird, 54 native reptile, and five amphibian species.

Of the 247 species of vertebrate fauna identified, 20 species are listed as being of significance, comprising six mammals, 12 birds, and two reptiles (**Table 3-6**). Of these, 14 are Commonwealth (EPBC Act) listed fauna, 15 are State (BC Act) listed and a further 5 are recognised as priority fauna by DBCA (**Table 3-6**).

Many of these species are unlikely to occur as these records have been collected from a large area encompassing a wide range of habitats, many of which do not occur within the Survey Area. Furthermore, some small, common, ground-dwelling reptile and mammal species tend to be patchily distributed even where appropriate habitats are present, and many species of bird can occur as regular migrants, occasional visitors or vagrants.

Table 3-6: Fauna of significance identified during the desktop assessment.

Species	Common name	State (BC Act)	Commonwealth (EPBC Act)
Aves			
Apus pacificus	Fork-tailed Swift	IA	Mi
Calidris acuminata	Sharp-tailed Sandpiper	IA	Mi
Calidris ferruginea	Curlew Sandpiper	Cr	Cr; Mi
Calidris melanotos	Pectoral Sandpiper	IA	Mi
Falco peregrinus	Peregrine Falcon	OS	
Leipoa ocellata	Malleefowl	Vu	Vu
Motacilla cinerea	Grey Wagtail	IA	Mi
Pezoporus occidentalis	Night Parrot	Cr	En
Platycercus icterotis xanthogenys	Western rosella (inland)	P4	
Thinornis cucullatus	Hooded Plover	P4	
Tringa hypoleucos	Common Sandpiper	IA	Mi
Tringa nebularia	Common Greenshank	IA	Mi
Mammalia			
Dasyurus geoffroii	Chuditch	Vu	Vu
Macrotis lagotis	Bilby	Vu	Vu
Myrmecobius fasciatus	Numbat	En	En
Notamacropus irma	Western Brush Wallaby	P4	
Petrogale lateralis lateralis	Black-footed Rock-wallaby	En	En
Phascogale calura	Red-tailed Phascogale	CD	Vu
Reptilia			
Aspidites ramsayi	Woma (southwest pop)	P1	
Paroplocephalus atriceps	Lake Cronin Snake	P3	

4. Field Survey Methods

4.1 Survey Timing

The EPA (2016a) recommends that flora and vegetation surveys be undertaken following the season of highest rainfall to optimise the likelihood of encountering flowering and fruiting taxa, and capturing ephemeral species. The recommended primary survey timing for the South-Western Interzone Province is during spring (September to November), with supplementary surveys recommended after autumn rains.

The recommended timing for fauna surveys to be undertaken in the South-Western Interzone is between October-December (Primary survey) and February-March (Secondary survey) for reptiles; May-June, July-August and November-December for amphibians; September-December and November-March for birds and September-December for mammals (DotE 2020).

The phase 1 (supplementary) field survey was undertaken between 22 and 24 April 2020, with the phase 2 (primary) survey being conducted from 25 to 26 September 2020. Rainfall received in the three months preceding the phase 1 field survey (116 mm), was 32 mm above the long-term average (83 mm) for that period, despite average annual rainfall being 64 mm below the long-term mean of 304 mm (BoM 2020) (**Figure 4-1**). The above average rainfall was due to a significant rainfall event that occurred in February (BoM 2020).

Prior to the phase 2 field survey, annual rainfall was 269 mm, which was 35 mm below the long-term mean (1996-2020) of 304 mm (BoM 2020) (**Figure 4-1**). Rainfall in the three months prior to the phase 2 field survey (66 mm) was 19 mm below the long-term mean (85 mm) for that period (BoM 2020).

A subsequent targeted priority flora survey was undertaken on the 19th and 20th April of 2021 roughly five weeks after an above average rainfall event in March. Rainfall eight weeks prior to the 2021 targeted survey (102.4 mm) was 44.2 mm higher than the long-term average of the same period (58.1 mm).

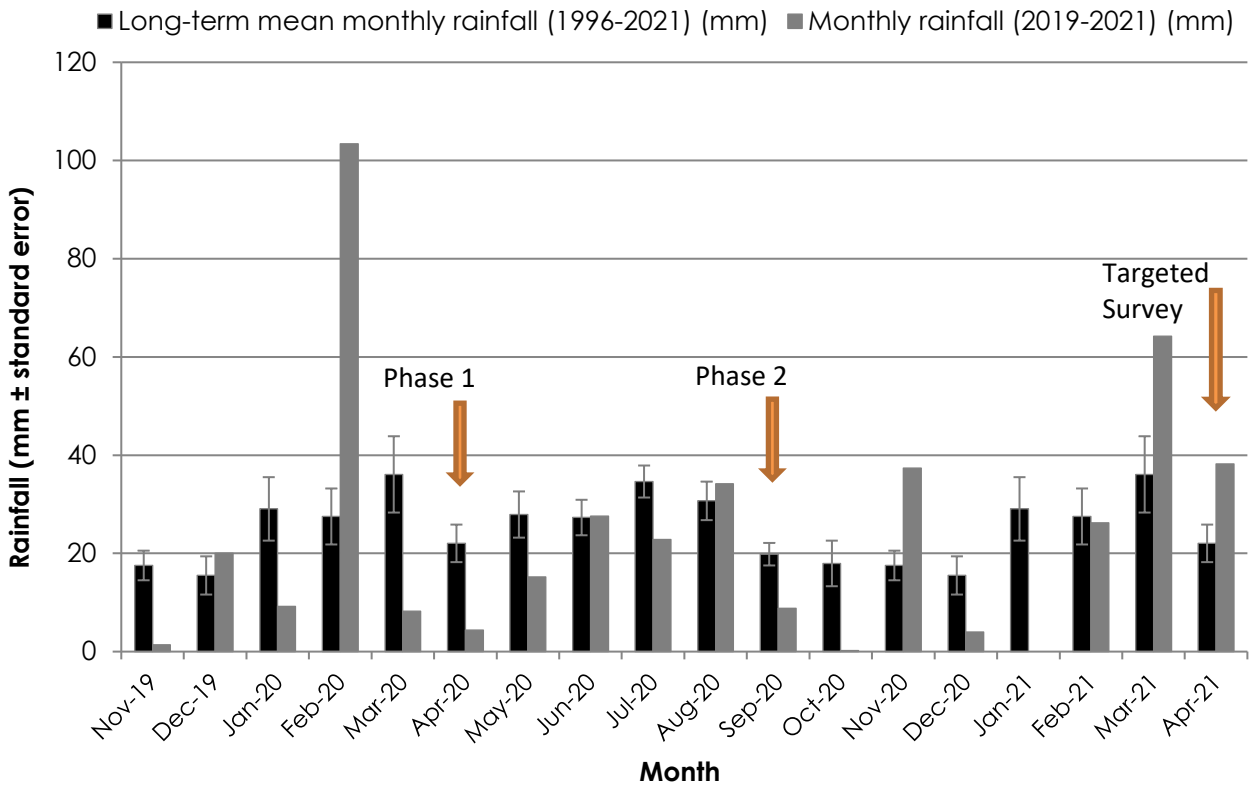

Figure 4-1: Long-term (1996 to 2021) mean monthly rainfall (mm) at Southern Cross Airfield weather station and actual monthly rainfall (mm) in the 17 months preceding the field surveys (BoM 2020).

4.2 Survey Team and Licensing

The phase 1 survey was undertaken by Jeni Alford (senior botanist/ecologist) and Scott Pansini (botanist) and the phase 2 survey by Scott Pansini and Julijanna Hantzis (botanist) (**Table 4-1**). The targeted flora survey was undertaken by Scott Pansini and Gearoid Fitzmaurice. All staff have technical knowledge and experience within the Coolgardie Bioregion.

Table 4-1: Survey team and licencing.

Personnel	Survey	Survey Role	Years of Experience	Flora Licence(s)
Scott Pansini	Phase 1 , Phase 2 & Targeted survey	Survey botanist/ ecologist	3	FB62000122 (Flora taking) TFL 22-1920 (DRF)
Jeni Alford	Phase 1	Senior botanist/ecologist	25+	FB62000154 (flora taking)
Julijanna Hantzis	Phase 2	Survey botanist/ecologist	3	FB62000132 TFL 21-1920
Gearoid Fitzmaurice	Targeted survey	Survey botanist/ecologists	3	FB62000320 TFL 159-2021

4.3 Flora and Vegetation Survey

4.3.1 Flora and Vegetation Assessment

Prior to the phase 1 field survey, broad vegetation units were identified using aerial imagery and proposed quadrat locations selected. A total of 12 quadrats, one relevé and eight mapping notes were sampled within the Survey Area. Three quadrats (QLOM51, QLOM52 and QLOM53) installed during the phase 2 field survey had a single season of survey only; the remaining nine quadrats were sampled during both phases of field survey (**Table 4-2**).

Table 4-2: Quadrats sampling effort within the Survey Area.

Quadrat	Phase 1	Phase 2
Lom8	✓	✓
Lom12	✓	✓
Lom19	✓	✓
Lom20	✓	✓
Lom21	✓	✓
Lom24	✓	✓
Lom25	✓	✓
Lom26	✓	✓
Lom42	✓	✓
QLOM51		✓
QLOM52		✓
QLOM53		✓

Quadrats comprised a square of 20 m x 20 m, which was permanently marked with a galvanised steel fence dropper in the north-western corner. The information collected from each quadrat and relevé is provided in **Table 4-3**. This data was used to characterise the vegetation types present and compile a representative species list. Mapping notes were also used to mark changes in vegetation throughout the Survey Area. The details collected at mapping note locations included co-ordinate, photograph and vegetation description.

Table 4-3: Summary of data recorded at each quadrat during the field surveys.

Parameter	Description
Quadrat ID	The unique name that was assigned to the site that was sampled
Recorder and Date	The recorder(s) involved in sampling the quadrat and date

Parameter	Description
Site dimensions	Measured using handheld GPS device and 100 m measuring tapes
Coordinates	Measured using a handheld GPS device (in GDA94 format) from the north-west corner
Site photograph	At least one representative photograph taken of the site
Soil description	A description of the soil colour and types based on the guide in the Australian Soil and Land Survey Field Handbook (McDonald *et al.* 1998)
Geology type	A description of the outcropping geology (if present) and coarse fragments
Habitat type	A description of the landform type and aspect
Vegetation Condition	Assessed according to the vegetation condition scale described by Keighery (1994), as presented in EPA Technical Guidance (EPA 2016a) (**Appendix B**)
Vascular flora species	A record of each flora species present
Height	The average height of each species in metres
Percent Foliar Cover (PFC)	An estimate of the PFC for each species will be recorded
Vegetation structure	A description of the vegetation in accordance with the National Vegetation Information System (NVIS), Level 5 – Association (ESCAVI 2003) based on height and foliar cover of strata (**Appendix C**)
Disturbances	A list of any disturbances in the quadrat if present
Time since fire	An estimation of the time since the vegetation was last burnt

4.3.2 Vegetation Type and Condition Mapping

The broad vegetation type mapping that was completed during the desktop assessment was refined on maps during the field survey, as required. Vegetation types were delineated and described using the quadrat/relevé and mapping note data. The vegetation types have been described in accordance with Level V (Vegetation Association) in the NVIS hierarchical structure (ESCAVI 2003) (**Appendix C**).

Vegetation condition was mapped according to vegetation association boundaries throughout the Survey Area, using a combination quadrat data and opportunistic observations. Vegetation condition was assigned at each survey site based on the six categories described by Keighery (1994) (**Appendix B**).

4.3.3 Targeted Flora Survey

Previous significant flora records (DBCA 2020a, e) and associated species habitat preferences were reviewed to assist in identifying vegetation associations and habitat within the Survey Area that have the potential to support threatened and priority flora. These areas were then targeted in the field, as a priority, to search for the presence of significant flora. Search effort, in the form of GPS tracklogs are presented in **Figure 4-2**.

A subsequent targeted flora survey was conducted in an indicative clearing footprint within the Windmills Survey Area in April 2021. The clearing footprint was systematically traversed on foot by Stantec botanists. Traverses were spaced at 40 metre intervals to ensure comprehensive coverage of the Survey Area **Figure 4-2**.

4.3.4 Opportunistic Records

Opportunistic flora records of additional species beyond those recorded within quadrats were taken to maximise the floristic inventory of the Survey Area. Each opportunistic collection was recorded electronically and geospatially referenced. All data was entered into a customised database enabling quality management and review.

4.4 Fauna Survey

4.4.1 Terrestrial Fauna Habitat Assessment

Major fauna habitat types were described and delineated based on landforms and vegetation types. Fauna habitat assessments were undertaken at each quadrat/relevé location, with the key habitat parameters recorded at each presented in **Table 4-4**.

Table 4-4: Summary of data collected at each fauna habitat assessment site.

Parameter	Description
Habitat assessment ID	The unique name that was assigned to the site that was sampled
Recorder and Date	The recorder(s) involved in sampling the site and date
Coordinates	Measured using a handheld GPS device (in GDA94 format)
Site photograph	At least one representative photograph taken of the site
Tree presence	A comment on any hollow-bearing trees and stag (dead) trees (average size and abundance)
Refuges	A comment on the presence of any fauna refuges e.g. burrows
Substrate	A description of the composition of the substrate and percentage of leaf litter

In addition, the habitat was assessed on extent and level of significance according to the following criteria:

- Distribution: whether the habitat is widespread and common within the surrounding region; or whether the habitat was categorised as being of limited extent; and
- Significance: whether the habitat is considered important to species of conservation significance or distinct fauna assemblages that are deemed significant; or whether the habitat was categorised as being of limited significance.

4.4.2 Opportunistic Records

The Survey Area was traversed on foot, and opportunistic records were made to document fauna assemblages and species of significance within the Survey Area. Any evidence of species encountered, including secondary signs such as the presence of tracks, diggings, scats, burrows and nests were recorded using the Survey123 in-field (electronic) data collection application.

4.5 Taxonomy and Nomenclature

Flora taxa collected in the field were taken to the WA Herbarium for identification by senior taxonomists, Frank Obbens and Sharnya Thomson. Both taxonomists have worked extensively in Western Australia and are familiar with the flora of the region. Species nomenclature was assigned according to the current listing of scientific names recognised by the WAH. Where specimens were lacking in diagnostic characteristics or were in poor condition, they were assigned the 'sp.' epithet, indicating that identification could not be confirmed beyond family or genus level.

Introduced flora species were compared to the list of declared pests listed under section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and the Weeds of National Significance list (WoNS) maintained by the Commonwealth Government. Nomenclature for fauna presented within this report follows the Western Australian Museum (WAM) checklist for terrestrial vertebrate fauna species(WAM 2020).

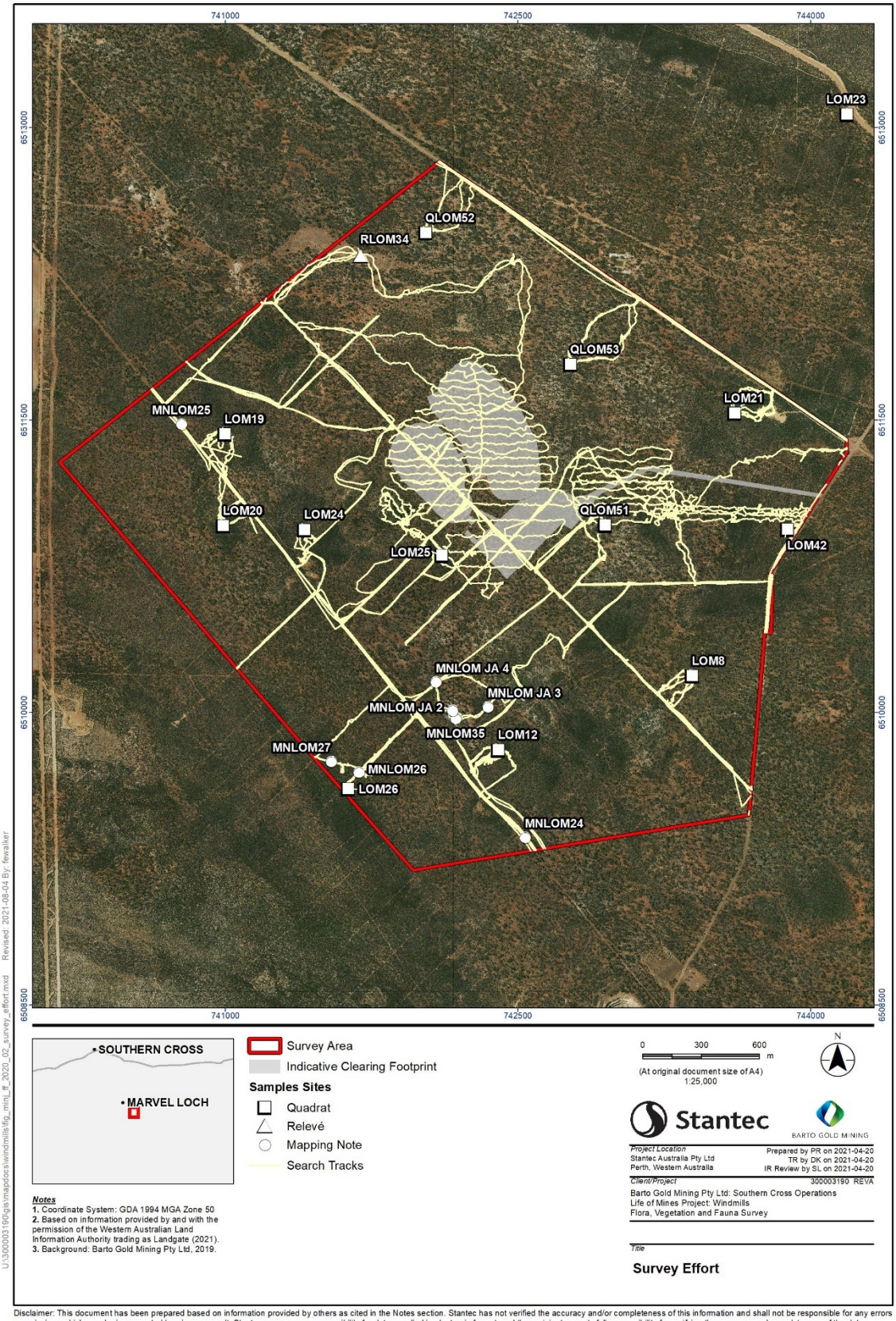

Figure 4-2: Survey effort.

5. Results and Discussion

5.1 Flora

5.1.1 Floristic Composition

A total of 115 vascular flora taxa, representing 31 families and 65 genera, were recorded during the field surveys (**Appendix F**). Of these, 17specimens were unable to be confidently identified beyond family or genus level due to a lack of diagnostic characteristics and are likely to represent additional species; these additional species are unlikely to represent significant flora. The dominant plant family was Myrtaceae, with 28 confirmed species, while *Acacia* was the most frequently recorded genus (**Table 5-1**). Floristic diversity and composition were considered typical of the COO2 subregion (Cowan *et al.* 2001) and also showed similarities to the nearby Avon Wheatbelt 1 (AW1) subregion, with the presence of mixed eucalypts and *Eucalyptus loxophleba* subsp. *lissophloia* woodland. Diversity was largely consistent with previous surveys undertaken within and in close proximity to the Survey Area (Botanica 2016a, GHD 2016, Gibson and Lyons 1998, MWH 2014, Recon Environmental 2008a, b, Spectrum Ecology 2020, Stantec 2019).

Table 5-1: Most represented vascular plant families and genera for the Survey Area.

Family	Number of taxa
Myrtaceae	28
Fabaceae	17
Chenopodiaceae	7
Poaceae	6
Genus	**Number of taxa**
Acacia	13
Eucalyptus	12
Melaleuca	7
Allocasuarina	5

5.1.2 Flora of Significance

No Commonwealth or State-listed threatened flora were recorded within the Survey Area. Three State-listed priority flora species, *Rinzia fimbriolata* (P1) *Hakea pendens* (P3) and *Stenanthemum bremerense* (P4), were recorded during the surveys (**Table 5-2** and **Figure 5-1**). These three species have been recorded within five kilometres of the Survey Area, either from DBCA databases or previous surveys (DBCA 2020a, e, Recon Environmental 2008b, Stantec 2019).

Rinzia fimbriolata (P1) was recorded at 23 locations within the Survey Area, with an estimated total of 431 individuals. This species usually favours open mallee *Eucalypt* woodland with an understorey dominated by Melaleuca and Acacia shrubs in brownish sandy loam soil. Three records of *Rinzia fimbriolata* (P1) are held by the Western Australian Herbarium, with records identified up to 50 km north-west of the Survey Area (WAH 2021). 2291 individuals of *Rinzia fimbriolata* have been recorded regionally by Stantec (**Figure 5-2**). This species is not considered restricted to this Survey Area(Stantec 2020a, 2021a, 2019).

Hakea pendens (P3) is restricted to the Parker Range System (which consists of Parker Range, Toomey Hill and Harris Find) (Beard 1972, 1976), in ironstone or in stony ridges in stony loam of mixed scrub (Barker 1990). Within the Survey Area, this species was recorded within tall open scrub dominated by *Allocasuarina campestris.* It was recorded from 49 locations, with 247 individuals estimated in total (**Table 5-2**). According to the WAH, only 23 records of *Hakea pendens* (P3) are currently listed (WAH 2021). The restriction of *Hakea pendens* (P3) to the Parker Range System is of regional and local significance. Stantec botanists have recorded 212 other *Hakea pendens* individuals regionally and do not consider the species restricted to the Survey Area (**Figure 5-2**).

Stenanthemum bremerense (P4) was recorded at 13 locations within the Survey Area, with an estimated total of 135 individuals (**Table 5-2**). Currently there are 33 records of *Stenanthemum bremerense* (P4) held by the Western Australian Herbarium, with records identified up to 160 km south-east of the Survey Area (WAH 2021). 991Individuals of this species have been recorded by Stantec outside the Survey Area(Stantec 2020a, 2021a, 2019)(**Figure 5-2**). As such, this species is not restricted to the Survey Area.

Database search results (DBCA 2020a, e) indicate that *Calamphoreus inflatus* (P4) has been previously recorded at three locations within the Survey Area, with at least 13 individuals noted (**Table 5-2** and **Figure**

5-1). During the Surveys, searches for this species were conducted within the locality of the provided waypoint locations, however the species was not detected. Given that the known flowering time for this species is October to December and February to March, it is possible that it was not flowering at the time of surveys and was therefore not easily detectable. According to the WAH, there are 32 records of this species currently listed and it is not considered to be restricted to the Survey Area (WAH 2021).

Table 5-2: Priority flora species recorded in the Survey Area.

Species	Number of occurrences (estimated abundance)	Life stage (average)	Reproductive stage (average)	Health (range)	Regional individuals recorded
Rinzia fimbriolata (P1)	23(431)	Mature	Vegetive	Healthy	2725
Hakea pendens (P3)	49 (247)	Mature	Dehisced fruit	Healthy	1300
Stenanthemum bremerense (P4)	13(135)	Mature	Vegetive	Healthy	1376
Calamphoreus inflatus (P4)^	2 (13)	Mature	Flowering and vegetative	Unknown	5454

^Specimen record details represent those provided with the DBCA database search results (DBCA 2020a, e).

Table 5-3 Photos of priority flora species present within Survey Area

Rinzia fimbriolata (P1)	
	

Hakea pendens (P3)

Stenanthemum bremerense (P4)

Calamphoreus inflatus (P4)	
	

The EPA advises that flora species, subspecies, varieties, hybrids and ecotypes may be considered significant for reasons other than listing as a threatened or priority flora taxa, and may include the following:

- a keystone role in a particular habitat for Threatened taxa, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status;
- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution; and/or
- being poorly reserved.

Based on these parameters, none of the native vascular flora taxa recorded from the Survey Area are of 'other' significance. The native vascular flora taxa recorded from the Survey Area are all represented in the local and broader Coolgardie region.

5.1.2.1 Post-Survey Likelihood of Occurrence

The pre- and post-survey likelihood of occurrence assessments are presented in **Appendix D.** Post-survey assessment was based on a greater understanding of the habitats and following targeted searches of the Survey Area. A total of three priority flora species have been recorded within the Survey Area, either during this Survey or during previous surveys. In addition, three priority flora species were considered 'possible' to occur, with the remaining 35 species considered 'unlikely' (**Appendix D**). Species that were assessed as having the possibility to occur post-survey include *Goodenia heatheriana* (P1), *Acacia concolorans* (P2) and *Notisia intonsa* (P3). If present, these species may have gone unnoticed due a likely absence of flowers at the time of the surveys, a small growth habit or a combination of both. It is considered unlikely that, if present within the Survey Area, these species would be restricted to the Survey Area (WAH 2020).

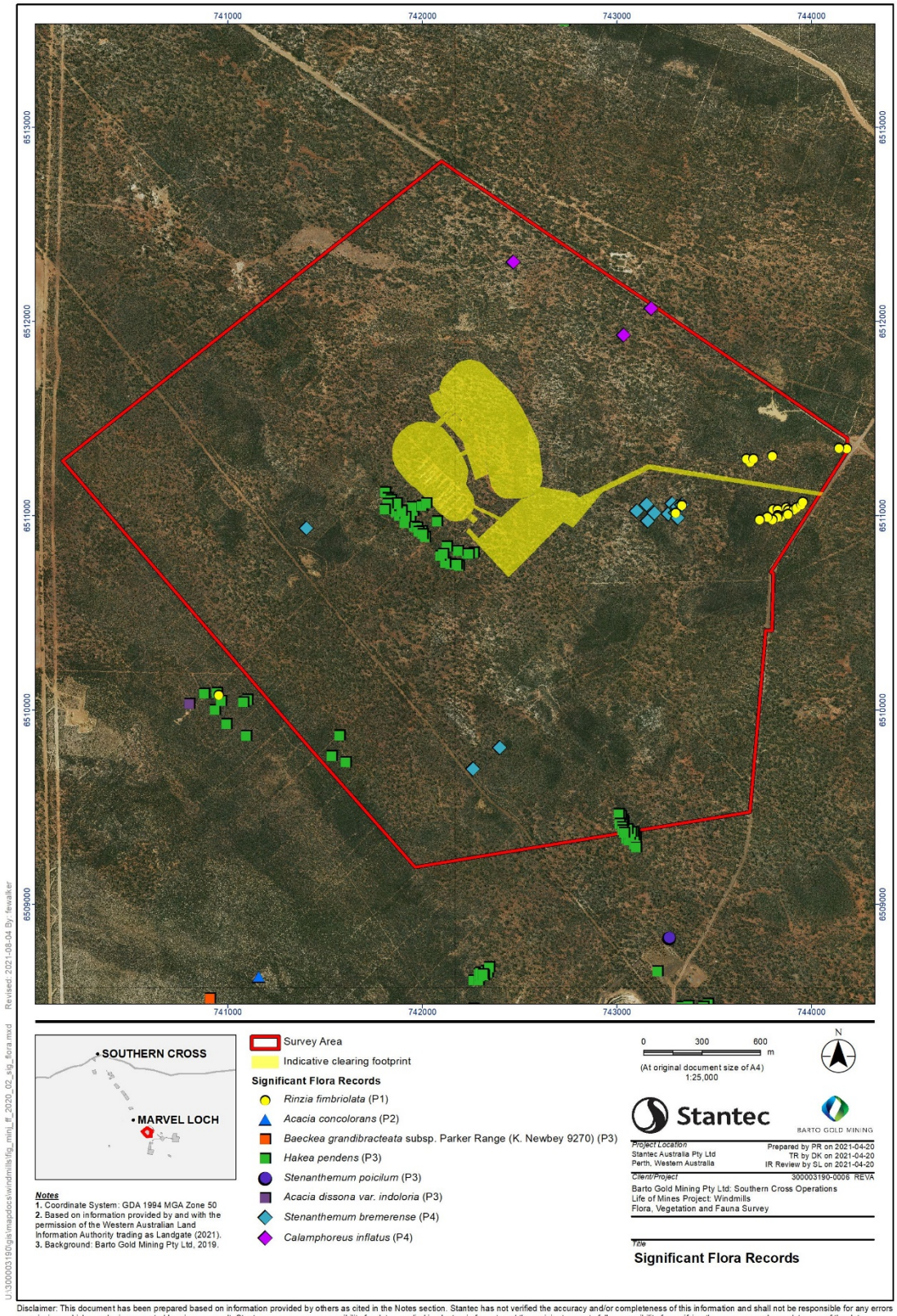

Figure 5-1: Location of priority flora recorded in the Survey Area.

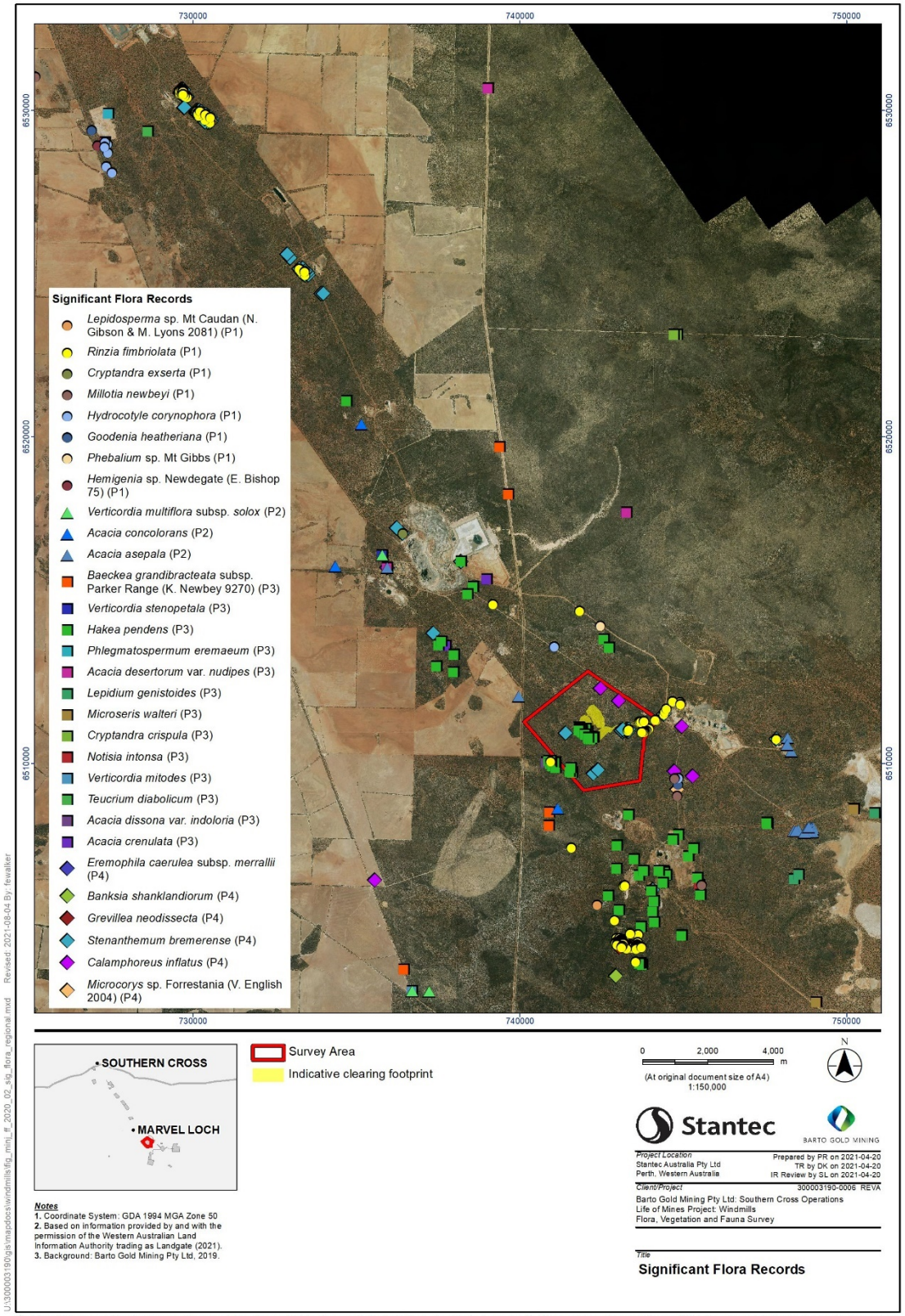

Figure 5-2 Regional locations of priority flora

5.1.3 Introduced Flora

Seven introduced flora (weed) species were recorded within the Survey Area (**Table 5-3** and **Plate 5-1**). None of these species represents a declared pest under Section 22 of *the Biosecurity and Agriculture Management Act 2007* (BAM Act) or are listed as a Weed of National Significance (WoNS) (Commonwealth of Australia 2020b). Cover and abundance for each of the introduced species was low and generally recorded in small patches within previously disturbed areas.

Table 5-4: Introduced flora taxa identified in the Survey Area.

Taxon	Common name
**Erodium cicutarium*	Common Storksbill
**Lysimachia arvensis*	Pimpernel
**Medicago minima*	Small Burr Medic
**Pentameris airoides*	False Hairgrass
**Pentameris airoides* subsp. *airoides*	-
**Rostraria pumila*	-
**Sonchus* sp. indet.	Sowthistle

Plate 5-1: 1). **Erodium cicutarium*, 2). **Lysimachia arvensis*, 3). **Medicago minima*, 4). **Pentameris airoides*, 5). **Pentameris airoides* subsp. *airoides* and 6). **Rostraria pumila*.

Photographs by Scott Pansini and Julijanna Hantzis.

5.2 Vegetation

There were six vegetation types described and delineated for the Survey Area (**Table 5-4**). Vegetation type mapping is presented in **Figure 5-2**, while the data collected from each quadrat/relevé is provided in **Appendix E.**

The vegetation in the Survey Area is broadly represented by mid height to tall *Eucalyptus* Woodlands, *Acacia* and *Melaleuca* shrublands and a low Chenopod shrubland. *Eucalyptus* woodlands comprised the majority of the Survey Area (approximately 823 ha or 94%) and consisted of three vegetation types: EllMhBe, EcAcGooHeEm and EsEsuElMpEaSaHe (**Table 5-4**). The pattern of vegetation within the Survey Area is considered typical of the South-Western Interzone (Gibson and Lyons 1998, 2001, Recon Environmental 2008a, b).

Table 5-5: Summary of vegetation types recorded within the Survey Area.

Vegetation type code	Vegetation type description	Sample sites	Extent within Survey Area		Representative photograph
			Hectares (ha)	Proportion (%)	
EllMhBe	*Eucalyptus loxophleba* subsp. *lissophloia* low open woodland over *Melaleuca hamata* tall shrubland over *Baeckea elderiana* shrubland to low open shrubland. Associated species: *Acacia yorkrakinensis* subsp. *acrita, Allocasuarina campestris, Alyxia buxifolia, Euryomyrtus maidenii, Grevillea obliquistigma* subsp. *obliquistigma, Grevillea paradoxa, Hakea francisiana, Leucopogon* sp. outer wheatbelt (M. Hislop 30), *Melaleuca cordata, Melaleuca eleuterostachya, Melaleuca lateriflora, Santalum acuminatum* and *Thryptomene kochii.*	LoM21 LoM42	67.43	7.71	
EcAcGooHeEm	*Eucalyptus capillosa* low open woodland over *Allocasuarina campestris* tall shrubland over *Grevillea obliquistigma* subsp. *obliquistigma* scattered shrubs over *Hibbertia eatoniae*, *Euryomyrtus maidenii* low shrubland. Associated species: *Acacia colletioides, Allocasuarina acutivalvis* subsp. *acutivalvis, Alyxia buxifolia, Cassytha nodiflora, Dodonaea microzyga* var. *acrolobata, Grevillea paradoxa, Dianella revoluta* var. *divaricata, Hakea francisiana, Hakea subsulcata, Melaleuca hamata, Prostanthera semiteres* subsp. *semiteres, Calothamnus gilesii, Phebalium tuberculosum, Styphelia serratifolia.*	LoM12 LoM24 LoM25 LoM26 mnLoM26 mnLoM27 mnLoMJA3	106.79	12.20	

Vegetation type code	Vegetation type description	Sample sites	Extent within Survey Area		Representative photograph
			Hectares (ha)	Proportion (%)	
E?rAaaAbMhTkBeLfEm	*Eucalyptus ?rigidula* scattered low trees over *Acacia assimilis* subsp. *assimilis, Acacia beauverdiana, Melaleuca hamata* tall shrubland over *Thryptomene kochii, Baeckea elderiana, Leptospermum fastigiatum* shrubland over *Euryomyrtus maidenii* low open shrubland . <u>Associated species:</u> *Allocasuarina ?spinosissima, Cassytha nodiflora, Drosera macrantha, Grevillea obliquistigma* subsp. *obliquistigma, Hibbertia eatoniae, Leucopogon* sp. outer wheatbelt (M. Hislop 30), *Lepidosperma* sp., *Prostanthera semiteres subsp. Semiteres, Santalum acuminatum, Trachymene ornata, Thysanotus manglesianus* and *Waitzia acuminata.*	LoM19	31.46	3.60	
EhAbMhTkLfEm	*Eucalyptus horistes* scattered low trees over *Acacia beauverdiana, Melaleuca hamata* tall open scrub over *Thryptomene kochii, Leptospermum fastigiatum* shrubland over *Euryomyrtus maidenii* low open shrubland. <u>Associated species:</u> *Drosera macrantha, Lawrencella rosea, Prostanthera semiteres* subsp. *semiteres, Trachymene ornata.*	LoM20	6.02	0.69	

Vegetation type code	Vegetation type description	Sample sites	Extent within Survey Area		Representative photograph
			Hectares (ha)	Proportion (%)	
AvTptptTpepeEt	*Atriplex vesicaria, Tecticornia pterygosperma* subsp. *pterygosperma, T. pergranulata* subsp. *pergranulata* and *Enchylaena tomentosa* low open shrubland. <u>Associated species:</u> *Atriplex nummularia* subsp. *spathulata, ?Eriochiton sclerolaenoides*	rLoM34	4.27	0.49	
EsEsuElMpEaSaHe	*Eucalyptus salmonophloia, E. salubris* and *E. longicornis* woodland over *Melaleuca pauperiflora, Exocarpos aphyllus* and *Santalum acuminatum* tall shrubland over *Hibbertia eatoniae* low open shrubland. <u>Associated species:</u> *Acacia merrallii, Alyxia buxifolia, Austrostipa elegantissima, Dodonaea stenozyga, Eremophila ionantha, Olearia muelleri, Scaevola spinescens, Templetonia ceracea, Eriochiton sclerolaenoides.*	LoM8 QLoM51 QLoM52 QLoM53 mnLoM24 mnLoM25 mnLoM35 mnLoMJA2 mnLoMJA4	649.10	74.20	
Cleared	Disturbed unvegetated areas	-	9.68	1.11	-
Total			**874.75**	**100**	

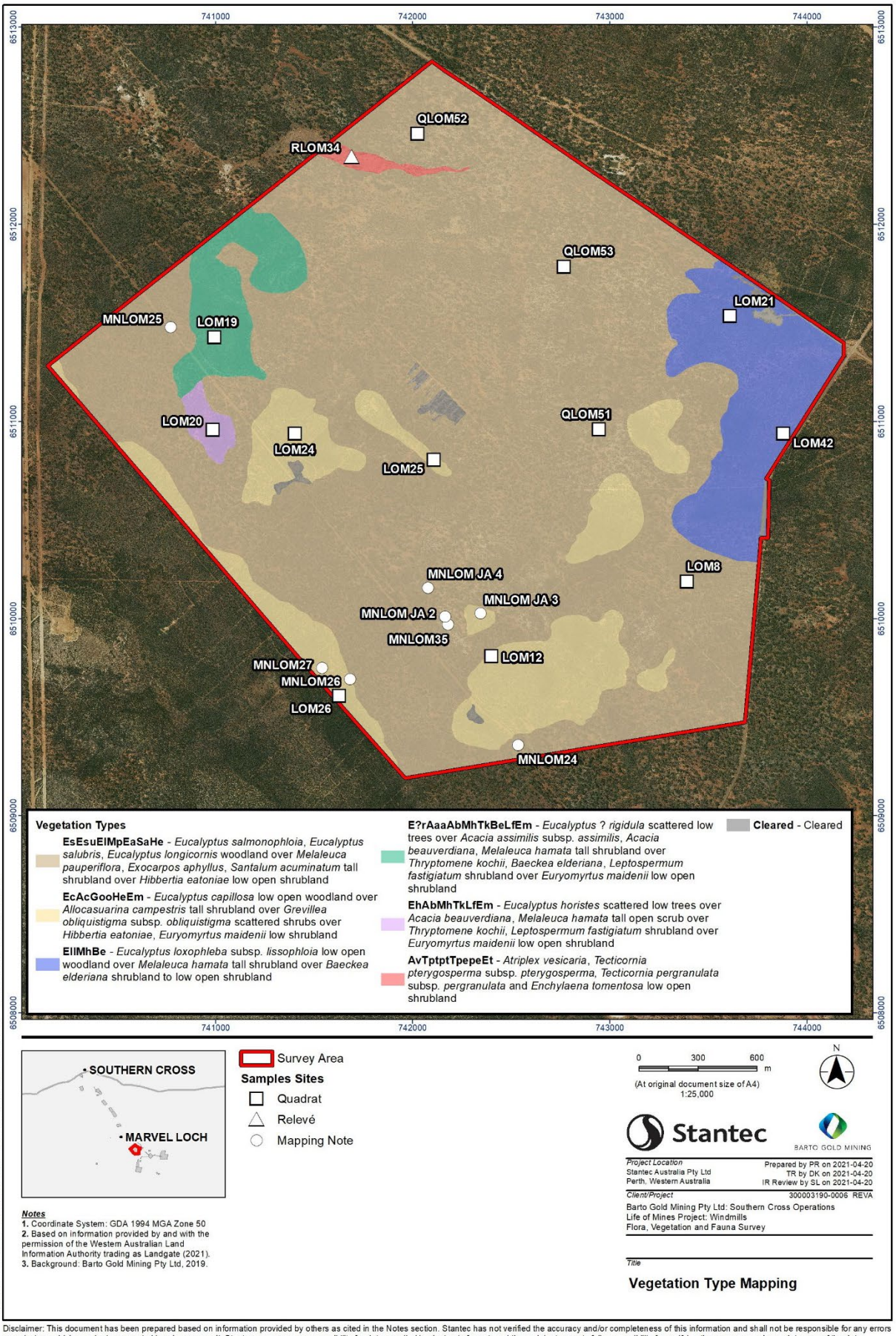

Figure 5-3: Vegetation type mapping for the Survey Area.

5.2.1 Vegetation of Significance

Based on the desktop assessment, one P3 PEC, the *Parker Range vegetation complexes*, had a buffer that was mapped across the Survey Area (DBCA 2020a) (**Section 3.2.2**). Vegetation defined within the Survey Area was assessed against the descriptions of the vegetation communities that comprise the PEC, as detailed in Gibson and Lyons (1998).

Within the Survey Area, vegetation unit EsEsuElMpEaSaHe was considered to be analogous with Community 3 of the PEC (**Table 5-5** and **Figure 5-3**). This vegetation type covered an area of 649.10 ha, representing almost 75% of the Survey Area. It predominantly occurred on the broad flats and was dominated by *Eucalyptus salmonophloia* and *E. salubris.* Previous surveys undertaken within (Stantec 2019), immediately adjacent (Recon Environmental 2008a) and within 10 km of the Survey Area ((Botanica 2016a, Gibson and Lyons 1998, Recon Environmental 2008b) have also identified the presence of this PEC.

Table 5-6: Vegetation types representing the *Parker Range vegetation complexes* PEC within the Survey Area.

Vegetation type description	Parker Range vegetation community type	Extent within Survey Area	
		Hectares (ha)	Proportion (%)
Eucalyptus salmonophloia, Eucalyptus salubris, Eucalyptus longicornis woodland over *Melaleuca pauperiflora, Exocarpos aphyllus, Santalum acuminatum* tall shrubland over *Hibbertia eatoniae* low open shrubland	**Community Type 3:** occurs on the broad flats within the greenstone belt. Usually dominated by *Eucalyptus salmonophloia* and *E. salubris.* Typical understorey species include *Eremophila oppositifolia, Acacia concolorans* ms, *Dodonaea stenozyga* and *Scaevola spinescens*	649.10	74.20

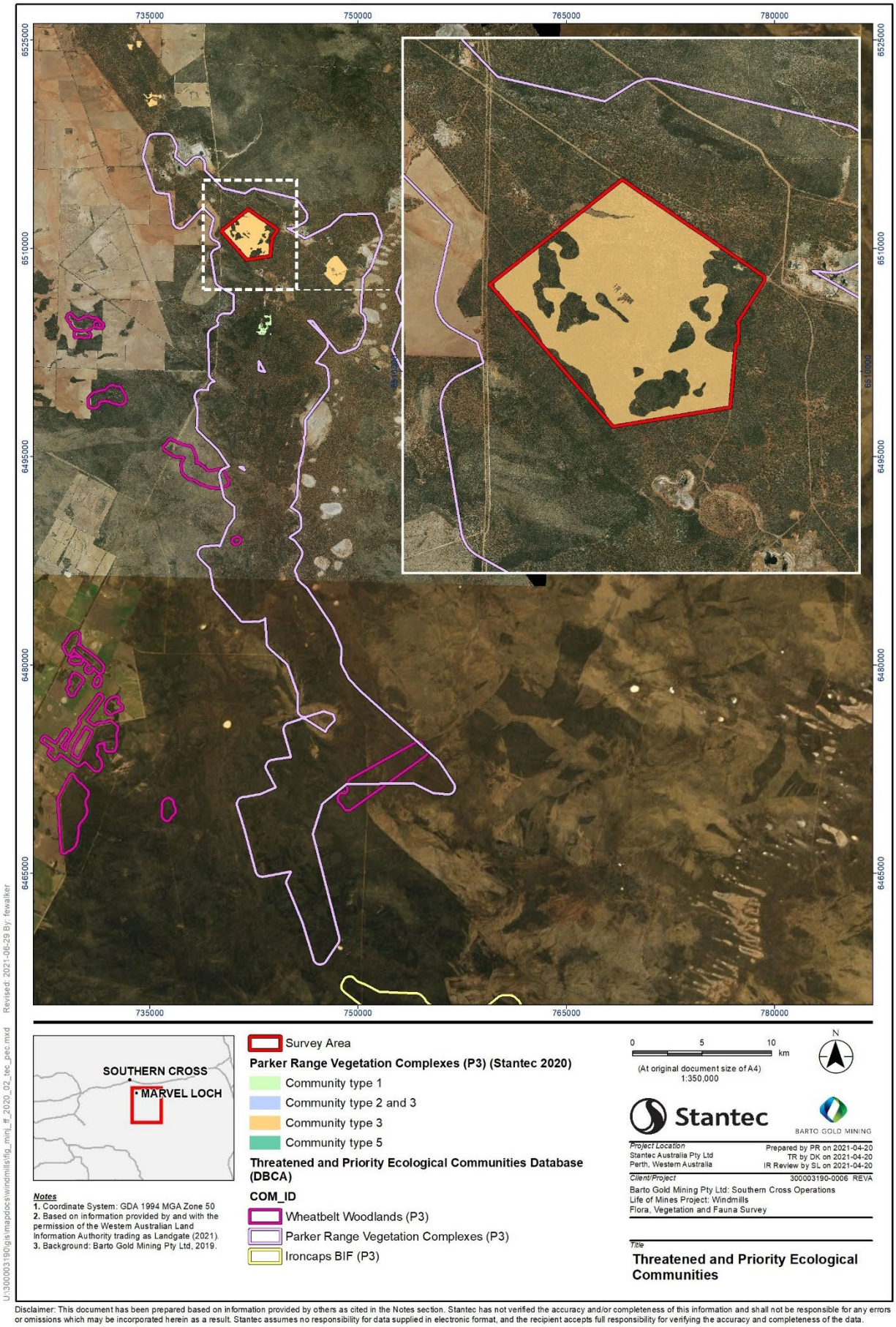

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Figure 5-4: Significant ecological communities mapped within the Survey Area.

5.2.2 Vegetation Condition

Vegetation condition within the Survey Area ranged from 'Excellent' to 'Completely Degraded', with the majority in 'Excellent' condition (approximately 96%) (**Table 5-6**; **Figure 5-4**). These areas represented intact vegetation with minimal disturbance. Approximately 28 ha (3.22%) of the Survey Area was mapped as 'Completely Degraded' through to 'Good', due to the varying presence of weed species, and the presence and condition of access tracks and exploration drill lines.

Weed diversity and density within the Survey Area was considered low, with only seven weeds recorded, all of which were noted as having less than one percent cover. Weed species were recorded in areas which had been previously disturbed.

Table 5-7: Vegetation condition recorded in the Survey Area.

Vegetation condition	Extent within Survey Area	
	Hectares (ha)	Proportion (%)
Excellent	836.04	95.57
Very Good	10.61	1.21
Good	18.39	2.11
Degraded	3.90	0.45
Completely Degraded	5.81	0.66
Total	**874.75**	**100**

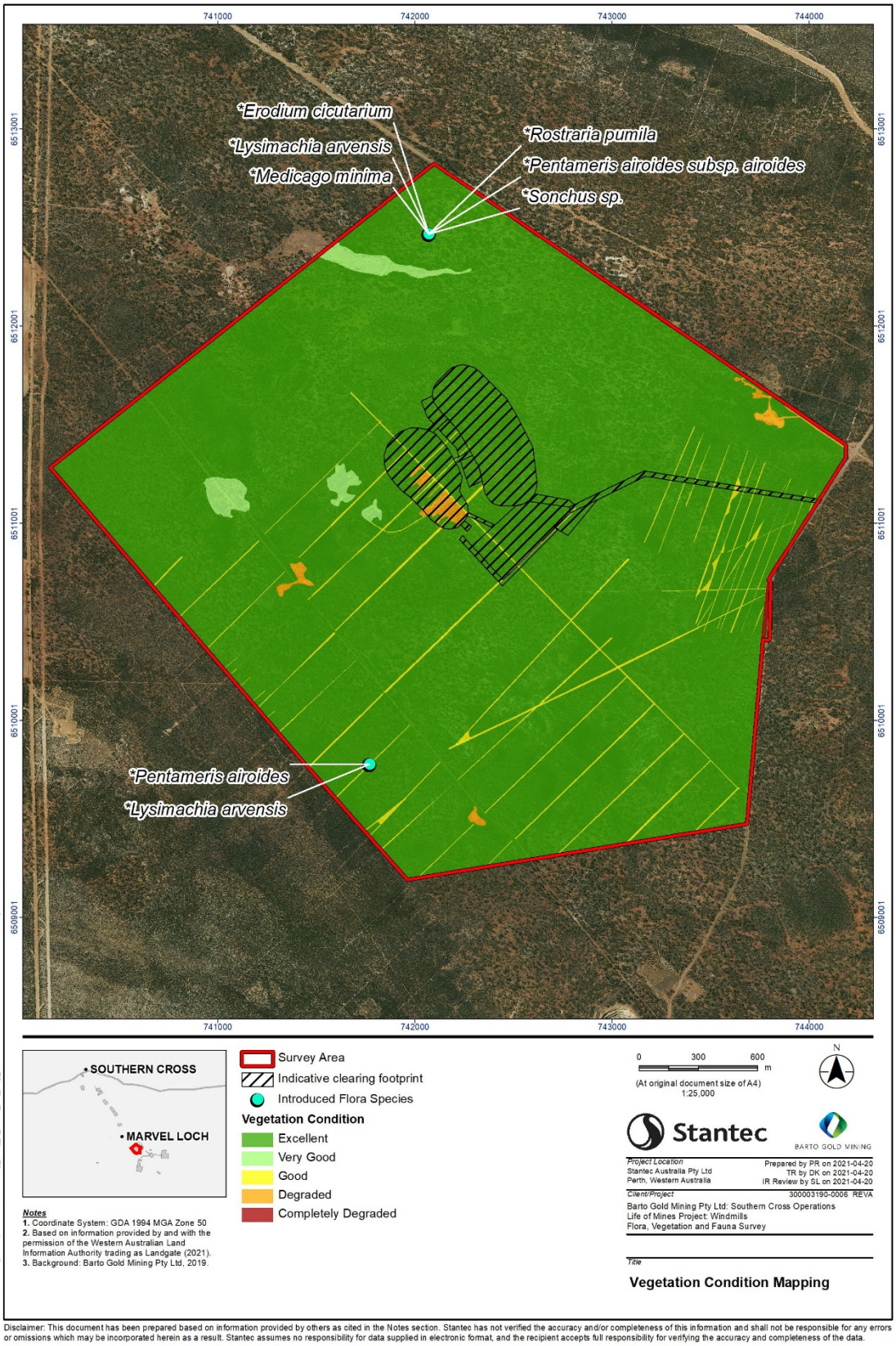

Figure 5-5: Vegetation condition mapping of the Survey Area.

5.3 Fauna

5.3.1 Fauna Habitats

Four broad fauna habitats were described and delineated from fauna habitat assessments across the Survey Area. These comprised:

- *Eucalyptus* Woodland;
- Saline Depressions and Claypans;
- Shrubland; and
- Shrubland Stony Rise.

A description of each of these fauna habitats and the characterisation of each, in terms of distribution and significance, is provided in **Table 5-7**. Fauna habitat mapping is presented in **Figure 5-5**.

Within the Survey Area, all fauna habitats were identified as important for species of significance (**Table 5-7**). The *Eucalyptus* Woodland habitat was the most extensive, encompassing approximately 75% (649.11 ha) of the Survey Area **Table 5-7**. The large hollow bearing trees within this habitat provide important habitat for the Western Rosella (*Platycercus icterotis xanthogenys*) (inland pop.) (P4) and the Peregrine Falcon (*Falco peregrinus*) (OS). Large woody debris and logs may provide denning habitat for the Chuditch (Dasyurus geoffroii). Additionally, the thick vegetation at some sites may also serve as suitable foraging habitat for the Western Rosella. Unvegetated (cleared) areas, which did not represent habitat of significance, accounted for 9.72 ha of the Survey Area **Table 5-7**.

Table 5-8: Fauna habitats recorded within the Survey Area.

Habitat and category	Extent within Survey Area		Associated vegetation codes	Broad description and value to fauna	Reference photographs
	Area (ha)	Proportion (%)			
Eucalyptus Woodland • Widespread • Significant	649.11	74.21	EsEsuElMpEaSaHe	Gently undulating terrain, dominated by a woodland of *Eucalyptus salmonophloia* and *E. salubris* over *Melaleuca pauperiflora*. A mix of myrtaceous shrubs comprised the understory species. The habitat ranged from relatively open areas dominated by mature tall Eucalypts to densely vegetated areas with immature Eucalypts, regenerating after fire. Mallee forms of the Eucalypts also occurred within the Eucalypt Woodland habitat. This habitat supports high levels of leaf litter and large woody debris, forming shelter for a range of fauna including the Chuditch. Additionally, mature Eucalypt trees may contain hollows and provide suitable nesting and/or roosting habitat for a range of avifauna, including the Peregrine Falcon (OS) (however the species preferentially nests in cliff faces (Menkhorst *et al.* 2017)), as well as denning for Chuditch. Areas of mature Eucalypt woodland with thick vegetation may serve as suitable foraging and nesting habitat for the Western Rosella which was recorded within this habitat (Stantec 2019). This habitat may also support Malleefowl mound building and the Western Brush Wallaby.	
Saline Depressions and Claypans • Limited extent • Significant	4.27	0.49	AvTptptTpepeEt	This habitat is characterised by a saline depression in the Survey Area. The habitat occurs low in the landscape where it may be inundated with water after heavy rainfall and is dominated by *Atriplex vesicaria, Tecticornia* spp., and *Enchylaena tomentosa*. This habitat may be suitable for migratory bird species' when inundated with water.	

Habitat and category	Extent within Survey Area		Associated vegetation codes	Broad description and value to fauna	Reference photographs
	Area (ha)	Proportion (%)			
Shrubland • Widespread • Significant	146.50	16.75	E?rAaaAbMhTkBeLfEm EllMhBe EhAbMhTkLfEm	Plains on sandy or loamy substrates supporting a minimal upper storey of *Eucalyptus ?rigidula, E. loxophleba* subsp. *lissophloia* and *E. horistes* mallee over dense mid to low heath shrubs dominated by taxa such as *Acacia* beauverdiana, *Melaleuca hamata, Leptospermum fastigiatum* and *Euryomyrtus maidenii*. Leaf litter providing shelter to small ground-dwelling fauna was moderate and generally associated with the presence of mallee. This habitat lacked large trees with the potential to form hollows or substantial woody debris. The habitat was considered significant for the Malleefowl (*Leipoa ocellata*), providing areas of scrub and shrubland with leaf litter on a sandy substrate for mound building. Malleefowl mounds were recorded on 11 occasions from within this habitat (Stantec 2019, Stantec 2021b). Areas where this habitat occurs in depressions or flats supporting myrtaceous shrubs would be particularly suitable for the Tree-stem trapdoor spider. While reduced woody debris and the lack of large trees would reduce habitat for the Chuditch, the species may still use pre-existing burrows if present and/or forage in the area. The habitat may also support the Western Brush Wallaby.	
Shrubland Stony Rise • Limited extent • Significant	65.15	7.45	EcAcGooHeEm	Sloped terrain on stony lateritic substrate, dominated by dense mid storey of *Allocasuarina campestris* over *Hibbertia eatoniae*. The habitat varied in the vegetation composition with patches of *Grevillea obliquistigma, G. paradoxa* and Calothamnus gilesii present within the habitat. The stony substrates comprised lateritic gravel rather than large rocks. The dense shrub cover and presence of gravel would potentially support mound building for the Malleefowl. Portions of this habitat with *Allocasuarina campestris* and/or myrtaceous shrubs may provide important habitat for the Tree-stem trapdoor spider. However the habitat tends to lack the sandy loam depressions and plains that are important to support the species.	
Cleared	9.72	1.11	-	-	-
Total	**874.75**	**100**	**-**	**-**	**-**

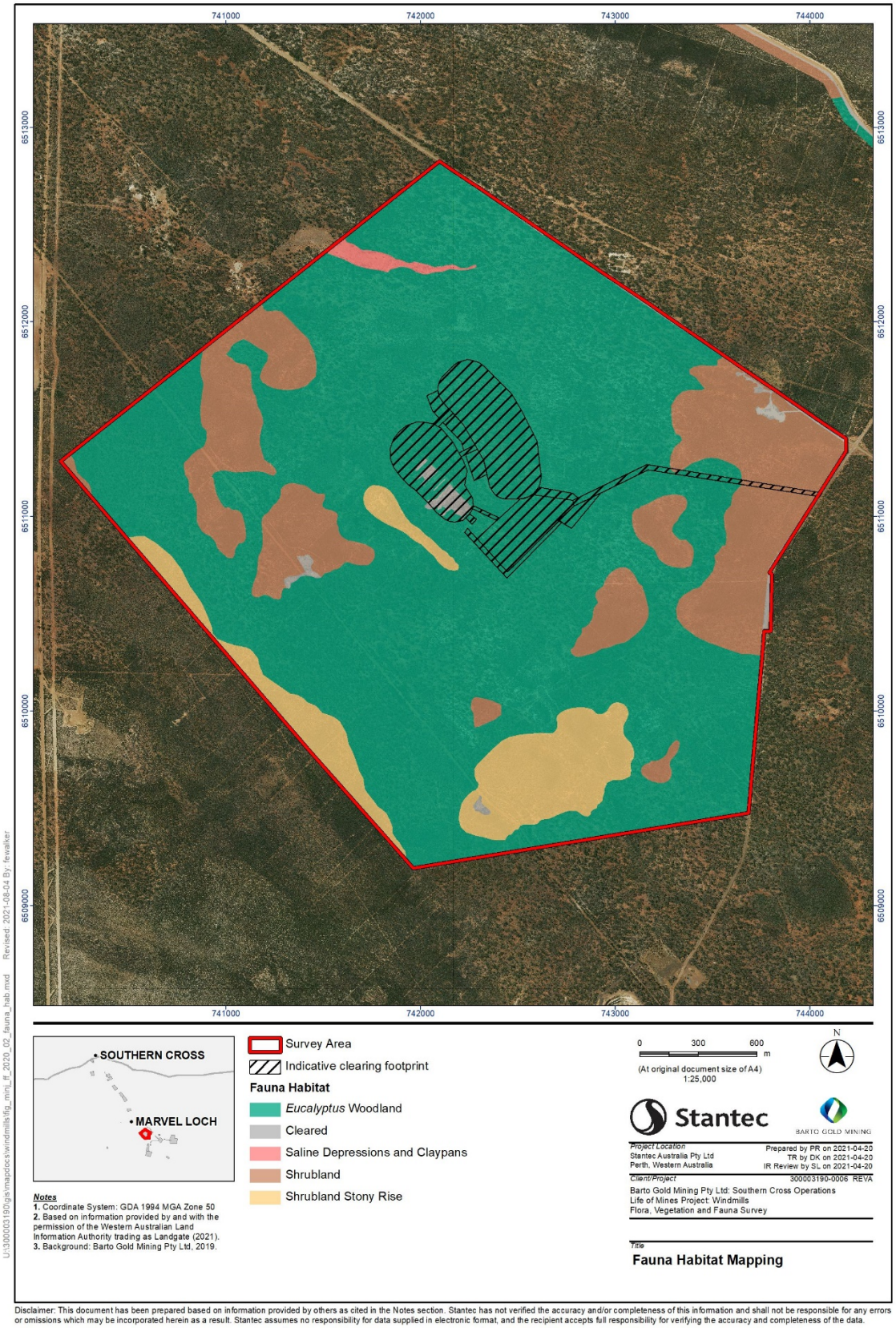

Figure 5-6: Fauna habitats in the Survey Area.

5.3.2 Fauna Assemblages

In total, 31 vertebrate fauna species were recorded within or in the vicinity of the Survey Area during the current survey, and other recent surveys conducted for the greater Life of Mines project (**Table 5-8**). Two of the fauna species recorded are listed as Threatened by the Commonwealth and State; the Malleefowl (*Leipoa ocellata* [Vu, Vu]) and the Chuditch (*Dasyurus geoffroii* [Vu, Vu]). Additionally, one species is recognised by DBCA as a priority fauna; the Western Brush Wallaby (*Notamacropus irma* [P4]). All fauna species recorded during the field survey were identified as having the potential to occur during the desktop assessment (**Section 3.2.3**).

Table 5-9: Vertebrate fauna species recorded in the vicinity of the Survey Area.

Species	Common name	Conservation Status	
		WA	EPBC
Aves			
Leipoa ocellata	Malleefowl	Vu	Vu
Aegotheles cristatus	Australian Owlet-nightjar		
Barnardius zonarius	Australian Ringneck		
Cacatua roseicapilla	Galah		
Cinclosoma clarum	Copper-backed Quail-thrush		
Climacteris rufus	Rufous Treecreeper		
Corvus coronoides	Australian Raven		
Drymodes brunneopygia	Southern Scrub-robin		
Malurus pulcherrimus	Blue-breasted Fairy-wren		
Oreoica gutturalis	Crested Bellbird		
Ocyphaps lophotes	Crested Pigeon		
Pachycephala occidentalis	Western Whistler		
Pomatostomus superciliosus	White-browed Babbler		
Rhipidura leucophrys	Willie Wagtail		
Strepera versicolor	Grey Currawong		
Cracticus tibicen	Australian Magpie		
Dromaius novaehollandiae	Emu		
Grallina cyanoleuca	Magpie-lark		
Mammalia			
Dasyurus geoffroii	Chuditch	Vu	Vu
Notamacropus irma	Western Brush Wallaby	P4	
Osphranter robustus	Euro		
Notomys mitchellii	Mitchell's Hopping Mouse		
Felis catus	*Feral Cat		
Oryctolagus cuniculus	*Rabbit		
Vulpes vulpes	*Red Fox		
Sminthopsis dolichura	Little Long-tailed Dunnart		
Tachyglossus aculeatus	Short-beaked Echidna		
Reptilia			
Ctenophorus cristatus	Bicycle Dragon		
Moloch horridus	Thorny Devil		
Tiliqua occipitalis	Western Blue-tongue		
Varanus gouldii	Sand Monitor		

* Denotes introduced fauna species.

5.3.3 Fauna of Significance

Of the 247 species of vertebrate fauna identified during the desktop assessment, 20 species are listed as being of significance, comprising six mammals, 12 birds, and two reptiles (**Appendix H**). Of these:

- eight are listed as Threatened under the EPBC Act and/or BC Act;
- five are recognised by DBCA as priority fauna (DBCA recognises several species that are not listed under the BC Act or the EPBC Act, but for which there is some conservation concern, and has produced a supplementary list of priority fauna) (**Appendix H**);
- one species, the Peregrine Falcon (*Falco peregrinus*) is recognised by the State (BC Act), as being in need of special protection;
- one species, the Red-tailed Phascogale (*Phascogale calura*), is recognised by the State (BC Act) to be conservation dependent;
- seven species are listed as Migratory under the EPBC Act or as being under International Agreement under the BC Act; and
- one species, the Bilby (*Macrotis lagotis*), is considered to be extinct in the Coolgardie and Avon Wheatbelt bioregions (Woinarski *et al.* 2014) and are therefore unlikely to occur within the Survey Area.
- three invertebrates of significance were recorded as potentially occurring within the Survey Area, two of which are aquatic and the remainder terrestrial.

Some of the species, listed as threatened, migratory and/or priority fauna, may be included in multiple categories. The likelihood for species of significance occurring in the Survey Area was assessed and ranked based on the definitions described in **Section 3.1.3**. One species, the Malleefowl (*Leipoa ocellata*) (Vu, Vu), was confirmed in the Survey Area (**Figure 5-6**). Seven species were considered likely to occur comprising the Chuditch (*Dasyurus geoffroii*) (Vu, Vu), Western Brush Wallaby (*Notamacropus irma*) (P4), Western Rosella (*Platycercus icterotis xanthogenys*) (P4), Peregrine Falcon (*Falco peregrinus*) (OS), Common Greenshank (*Tringa nebularia)* (IA, Mi), Woma Python (southwest pop) (*Aspidites ramsayi*) (P1) and the Tree-stem trapdoor spider (*Aganippe castellum*) (P4). Two species, the Lake Cronin Snake (*Paroplocephalus atriceps*) (P3) and Common Sandpiper (*Tringa hypoleucos*) (IA, Mi), were considered to possibly occur. The remaining 10 species were considered 'Unlikely' to occur within the Survey Area based on a lack of recent records, unsuitable habitat and/or the Survey Area occurring outside the known species range, with specific details presented in **Appendix H**.

Database search results confirm that the Red-Tailed Black-Cockatoo species *Calyptorhynchus banksii* was recorded recently nearby, with several records along Coolgardie Road over 20 km from the Survey Area (Birdlife Australia 2019). Based on the location of the Survey Area, these are likely to represent the *Calyptorhynchus banksii* subsp. *samueli* (Menkhorst *et al.* 2019), which is not a listed species.

The closest records of Threatened Black Cockatoos to the Survey Area are approximately 100 km to the south of the Survey Area (DBCA 2020e). The closest breeding site (confirmed, buffered 12 km) is approximately 125 km south south-west of the central point coordinates (DBCA 2020e). There were no roost sites (buffered 6 km) within a 200 km radius of the coordinates. Based on the distributions, the Western Australian threatened Black Cockatoo species (DotEE 2017), Red-Tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) (Vu, Vu) and Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (En, En) do not occur within the Survey Area. Therefore, they have not been considered any further in this assessment (and were subsequently excluded from significant species numbers).

Two Malleefowl (*Leipoa ocellata*) mounds have previously been recorded within the Survey Area by Barto (**Figure 5-6**). Of these mounds, one was recorded as active, and the second mound was recorded as inactive (**Figure 5-6**). Both mounds were recorded in shrubland habitat, which would provide suitable dense shrub cover and leaf litter on substrates suitable for mound building. Additionally, Malleefowl were recorded recently in the surrounds on numerous occasions. This includes an active mound <200m from the Survey Area boundary (located by Barto Gold), five active and two inactive mounds recorded in the Phoenix, Bronco, Brumby Zeus Survey Area ~3 .5km southeast of the Survey Area (Stantec 2021b) and six sightings within 4 km of the Survey Area ranging from 2001 – 2005 (DBCA 2020e) (**Figure 5-6**).

Chuditch (*Dasyurus geoffroii*) have been recorded at three locations via motion-sensing camera approximately 3 km south in the Phoenix, Bronco, Brumby Zeus Survey Area (**Figure 5-6**) (Stantec unpublished data). Of these locations one occurred within the Eucalypt Woodland habitat and the remaining two within Shrubland habitat. The Western Brush Wallaby (*Notamacropus irma*) was recorded once via motion-sensing camera within the Phoenix, Bronco, Brumby Zeus Survey Area, approximately 3.5 km south of the Survey Area (**Figure 5-6**). This record was made within the Shrubland habitat.

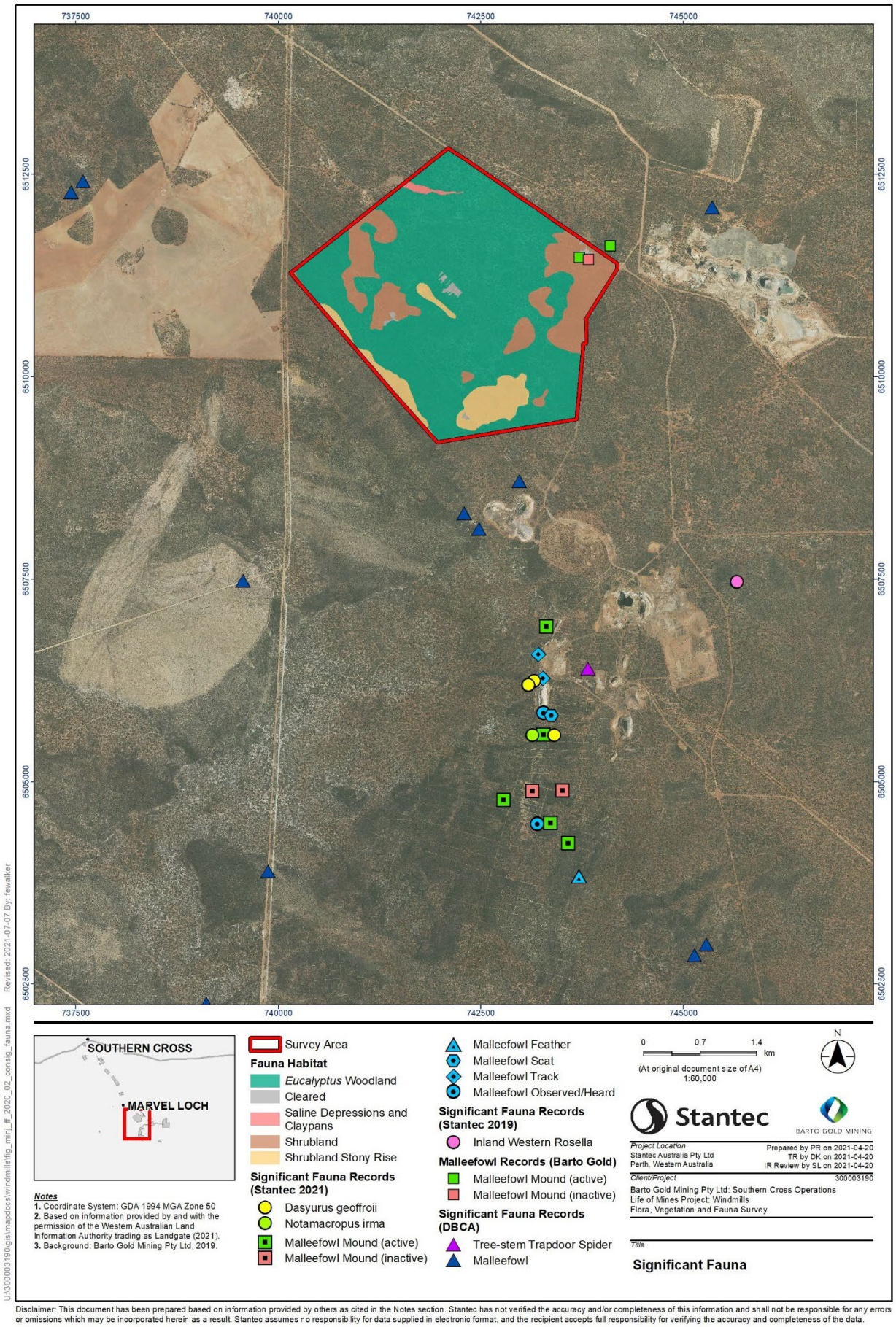

Figure 5-7: Significant fauna recorded in the area

5.4 Survey Limitation and Constraints

There are a number of potential limitation and constraints that can affect the adequacy of flora, vegetation and fauna surveys (DotE 2020, EPA 2016a). For the Survey, potential limitations have been summarised in **Table 5-9** with respect to this survey.

Table 5-10: Potential limitations and constraints of the field survey.

Factor	Constraint	Comments
Competency and experience of consultants	No	The field personnel, Jeni Alford, Julijanna Hantzis, Scott Pansini and Gearoid Fitzmaurice have appropriate qualifications and experience to undertake the relevant components of the flora, vegetation and fauna survey. The flora specimen identifications were undertaken by senior taxonomists Frank Obbens and Sharnya Thompson, both of whom have extensive experience identifying flora from Western Australia.
Scope	Potential	The scope of works originally incorporated eight project areas that were to be surveyed, and reported on, as one Survey Area for the Life of Mines project. Post field survey changes to the reporting component of the scope meant that project areas were to instead be reported on individually. As such, not all vegetation types were represented by the recommended minimum number of three quadrats. The targeted field survey only covered the potential clearing footprint and did not incorporate the complete Survey Area. There were subsequent changes to the March indicative clearing footprint (dated July 2021). These changes coincide with the survey effort that was covered by Stantec botanists.
Proportion of species identified	No	Field surveys were undertaken in April and September 2020. A targeted significant flora survey was undertaken in April 2021. Of the 115 flora species recorded, 16 specimens could not be confidently identified to species level. Most taxonomic groups expected within the Survey Area were represented and the total floristic richness was considered comparable to other surveys in the area conducted during similar seasonal conditions. Fauna habitat was assessed at each flora quadrat site (12 sites) for their importance to accommodate vertebrate fauna and fauna of significance.
Information sources (e.g. historic or recent)	No	Regional contextual information was obtained from historic vegetation mapping conducted by Beard (1975) and Shepherd *et al.* (2002b), soil and landform mapping (Mitchell *et al.* 2002), IBRA classification system (Thackway and Cresswell 1995) and several flora, vegetation and fauna surveys previously conducted in the wider region.
Completeness and intensity	Potential	A total of 12 quadrats, one relevé and eight mapping notes were established and sampled across the Survey Area. Fauna habitat assessments were completed at quadrat locations and opportunistic fauna observations were collected throughout the survey. Targeted searches were also conducted throughout the Survey Area for significant flora species. The field surveys undertaken within the Survey Area were conducted as part of the greater Life of Mines project and, as such, sample sites were spread across a number of survey areas to achieve quadrat replication. Although replication within the Windmills Survey Area is sufficient to understand the vegetation and develop a representative species list, not all vegetation types were represented by the recommended minimum number of three quadrats.

Factor	Constraint	Comments
Timing / weather / season / cycle	Potential	The phase 1 and 2 field surveys took place over two seasons (autumn and spring) to maximise the chance of capturing as many species as possible. The Phase 1 and targeted surveys were conducted in April (2020 and 2021) to take advantage of a significant rainfall event that brought above-average rainfall to the region in February during both years. The phase 2 survey was conducted in September (within the recommended timing outlined in the guidelines for flora and vegetation surveys (EPA 2016a) and fauna surveys (DotE 2020)). Rainfall prior to this field survey was, however, slightly below-average for the three months prior to the survey. This below-average rainfall may have contributed to some ephemeral and annual species not being present at the time of survey. The supplementary targeted field survey took place in April 2021 about 4 weeks after a significant rainfall event in March.
Disturbances	No	Disturbances within the Survey Area were considered minimal and were primarily associated with previous clearing for mineral exploration. The small areas of disturbance within the Survey Area (9.68 ha; 1.11 %) did not limit the outcomes of this report. Much of the Survey Area was in 'Excellent' condition, and therefore this was not considered a constraint impacting on the key findings.
Resources	No	Resources were adequate to carry out the field survey and the field personnel were competent in the identification of species present. WA Herbarium specimens, taxonomic guides, DBCA database searches and the FloraBase database were all used to prepare for the field survey and for confirmation of flora or fauna species where identification was uncertain. Specimen identification was conducted by a senior taxonomist.
Remoteness / access problems	No	The Survey Area was easily accessible by vehicle and on foot.

6. Summary

Phase 1 and 2 surveys took place over two seasons (autumn and spring) to maximise the chance of capturing the diversity of species within the Survey Area. The Phase 1 survey was conducted in April to take advantage of a significant rainfall event that brought above-average rainfall to the region in February. The phase 2 survey was conducted in September, within the recommended timing outlined in the guidelines for flora and vegetation surveys (EPA 2016a) and fauna surveys (DotE 2020). Rainfall prior to this field survey was, however, slightly below-average for the three months prior to the survey. This below-average rainfall may have contributed to some ephemeral and annual species not being present at the time of that survey. In April 2021 a targeted field survey took place within the then indicative clearing footprint of the Survey Area. As per the EPA guidelines this was in recommended survey timing following autumn rains. The rainfall in the three months preceding this survey was above average mainly due to a significant rainfall event four weeks prior to the survey. Floristic diversity and composition was considered typical of the Southern Cross subregion and also showed similarities to the nearby Avon Wheatbelt (AW1) subregion, with the presence of *Eucalyptus loxophleba* subsp. *lissophloia* woodland. An additional targeted field survey was also conducted in April 2021

A total of 116 vascular flora species from 31 families and 66 genera have been recorded within the Survey Area. Of these, none were Commonwealth or State-listed threatened flora, however three priority flora species were recorded: *Rinzia fimbriolata* (P1), *Hakea pendens* (P3) and *Stenanthemum bremerense* (P4). Database search results indicate that *Calamphoreus inflatus* (P4) has been previously recorded within the Survey Area at two locations, however the species was not detected during targeted searches. It is possible that this species was not flowering at the time of the surveys and was not easily detectable. A further three species (*Goodenia heatheriana* (P1), *Acacia concolorans* (P2) and *Notisia intonsa* (P3)) are considered 'possible' to occur based on the post-survey likelihood of occurrence assessment. These species were either inconspicuous and low-growing or annuals that may have gone unnoticed during the survey, despite targeted searches.

Introduced flora diversity and density was considered low, with occurrences predominantly occurring in small patches within previously disturbed areas. None of the weed species recorded are listed as a declared pest or a WoNS.

Vegetation in the Survey Area was broadly represented by *Eucalyptus* Woodlands, *Acacia* and *Melaleuca* shrublands and a low Chenopod shrubland occurring on typically red/brown sandy clay loam. Vegetation type EsEsuElMpEaSaHe was the most represented within the Survey Area, accounting for almost 75%. All vegetation types recorded within the Survey Area are considered typical of similar landforms from the broader region. One vegetation type, EsEsuElMpEaSaHe, was considered to represent Community 3 of the P3 PEC *Parker Range vegetation complexes.*

Disturbance throughout the Survey Area was predominantly associated with existing access tracks and exploration drill lines. These disturbed areas ranged in condition from 'Completely Degraded' to 'Good' and accounted for approximately 28 ha (3.22%) of the Survey Area. Vegetation throughout the remainder of the Survey Area was considered to be in either 'Excellent' (836.04 ha or 95.57%) or 'Very Good' (10.61 ha or 1.21%) condition.

Four broad fauna habitats were identified within the Survey Area, comprising *Eucalyptus* Woodland, Saline Depressions and Claypans, Shrubland, and Shrubland Stony Rise. The *Eucalyptus* Woodland habitat comprised the majority of the Survey Area, covering 649.11 ha (approximately 75%). All four habitats were identified as potentially providing habitat for significant fauna species, owing to the presence of woody debris and hollows for Chuditch, shrub cover and suitable substrates for Malleefowl mound-building, and when inundated, potential foraging for migratory birds in one or more of the habitats.

In total, 31 vertebrate fauna species were recorded from the greater Life of Mines field surveys, of which three are species of significance; the Malleefowl (*Leipoa ocellata*) (Vu, Vu), Chuditch (*Dasyurus geoffroii*) (Vu, Vu) and the Western Brush Wallaby (*Notamacropus irma*) (P4). Two Malleefowl (*Leipoa ocellata*) (Vu; Vu) mounds have been recorded within the Survey Area by Barto. One mound was recorded as active, the second mound was recorded as inactive. Both mounds were recorded in shrubland habitat, which would provide suitable dense shrub cover and leaf litter on substrates for mound building.

Based on proximity of previous records and presence of preferential habitat in the Survey Area, seven species were considered likely to occur; the Chuditch (*Dasyurus geoffroii*) (Vu, Vu), Western Brush Wallaby (*Notamacropus irma*) (P4), Western Rosella (*Platycercus icterotis xanthogenys*) (P4), Peregrine Falcon (Falco peregrinus) (OS), Common Greenshank (*Tringa nebularia*) (IA, Mi), Woma Python (southwest pop) (*Aspidites ramsayi*) (P1) and the Tree-stem trapdoor spider (*Aganippe castellum*) (P4). Two species, the

Lake Cronin Snake (*Paroplocephalus atriceps*) (P3) and Common Sandpiper (*Tringa hypoleucos*) (IA, Mi), were considered 'possible' to occur.

7. Assessment against the 10 Native Vegetation Clearing Principles

The 10 Clearing Principles, listed under Schedule 5 of the *Environmental Protection Act 1986*, stipulate when native vegetation should not be cleared. The proposal to clear native vegetation for Barto's Windmills project area, located within their Southern Cross Operations, is considered in terms of these principles, in accordance with the Department of Environment Regulation (now Department of Water and Environment Regulation) assessment guidelines (DER 2014) in **Table 7-1.** The proposed clearing footprint within the Survey Area was not available at the time of this assessment and, as such, assessment was based on the total Survey Area size of 874.75 hectares.

Table 7-1: Assessment of proposed clearing of native vegetation within the Survey Area against the 10 Clearing Principles.

Clearing Principle	Justification of Variance	Reference	Variance
Principle (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	The Survey Area is 874.75 hectares (ha) in size, of which 865 ha (99%) contains remnant vegetation. A total of 100 confirmed vascular flora taxa, representing 31 families and 66 genera were recorded during the field survey. No Commonwealth or State-listed threatened flora were recorded within the Survey Area. Three State-listed priority flora species, *Rinzia fimbriolata* (P1), *Hakea pendens* (P3) and *Stenanthemum bremerense* (P4) were recorded during the survey, all of which have been recorded within five kilometres of the Survey Area, either from database search results or previous surveys. Database search results (DBCA 2020a, e) indicate that *Calamphoreus inflatus* (P4) has been previously recorded at two locations within the Survey Area, however, despite searches for this species during the field survey, it was not detected. Six vegetation types were delineated within the Survey Area. The vegetation in the Survey Area was broadly represented by mid height to tall *Eucalyptus* Woodlands, *Acacia* and *Melaleuca* shrublands and a low Chenopod shrubland. Vegetation types were not restricted to the Survey Area and were considered comparable to that described for the Southern Cross subregion. No threatened ecological communities (TECs) are known to occur within the Survey Area, however one priority ecological community (PEC), the P3 *Parker Range Vegetation Complexes*, is mapped for the Survey Area. One vegetation type, EsEsuElMpEaSaHe, was considered to represent Community 3 of this PEC, and accounted for 649.10ha, or 74.20% of the Survey Area. The *Parker Range Vegetation Complexes* PEC has been identified outside of the Survey Area by previous surveys undertaken within 10 km. One significant species was recorded in the Survey Area; two Malleefowl (*Leipoa ocellata*) (Vu, Vu) mounds, one active and one inactive, were recorded by Barto Gold Mining Pty Ltd. The desktop assessment identified seven terrestrial fauna species of significance as being 'likely' to occur within the Survey Area; Chuditch (*Dasyurus geoffroii*) (Vu, Vu), Western Brush Wallaby (*Notamacropus irma*) (P4), Western Rosella (*Platycercus icterotis xanthogenys*) (P4), Peregrine Falcon (*Falco peregrinus*) (OS), Common Greenshank (*Tringa nebularia)* (IA, Mi), Woma Python (southwest pop) (*Aspidites ramsayi*) (P1) and the Tree-stem trapdoor spider (*Aganippe castellum*) (P4). Four fauna habitats were described for the Survey Area, all of which are considered important for significant species: *Eucalyptus* Woodland, Saline Depressions and Claypans, Shrublands and Shrubland Stony Rise. Shrublands contain patches of dense vegetation cover, leaf litter and suitable substrates optimal for supporting Malleefowl mound building. *Eucalyptus* Woodlands and areas of shrubland stony rise may also support the species. Eucalyptus Woodlands and Shrublands would also support a range of other significant species considered likely to occur in the Survey Area owing to the abundance of debris, shelter and foraging suitability. *Eucalyptus* woodlands would also support nesting birds such as the Peregrine Falcon and Western Rosella (inland pop.) and denning Chuditch where hollows are present. Saline Depressions and Claypans may support migratory shorebirds when inundated. Based on the survey findings and the desktop assessment, the biological diversity of the Survey Area is anticipated to be comparable to the surrounding area and the vegetation and habitats recorded are not considered restricted to the Survey Area. However, given that the Survey Area contains vegetation that is analogous with the *Parker Range Vegetation Complexes* (P3) PEC, is confirmed to support one threatened species and is considered likely to support seven significant fauna species, clearing may be at variance with this Principle. **The proposed clearing may be at variance with this Principle.**	DBCA (2019) DBCA (2020a, 2020e) Commonwealth of Australia (2020b) DPIRD (2020) Cowan *et al.* (2001) Stantec (2019) Gibson and Lyons (1998) Recon Environmental (2008b)	May be at variance
Principle (b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	The Survey Area contains four broad fauna habitats: *Eucalyptus* Woodland, Saline Depressions and Claypans, Shrubland, and Shrubland Stony Rise. These habitats are considered typical of the Southern Cross subregion and were broadly represented outside of the Survey Area. Two Malleefowl (Leipoa ocellata) mounds have previously been recorded within the Survey Area by Barto Gold Mining Pty Ltd. Of these mounds, one was recorded as active, and the second mound was recorded as inative. Both mounds were recorded in Shrubland habitat. The desktop assessment identified seven terrestrial fauna species of significance as being 'likely' to occur within the Survey Area; Chuditch (*Dasyurus geoffroii*) (Vu, Vu), Western Brush Wallaby (*Notamacropus irma*) (P4), Western Rosella (*Platycercus icterotis xanthogenys*) (P4), Peregrine Falcon (*Falco peregrinus*) (OS), Common Greenshank (*Tringa nebularia)* (IA, Mi), Woma Python (southwest pop) (*Aspidites ramsayi*) (P1) and the Tree-stem trapdoor spider (*Aganippe castellum*) (P4). **The proposed clearing of Shrubland habitats within the Survey Area may be at variance with this Principle.**	Cowan *et al.* (2001) Stantec (2019) GHD (2016) Botanica (2016b)	May be at variance
Principle (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No Commonwealth or State-listed threatened flora were recorded within the Survey Area or were considered to have potential to occur. **The proposed clearing is not likely to be at variance with this Principle.**	DBCA (2020a, 2020e) DoAWE (2020)	Unlikely to be at variance

<table>
<tr><th>Clearing Principle</th><th>Justification of Variance</th><th>Reference</th><th>Variance</th></tr>
<tr><td>Principle (d)

Native vegetation should not be cleared if it comprises the whole or a part of or is necessary for the maintenance of a Threatened ecological community.</td><td>No TECs listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) or the Biodiversity Conservation Act 2016 (BC Act) are known to occur within or adjacent to the Survey Area. The closest TEC to the Survey Area is the Eucalypt Woodlands of the Western Australian Wheatbelt (Wheatbelt Woodlands), located approximately 8 km west of the Survey Area. This TEC is restricted to the Avon Wheatbelt region, outside of the Survey Area.

The proposed clearing is not likely to be at variance with this Principle.</td><td>DBCA (2020c)</td><td>Unlikely to be at variance</td></tr>
<tr><td>Principle (e)

Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</td><td>The Survey Area occurs within the Southern Cross subregion (COO2) of the Coolgardie (COO) IBRA bioregion and is under the jurisdiction of the Shire of Yilgarn. The Survey Area occurs within four pre-European vegetation associations; 128, 552, 1068 and 1148.

Table A outlines the pre-European vegetation extents (measured in 2018) remaining within the IBRA bioregion, subregion, and within the local government area (LGA). The remaining proportions of all four vegetation associations for the Bioregion, Subregion and Yilgarn LGA are above the 30% threshold considered to be required for maintaining ecological viability. The area of native vegetation proposed for potential clearing within the Survey Area (861 ha) will not significantly reduce the pre-European vegetation extent.

Table A: Extent of pre-European vegetation associations remaining across three scales (Bioregion, Subregion and Local Government Area).
<table>
<tr><th>Vegetation Association</th><th>Scale</th><th>Pre-European extent (ha)</th><th>Current extent (ha)</th><th>Proportion remaining (%)</th></tr>
<tr><td rowspan="3">128</td><td>Bioregion (COO)</td><td>184,550</td><td>183,891</td><td>99</td></tr>
<tr><td>Subregion (COO2)</td><td>156,193</td><td>155,552</td><td>99</td></tr>
<tr><td>LGA (Yilgarn)</td><td>45,797</td><td>41,452</td><td>90</td></tr>
<tr><td rowspan="3">552</td><td>Bioregion (COO)</td><td>6,173</td><td>5,897</td><td>96</td></tr>
<tr><td>Subregion (COO2)</td><td>6,173</td><td>5,897</td><td>96</td></tr>
<tr><td>LGA (Yilgarn)</td><td>12,510</td><td>12,167</td><td>97</td></tr>
<tr><td rowspan="3">1068</td><td>Bioregion (COO)</td><td>193,988</td><td>104,804</td><td>54</td></tr>
<tr><td>Subregion (COO2)</td><td>193,988</td><td>104,804</td><td>54</td></tr>
<tr><td>LGA (Yilgarn)</td><td>268,900</td><td>142,088</td><td>53</td></tr>
<tr><td rowspan="3">1148</td><td>Bioregion (COO)</td><td>254,932</td><td>252,776</td><td>99</td></tr>
<tr><td>Subregion (COO2)</td><td>254,932</td><td>252,776</td><td>99</td></tr>
<tr><td>LGA (Yilgarn)</td><td>79,301</td><td>77,149</td><td>97</td></tr>
</table>
The proposed clearing not likely to be at variance with this Principle.</td><td>Shepherd et al. (2002a)

Government of Western Australia (2019)

Thackway and Cresswell (1995)

Cowan et al. (2001)</td><td>Unlikely to be at variance</td></tr>
<tr><td>Principle (f)

Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.</td><td>No internationally or nationally significant wetlands are located within the Survey Area. The nearest nationally important wetland is Lake Cronin, located 97 km south of the Survey Area. The nearest named water course to the Survey Area is Esdaile Creek, which is 88 km north-east of the Survey Area.

The proposed clearing is not likely to be at variance with this Principle.</td><td>State of Western Australia (2020)

Commonwealth of Australia (2020a)</td><td>Unlikely to be at variance</td></tr>
<tr><td>Principle (g)

Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.</td><td>Land degradation includes any alteration to land capability, soil erosion, salinity, nutrient export, acidification, waterlogging and flooding that affects the present or future use of land.

The Survey Area lies outside the soil landscape land quality mapping and assessment of land capability, which extends to the edge of the wheatbelt. The Survey Area occurs within two land systems.
<table>
<tr><th rowspan="2">Land system</th><th rowspan="2">Description</th><th colspan="2">Extent within Survey Area</th></tr>
<tr><th>Area (ha)</th><th>Proportion (%)</th></tr>
<tr><td>DD15</td><td>Undulating plains with some low dunes, seasonal lakes, and clay pans</td><td>489.60</td><td>55.97</td></tr>
<tr><td>My44</td><td>Undulating ridge and low hilly terrain with some mesas and buttes and small valley plains</td><td>385.15</td><td>44.03</td></tr>
</table></td><td>State of Western Australia (2020)

(Purdie et al. 2004)

(van Gool et al. 2005)

(Cowan et al. 2001)

(DPIRD 2015)</td><td>May be at variance</td></tr>
</table>

Clearing Principle	Justification of Variance	Reference	Variance
	The DD15 land system includes low lying areas identified within this report as Saline depressions and claypans (4.27 ha or 0.49% of the Survey Area). These areas may be prone to land degradation from clearing in the form of salinisation, water logging, soil erosion and acidity. Further work would be required to verify the soil characteristics. The My44 land system does not include wetlands, salt lakes, and is unlikely to comprise fine loose sands or calcareous loamy earth. Consequently, soils within the Survey Area are unlikely to be prone to erosion. However, some areas of the Survey Area include steep slopes nearing 9% which may be more prone to erosion. These areas are associated with the Shrubland Stony Rise habitat which comprises 65.15 ha or 7.45 % of the Survey Area. ***Based on the information available, the proposed clearing may be at variance with this Principle.***		
Principle (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The Survey Area does not occur within, or adjacent to, a conservation area. The closest reserves to the Survey Area are Jilbadji Nature Reserve and Yellowdine Nature Reserve, respectively located approximately 10.5 km to the east and 16 km to the north-east. Boorabin National Park is located approximately 48 km north-east of the Survey Area. **The proposed clearing is not likely to be at variance with this Principle.**	State of Western Australia (2020)	Unlikely to be at variance
Principle (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	The Survey Area does not intersect any surface water bodies. The nearest nationally important wetland is Lake Cronin, located 97 km south of the Survey Area. The nearest named water course to the Survey Area is Esdaile Creek, which is 88 km north-east of the Survey Area. The closest Public Drinking Water Source Area is associated with the Broad Arrow Dam Catchment Area, located over 200 km north east of the Survey Area. Additionally, the proposed clearing is not in any controlled catchments under the *Country Areas Water Supply Act 1947* (CAWS) where clearing controls are in place to prevent salinisation. The closest CAWS catchment to the Survey Area is the Mundaring Weir Catchment Area, located over 200 km west of the Survey Area. **The proposed clearing is not likely to be at variance with this Principle.**	Government of Western Australia (2020)	Unlikely to be at variance
Principle (j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	The proposed native vegetation clearing is unlikely to alter the hydrological regime of the area leading to an increase in the frequency or intensity flooding. As the Survey Area does not intersect any drainage areas or watercourses, clearing is unlikely to cause or exacerbate the incidence of flooding. **The proposed clearing is not likely to be at variance with this Principle.**	State of Western Australia (2020)	Unlikely to be at variance

8. References

Barker, R. M. (1990) New Species, New Combinations and Other Name Changes in Hakea (Proteaceae). *Journal of the Adelaide Botanic Gardens* 13: 95-110.

Beard, J. S. (1972) *The Vegetation of the Southern Cross area, Western Australia : Map and Explanatory Memoir, 1:250,000 Series.* Vegmap Publications, Perth.

Beard, J. S. (1975) *Map and Explanatory Notes to Sheet 5: The Vegetation of the Pilbara Area.* University of Western Australia Press, Nedlands, Western Australia.

Beard, J. S. (1976) *The Vegetation of the Boorabbin and Lake Johnston areas, Western Australia.* Vegmap Publications, Perth.

Beard, J. S. (1981) *Map and Explanatory Notes to Sheet 7: The Vegetation of the Swan Area.* University of Western Australia Press, Nedlands, Western Australia.

Beard, J. S. (1990) *Plant Life of Western Australia.* Kangaroo Press, Kenthurst, New South Wales.

Benshemesh, J. (2007) *National Recovery Plan for Malleefowl Leipoa ocellata.* Department for Environment and Heritage, South Australia.

Birdlife Australia (2019) *Birdata: Custom Atlas Bird Lists (custom search)*. Available online at.

BoM, Bureau of Meteorology (2020) *Climate Data Online (custom search)*. Commonwealth of Australia. Available online at http://www.bom.gov.au/climate/data/.

BoM, B. o. M. (2012) *Australian Water Resources Assessment 2012*. Available online at http://www.bom.gov.au/water/awra/2010.

Botanica, Botanica Consulting. (2016a) *Level 1 Reconnaissance Flora & Vegetation Survey of the Martin's Prospect*, Unpublished report prepared for Hanking Gold Mining Pty Ltd.

Botanica, Botanica Consulting. (2016b) *Level 2 Flora & Fauna Survey: Redwing Project For Hanking Gold Mining Pty Ltd*, Unpublished report prepared for Hanking Gold Mining Pty Ltd.

Bruton, M. (2013) Arboreality, excavation, and active foraging: novel observations of radiotracked woma pythons *Aspidites ramsayi*. *Nature* 56(2): 17.

Colbourne, J. K., Wilson, C. C. and Herbert, P. D. N. (2006) The systematics of Australian Daphnia and Daphniopsis (Crustacea: Cladocera): a shared phylogenetic history transformed by habitat-specific rates of evolution. *Biological Journal of the Linnean Society* 89: 469-488.

Commonwealth of Australia. (2020a) *Australian Wetlands Database*. Department of the Environment and Energy. Available online at https://www.environment.gov.au/water/wetlands/australian-wetlands-database.

Commonwealth of Australia. (2020b) *Weeds of National Significance*. Department of Agricuture, Water and Environment. Available online at https://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html.

Cowan, M., Graham, G. and McKenzie, N. (2001) Coolgardie 2 (COO2 - Southern Cross subregion). In: *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Kensington, W.A., pp 143-155

DBCA, Department of Biodiversity Conservation and Attractions (2019) *Threatened and Priority Ecological Communities Database (custom search)*. Available online at http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities.

DBCA, Department of Biodiversity Conservation and Attractions (2020a) *Threatened and Priority Ecological Communities Database (custom search)*. Available online at http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities.

DBCA, Department of Biodiversity Conservation and Attractions (2020b) *Threatened and Priority Fauna List*. Available online at https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals.

DBCA, Department of Biodiversity Conservation and Attractions (2020c) *Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) (custom search)*. Available online at http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/wa-s-threatened-ecological-communities.

DBCA, Department of Biodiversity Conservation and Attractions (2020d) *Western Australian Herbarium Specimen database (WAHerb) (custom search)*. Available online at https://florabase.dpaw.wa.gov.au/.

DBCA, Department of Biodiversity Conservation and Attractions. (2021) Priority Ecological Communities for Western Australia Version 31.

DBCA, Department of Biodiversity, Conservation and Attractions (2020e) *Threatened and Priority Flora Database (custom search)*. Available online at http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants.

DEC, Department of Environment and Conservation (2009) *Fauna Notes, Information about Western Australia's Fauna: No. 24 Western Rosella*. Available online at https://library.dbca.wa.gov.au/static/FullTextFiles/922919.pdf.
DEC, Department of Environment and Conservation. (2012a) *Chuditch (Dasyurus geoffroii) Recovery Plan: Wildlife Management Program No. 54*, Perth, Western Australia.
DEC, Department of Environment and Conservation (2012b) *Fauna Profiles: Western Brush Wallaby Macropus irma (Jourdan, 1837)*. Available online at https://library.dbca.wa.gov.au/static/FullTextFiles/071535.pdf.
DER, Department of Environment Regulation. (2014) *A Guide to the Assessment of Applications to Clear Native Vegetation; Under Part V Division 2 of the Environmental Protection Act 1986* Department of Environment Regulation, Perth, Western Australia.
DoAWE, Department of Agriculture, Water and the Environment (2020) *Protected Matters Search Tool (custom search)*. Commonwealth of Australia. Available online at http://www.environment.gov.au/epbc/protected-matters-search-tool.
DotE, Department of Environment,, (2020) *Calidris melanotos in Species Profile and Threats Database*. Available online at http://www.environment.gov.au/sprat.
DotE, Department of the Environment. (2013) *Significant Impact Guidelines 1.1: Matters of National Environmental Significance* Commonwealth of Australia, Canberra, Australian Capital Territory.
DotEE, Department of the Environment and Energy. (2017) *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo (Endangered) Calyptorhynchus latirostris, Baudin's Cockatoo (Vulnerable) Calyptorhynchus baudinii, Forest Red-tailed Black Cockatoo (Vulnerable) Calyptorhynchus banksii naso* Department of the Environment and Energy.
DotEE, Department of the Environment and Energy (2019a) *Australian Heritage Database Listing: Jilbadji Nature Reserve, Forrestania - Southern Cross Rd, Barker Lake via Marvel Loch, WA, Australia*. Available online at http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;place_id=9790.
DotEE, Department of the Environment and Energy (2019b) *Australian Heritage Database Listing: Yellowdine Proposed Reserve, Yellowdine Rd, Yellowdine via Southern Cross, WA, Australia*. Available online at http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;place_id=9917.
DotEE, D. o. t. E. a. E. (2020) *Protected Matters Search Tool (custom search)*. Commonwealth of Australia. Available online at http://www.environment.gov.au/epbc/protected-matters-search-tool.
DPaW. (2017) *Interim Guideline for Preliminary Surveys of Night Parrot (Pezoporus occidentalis) in Western Australia* Department of Parks and Wildlife.
DPIRD, Department of Primary Industries and Regional Development (2015) *MySoil: Sandy Earths (Central North)*. Available online at https://www.agric.wa.gov.au/mycrop/mysoil-sandy-earths-central-north.
DPIRD, Department of Primary Industries and Regional Development. (2020) *Western Australian Organism List (WAOL)*. Government of Western Australia. Available online at https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol.
EPA, Environmental Protection Agency. (2000) Environmental Protection of Native Vegetation in Western Australia. Clearing of native vegetation, with particular references to the agricultural area. Position Statement No. 2.
EPA, Environmental Protection Authority. (2016a) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* Environmental Protection Authority, Western Australia.
EPA, Environmental Protection Authority. (2016b) *Technical Guidance: Terrestrial Fauna Surveys.* Environmental Protection Authority, Perth, Western Australia.
EPA, Environmental Protection Authority, (2016c) *Environmental Factor Guideline - Flora and Vegetation*. Environmental Protection Authority. Available online at http://www.epa.wa.gov.au/policies-guidance/environmental-factor-guideline-flora-and-vegetation.
EPA, E. P. A. (2016d) *Technical Guidance Subterranean Fauna Survey (equivalent to former EPA 2013 EAG 12 Environmental Assessment Guideline for Consideration of subterranean fauna in environmental impact assessment in Western Australia*, Perth, Western Australia.
ESCAVI, Executive Steering Committee for Australian Vegetation Information. (2003) *Australian Vegetation Attribute Manual: National Vegetation Information System Version 6.0* Department of Environment and Conservation, Report prepared by the Department of Environment Executive Steering Committee for Australian Vegetation Information, Canberra, Australian Capital Territory.
GHD. (2016) *Yilgarn Star North Prospect Biological Assessment*.
Gibson, N. and Lyons, M. N. (1995) *Floristic Survey of the Bremer and Parker Ranges of the Eastern Goldfields of Western Australia* Department of Conservation and Land Management,, Wanneroo, Western Australia.
Gibson, N. and Lyons, M. N. (1998) Flora and Vegetation of the Eastern Goldfields Ranges: Part 3. Parker Range. *Journal of the Royal Society of Western Australia* 81: 119-129.
Gibson, N. and Lyons, M. N. (2001) Flora and vegetation of the Eastern Goldfields Ranges: Part 4. Highclere Hills. *Journal of the Royal Society of Western Australia* 84: 71-81.

Government of Western Australia. (2017) *Environmentally Sensitive Areas.* Available online at https://www.der.wa.gov.au/your-environment/environmentally-sensitive-areas.
Government of Western Australia. (2018) *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of October 2020* https://www2.landgate.wa.gov.au/web/guest/downloader, Perth, WA.
Government of Western Australia (2019) *Black Cockatoo breeding and roosting layer*. data.wa.gov.au. Available online at https://catalogue.data.wa.gov.au/dataset?q=black+cockatoo.
Government of Western Australia (2020) *Public Drinking Water Source Area online mapping tool*. Department of Water and Environmental Regulaiton. Available online at http://water.wa.gov.au/maps-and-data/maps/public-drinking-water-source-area-mapping-tool.
Inglis, R. (2008) *tree-stem trapdoor spider (Aganippe castellum) conservation plan (2008-2013)* Avon Catchment Council.
Johnstone, R. E. and Storr, G. M. (1998) *Handbook of Western Australian Birds. Volume 1: Non-passerines (Emu to Dollarbird)*. Western Australian Museum, Perth, Western Australia.
Keighery, B. J. (1994) *Bushland Plant Survey: a Guide to Plant Community Surveys for the Community*. Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia.
McDonald, R. C., Isbell, R., Speight, J. G., Walker, J. and Hopkins, M. (1998) *Australian soil and land survey: field handbook*. CSIRO publishing, Collingwood, AU.
Menkhorst, P., Rogers, D. I., Clarke, R., Davies, J. N., Marsack, P. and Franklin, K. (2017) *The Australian Bird Guide*. CSIRO Publishing, Clayton, South Victoria.
Menkhorst, P., Rogers, D. I., Clarke, R., Davies, J. N., Marsack, P. and Franklin, K. (2019) *The Australian Bird Guide, Revised Edition*. CSIRO Publishing, Clayton, South Victoria.
Mitchell, D., Williams, K. and Desmond, A. (2002) *Swan Coastal Plain 2 (SWA2 - Swan Coastal Plain subregion)*, Perth, WA.
Murphy, S. A., Silcock, J., Murphy, R., Reid, J. and Austin, J. (2017) Movements and habitat use of the night parrot *Pezoporus occidentalis* in south-western Queensland. *Austral Ecology* 42: 10.
MWH, Australia. (2014) *Cheritons Find Level 1 Vegetation, Flora and Targeted Flora Survey*, CHER-VO-14001.
Pizzey, G. and Knight, E. (2007) *Field Guide to the Birds of Australia.* Harper Collins Publishers, Sydney, New South Wales.
Purdie, B. R., Tille, P. J. and Schoknecht, N. R. (2004) *Soil-landscape mapping in south-Western Australia : an overview of methodology and outputs.* Department of Agriculture and Food, Western Australia, Perth, Perth, W.A.
Pyke, G. H. and Ehrlich, P. R. (2014) Conservation and the Holy Grail: The Story of the Night Parrot. *Pacific Conservation Biology* 20(2): 221-226.
Recon Environmental. (2007) *Great Victoria Gold Vegetation Survey*.
Recon Environmental. (2008a) *Burbidge Rare Flora Distribution & Impact*.
Recon Environmental. (2008b) *Marvel Loch TSF Extension Vegetation Survey*.
Shepherd, D. P., Beeston, G. R. and Hopkins, A. J. M. (2002a) *Native Vegetation in Western Australia. Extent, Type and Status* Department of Agriculture, South Perth, Western Australia.
Shepherd, D. P., Beeston, G. R. and Hopkins, A. J. M. (2002b) *Native Vegetation in Western Australia. Extent, Type and Status*, Department of Agriculture, Perth, Western Australia.
Short, J. and Hide, A. (2012) Distribution and status of the Red-tailed Phascogale (*Phascogale calura*). *Australian Mammalogy* 34(1): 88-99.
Spectrum Ecology. (2020) *Leviathan Reconnaissance Flora & Vegetation and Targeted Fauna Survey*.
Stantec. (2020a) *Achilles Targeted Significant Flora Survey – October 2020*.
Stantec. (2021a) *Native Vegetation Clearing Permit Application - Significant flora recorded from the Glendower Survey Area*.
Stantec, Australia. (2019) *Parker Range PEC, Flora and Fauna Reconnaissance Survey and Priority Flora Search*, Perth, Western Australia.
Stantec, A. (2020b) *Leviathan and Victoria Vinto La Targeted Flora Survey Memorandum*.
Stantec, A. (2021b) *Phoenix, Bronco, Brumby and Zeus Targeted Malleefowl (Leipoa ocellata) Survey Memorandum*.
State of Western Australia. (2020) *Shared Location Information Platform (SLIP) Database*. Western Australia Land Information Authority (Landgate). Available online at https://maps.slip.wa.gov.au/landgate/locate/.
Thackway, R. and Cresswell, I. D. (1995) *An Interim Biogeographical Regionalisation for Australia.* Australian Nature Conservation Agency, Canberra, Australian Capital Territory.
Tille, P. (2006a) *Soil-landscapes of Western Australia's Rangelands and Arid Interior*, Department of Agriculture and Food Resource Management Technical Report 313.
Tille, P. J. (2006b) *Soil-landscapes of Western Australia's Rangelands and Arid Interior. Technical Report No. 313*, Department of Agriculture and Food Resource Management, Perth, Western Australia.
Timms, B. V. (2014) A review of the biology of Australian halophilic anostracans (Branchiopoda: Anostraca). *Journal of Biological Research* 21:21.

van Dyck, S. and Strahan, R. (2008) *The Mammals of Australia.* Australian Museum Trust and Queensland Museum, Sydney, New South Wales.
van Gool, D., Tille, P. J. and Moore, G. A. (2005) *Land Evaluation Standards for Land Resource Mapping: Assessing Land Qualities and Determining Land Capability in South-western Australia*. Available online at.
WAH, W. A. H. (2020) *FloraBase: the Western Australian Flora.* Department of Biodiversity Conservation and Attractions. Available online at.
WAH, W. A. H. (2021) *FloraBase: the Western Australian Flora.* Department of Biodiversity Conservation and Attractions. Available online at.
WAM, Western Australian Museum. (2020) *Checklist of the Vertebrates of Western Australia (updated April 2020)*. Available online at.
Western Wildlife. (2008) *St Barbara Limited, Southern Cross Operations: Baseline Fauna Survey; Spring 2007 & Autumn 2008*, Unpublished report prepared for St Barbara Limited.
Wilson, S. and Swan, G. (2013) *A Complete Guide to Reptiles of Australia.* New Holland Publishers, Sydney, New South Wales.
Woinarski, J. C. Z., Burbidge, A. A. and Harrison, P. L. (2014) *The Action Plan for Australian Mammals 2012.* CSIRO Publishing, Collingwood, Victoria.

Appendices

Appendix A Codes and Terms Used to Describe Species of Significance

Flora and Vegetation: The Environmental Factor Guideline for Flora and Vegetation (EPA 2016c) states that flora and vegetation may be considered significant for a range of reasons, including, but not limited to the following:

Flora: being identified as threatened or priority species, locally endemic or associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems), new species or anomalous features that indicate a potential new species, representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range), unusual species, including restricted subspecies, varieties or naturally occurring hybrids, relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Vegetation: being identified as threatened or priority ecological communities, restricted distribution, degree of historical impact from threatening processes, a role as a refuge, providing an important function required to maintain ecological integrity of a significant ecosystem.

Fauna: The Environmental Factor Guidelines for Terrestrial Fauna (EPA 2016b) states that terrestrial fauna may be significant for a range of reasons, including: being identified as a threatened or priority species; species with restricted distribution; degree of historical impact from threatening processes and providing an important function required to maintain the ecological integrity of a significant ecosystem.(EPA 2016c, d)(EPA 2016b, c)

Those flora, vegetation and fauna defined as Threatened and Priority are legislated protection under the EPBC Act and/or the BC Act, or by being listed on the DBCA Priority Species List. This Appendix presents a summary of the different rankings and listings used to describe conservation status. Some categories, such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are not presented here, as the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

Categories used under the EPBC Act		
Status	Code	Description
Critically Endangered	**Cr**	Taxa considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	**En**	Taxa considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	**Vu**	Taxa considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	**Mi**	Species that migrate to, over and within Australia and its external territories

Conservation Codes used under the BC Act		
Status	Code	Description
Critically Endangered	**CR**	Taxa rare or likely to become extinct, as critically endangered taxa
Endangered	**EN**	Taxa rare or likely to become extinct, as endangered taxa
Vulnerable	**VU**	Taxa rare or likely to become extinct, as vulnerable taxa
Presumed Extinct	**EX**	Taxa presumed to be extinct
Migratory	**IA**	Birds subject to international agreements relating to the protection of migratory birds
Conservation Dependent	**CD**	Taxa of special conservation need, being species dependent on ongoing conservation intervention
Special Protection	**OS**	Taxa in need of special protection

Priority Flora and Fauna Under the BC Act		
Status	Code	Description
Priority 1: Poorly-known 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.
Priority 2: Poorly-known Species	**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.
Priority 3: Poorly-known Species	**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.
Priority 4: Rare, Near Threatened and other species in need of monitoring	**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.

Definitions, Categories and Criteria for Threatened and Priority Ecological Communities General Definitions 1.	
Ecological Community	A naturally occurring biological assemblage that occurs in a particular type of habitat. Note: The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.
Threatened Ecological Community (TEC)	A threatened ecological community (TEC) is one which is found to fit into one of the following categories; "presumed totally destroyed", "critically endangered", "endangered" or "vulnerable". Possible threatened ecological communities that do not meet survey criteria are added to DEC's Priority Ecological Community (PEC) Lists under Priorities 1, 2 and 3. 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. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.
Assemblage	An assemblage is a defined group of biological entities.
Habitat	Habitat is defined as the areas in which an organism and/or assemblage of organisms lives. It includes the abiotic factors (eg. substrate and topography), and the biotic factors.
Occurrence	A discrete example of an ecological community, separated from other examples of the same community by more than 20 m of a different ecological community, an artificial surface or a totally destroyed community. By ensuring that every discrete occurrence is recognised and recorded future changes in status can be readily monitored.
Adequately Surveyed	An ecological community that has been searched for thoroughly in most likely habitats, by relevant experts.
Community structure	The spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage (eg. *Eucalyptus* salmonophloia woodland over scattered small shrubs over dense herbs; structure in a faunal assemblage could refer to trophic structure, eg. dominance by feeders on detritus as distinct from feeders on live plants).

Definitions and Criteria for Priority Ecological Communities	
Possible Threatened Ecological Communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.	
Priority 1 Poorly-known ecological communities	Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2 Poorly-known ecological communities	Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3 Poorly-known ecological communities	i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat or habitat destruction or degradation ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; iii) communities made up of large, and/or widespread occurrences, that may or 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 stick, and inappropriate fire regimes 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.
Priority 4 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. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c) Ecological communities that have been removed from the list of threatened communities during the past five years
Priority 5 Conservation Dependent ecological communities	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result int eh community becoming threatened within five years

Appendix B Vegetation Condition Scale for the South West and Interzone Botanical Provinces (Keighery 1994)

Rating	Description
Pristine	Pristine or nearly so; no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, 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 C NVIS Vegetation Structural Classification

Stratum	Canopy Cover (%)				
	70-100%	30-70%	10-30%	2-10%	<2%
Trees > 30 m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland	Scattered Tall Trees
Trees 10-30 m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees < 10 m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Shrubs > 2 m	Tall Closed Scrub	Tall Open Scrub	Tall Shrubland	Tall open Shrubland	Scattered Tall Shrubs
Shrubs 1-2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs < 1 m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Scattered Low Shrubs
Hummock Grasses	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Very Open Hummock Grassland	Scattered Hummock Grasses
Grasses, Sedges, Herbs	Closed Tussock Grassland / Bunch Grassland / Sedgeland / Herbland	Tussock Grassland / Bunch Grassland / Sedgeland / Herbland	Open Tussock Grassland / Bunch Grassland / Sedgeland / Herbland	Very Open Tussock Grassland / Bunch Grassland / Sedgeland / Herbland	Scattered Tussock Grasses / Bunch Grasses / Sedges / Herbs

Based on Muir (1977), and Aplin's (1979) modification of the vegetation classification system of Specht (1970); Aplin T.E.H. (1979). The Flora. Chapter 3 In O'Brien, B.J. (ed.) (1979). Environment and Science. University of Western Australia Press; Muir B.G. (1977). Biological Survey of the Western Australian Wheatbelt. Part II: Vegetation and habitat of Bendering Reserve. Records of the Western Australian Museum, Suppl. No. 3; Specht R.L. (1970). Vegetation. In: The Australian Environment. 4th edn (Ed. G.W. Leeper). Melbourne

Appendix D Likelihood of Occurrence of Significant Flora in the Survey Area

Species name	Conservation code		Broad habitat	Flowering period	Nearest known location (km)	Database/s Survey Report	Likelihood of occurrence within the Survey Area	
	EPBC Act	*BC Act*					Pre-survey	Post-survey
Acacia lobulata	EN	T	Gritty loam or sand. Low granitic breakaways.	July	99.7	PMST	**Unlikely:** The Survey Area is located well outside of the range of this species.	**Unlikely:** The Survey Area is located well outside of the range of this species.
Dasymalla axillaris	Cr	T	Sand plains (yellow sand).	July, September, October, November or December	276	PMST	**Unlikely:** The Survey Area is located well outside of the range of this species.	**Unlikely**: The Survey Area is located well outside of the range of this species.
Eremophila virens	En	T	Red/brown sand. Granite hillsides.	August to October	76	PMST	**Unlikely:** The Survey Area is located well outside of the range of this species.	**Unlikely**: The Survey Area is located well outside of the range of this species.
Eremophila viscida	En	T	Granitic soils, sandy loam. Stony gullies, sandplains.	September to November	92	PMST	**Unlikely:** The Survey Area is located well outside of the range of this species.	**Unlikely**: The Survey Area is located well outside of the range of this species.
Gastrolobium graniticum	En	T	Sand, sandy loam, granite. Margins of rock outcrops, along drainage lines.	August to September	36.3	PMST	**Unlikely:** The Survey Area is located outside of the range of this species.	**Unlikely**: The Survey Area is located outside of the range of this species.
Isopogon robustus	Cr	T	Skeletal grey sandy loam, laterite. Ridges.	October	11.92	PMST WAHerb TPFL Gibson and Lyons (1998)	**Possible:** The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Ricinocarpos brevis	En	T	Rocky hillslopes, rock outcrops.	June to July	166	PMST	**Unlikely:** The Survey Area is located well outside of the range of this species.	**Unlikely**: The Survey Area is located well outside of the range of this species.
Symonanthus bancroftii	En	T	White / grey coarse sandy clay. Moist, ephemeral wetland areas.	September	96.7	PMST	**Unlikely:** The Survey Area is located well outside of the range of this species.	**Unlikely**: The Survey Area is located well outside of the range of this species.
Chamelaucium sp. Parker Range (B. H. Smith 1255)		P1	Mid slopes, dry, yellow gravelly sand over laterite.	November, December	8.4	WAHerb	**Likely:** This species has been recorded in close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Cryptandra exserta		P1	Sandy soil with laterite gravel, red sand over clay. Gentle mid-slopes, plains.	July	6.8	Stantec (2019)	**Possible:** This species has been recorded in very close proximity to the Survey Area and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Goodenia heatheriana		P1	Red crumbly clay, greenstone gravel and cobbles. Lower slopes, moderately exposed gently undulating plain, roadsides.	September to October	1.0	WAHerb NatureMap Recon Environmental (2008a)	**Likely:** This species has been recorded in close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Possible:** The Survey Area is within the range of this species and does contain suitable habitat. If present in the Survey Area, this low (0.15 m) annual herb may not have been detectable. The survey timing was coincident with the flowering period of this species.
Grevillea lissopleura		P1	Stony loam on banded ironstone. On ridges.	August	15.6	WAHerb Stantec (2019)	**Possible:** The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.

Species name	Conservation code		Broad habitat	Flowering period	Nearest known location (km)	Database/s Survey Report	Likelihood of occurrence within the Survey Area	
	EPBC Act	*BC Act*					Pre-survey	Post-survey
Grevillea phillipsiana		P1	Red sand, stony loam, Granite hills.	July to September	12.7	Gibson and Lyons (1998)	**Possible:** The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Hemigenia sp. Newdegate (E. Bishop 75)		P1	Clay loam. Disturbed sites.	September to October	21.9	WAHerb Botanica (2016b) MWH (2014)	**Possible:** The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Hemigenia obovata		P1	White or black wet sand. Flats and wetlands.	October to November	10.0	Gibson and Lyons (1998)	**Unlikely:** Although this species has been recorded by a previous survey within proximity to the Survey Area, only two records are held by the WAH for this species, both of which are located west of Mount Barker, some 400 km away.	**Unlikely:** The Survey Area does not occur within the range of this species and does not contain suitable habitat.
Hydrocotyle corynophora		P1	Creek bed to shallow depression, red-brown cracking clay loam.	October	1.2	WAHerb NatureMap	**Possible:** This species has been recorded in close proximity to the Survey Area, however, the Survey Area is unlikely to contain suitable habitat for this species.	**Unlikely:** The Survey Area does not contain suitable habitat for this species.
Hysterobaeckea ochropetala subsp. *ochropetala*		P1	Orange brown gravelly sandy loam. Slope, Yellow clay loam. Flat, Brown clay loam. Sandy plain.	September to November	9.8	Stantec (2019)	**Possible:** The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is located well outside of the range of this species and if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Lepidosperma sp. Mt Caudan (N. Gibson & M. Lyons 2081)		P1	Slopes, ironstone/laterite gravel, brown/orange sandy loam.	No available information	12.4	Stantec (2019)	**Possible:** The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this tufted sedge would have been detectable at the time of the survey.
Lepidosperma sp. Parker Range (N. Gibson & M. Lyons 2094)		P1	Ridge/slope, clay/gravel to stony brown sandy loam.	No available information	10.3	WAHerb	**Possible:** The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this tufted sedge would have been detectable at the time of the survey.
Millotia newbeyi		P1	Red/brown loam, red clay. Undulating plains.	September	1.0	WAHerb NatureMap	**Likely:** This species has been recorded in close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Unlikely:** The Survey Area is within the range of this species and does contain suitable habitat. If present in the Survey Area, this annual herb would have been detectable at the time of the survey.
Rinzia fimbriolata		P1	Well drained soil, Brown sandy loam. Clay with quartz.	September	0.3	Stantec (2019)	**Likely:** This species has been recorded in close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Confirmed:** Recorded within the Survey Area during the current survey.
Rinzia medifila		P1	Red/orange/yellow brown sandy loam.	Approximately September, October	12.8	Gibson and Lyons (1998) MWH (2014) Botanica (2016b)	**Possible:** This species has been recorded in very close proximity to the Survey Area and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Acacia asepala		P2	Red-brown sandy loam. Undulating plains, along drainage lines.	August	0.7	WAHerb NatureMap Gibson and Lyons (1998)	**Likely:** This species has been recorded in close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this 0.5 - 1.05m perennial shrub would have been detectable at the time of the survey.
Acacia concolorans		P2	Red/brown loam, clay. Low lateritic hills, flats.	July to August	7.5	WAHerb NatureMap Stantec (2019) Recon Environmental (2008a)	**Possible:** The Survey Area is within the distribution range of this species and the Survey Area may contain suitable	**Possible:** The Survey Area is within the range of this species and does contain some suitable habitat. If present in the Survey Area this species may have gone undetected due to the small

Species name	Conservation code		Broad habitat	Flowering period	Nearest known location (km)	Database/s Survey Report	Likelihood of occurrence within the Survey Area	
	EPBC Act	*BC Act*					Pre-survey	Post-survey
						Gibson and Lyons (1998)	habitat, although it has been recorded infrequently in the area.	(0.1 – 0.5 m) and sometimes compact habit of this species, in conjunction with the survey being conducted outside of the known flowering period.
Eutaxia lasiocalyx		P2	Red sandy loam, laterite and quartz gravel. Gentle lower slopes.	November	12.7	NatureMap MWH (2014) Botanica (2016b)	**Possible:** The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Verticordia multiflora subsp. *solox*		P2	Yellow sand over gravel, sand over granite.	October to December or January	6.7	WAHerb NatureMap	**Possible**: The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely**: The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Acacia crenulata		P3	Clay, sandy clay, yellow sand. Rocky rises, granite outcrops, breakaways.	March to May, October	4.1	WAHerb TPFL NatureMap Stantec (2019) Recon Environmental (2008b)	**Likely:** This species has been recorded in close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Unlikely:** The Survey Area is within the range of this species however the Survey Area does not contain suitable habitat.
Acacia dissona var. indoloria		P3	Sand, sandy loam. Undulating plains.	August to September	1.3	Stantec (2019) Recon Environmental (2008a) Recon Environmental (2008b)	**Likely:** This species has been recorded in close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this distinctive (domed or rounded and pungent) perennial shrub would have been detectable at the time of the survey.
Acacia desertorum var. *nudipes*		P3	Yellow sand, lateritic gravel. Sandplains, flats.	August to October	5.0	WAHerb TPFL NatureMap	**Likely:** This species has been recorded in close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Unlikely:** The Survey Area is within the range of this species and does contain suitable habitat, however if present in the Survey Area, it is likely that this medium to tall perennial shrub would have been detectable at the time of the survey. The survey was also conducted during the known flowering period for this species.
Baeckea grandibracteata subsp. Parker Range (K. Newbey 9270)		P3	Mid slopes to sandplain, yellow silty sand to sandy loam.	November	5.9	WAHerb NatureMap Stantec (2019)	**Possible**: The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub (up to 1 m high) would have been detectable at the time of the survey.
Cryptandra crispula		P3	Brown sandy clay, yellow loamy sand, red soil, pebbles. Dune ridges, hills, near salt lakes.	July, August, September	10.6	WAHerb NatureMap	**Possible**: The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub (up to 1 m high) would have been detectable at the time of the survey. In addition, the survey was conducted during the known flowering period for this species.
Hakea pendens		P3	Stony loam, ironstone ridges.	September	0.10	WAHerb TPFL NatureMap Stantec (2019) Recon Environmental (2008b) Recon Environmental (2008a) Gibson and Lyons (1998)	**Likely:** This species has been recorded in very close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Confirmed:** Recorded within the Survey Area during the current survey.
Notisia intonsa		P3	Plain to floodplain, red to brown clay to clay loam.	September, October November	3.6	WAHerb TPFL NatureMap Gibson and Lyons (1998)	**Likely:** This species has been recorded in very close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Possible**: The Survey Area is within the range of this species and does contain some suitable habitat. If present in the Survey Area, this small (0.025 – 0.15 m) annual herb may have been undetected at the time of survey.

Species name	Conservation code		Broad habitat	Flowering period	Nearest known location (km)	Database/s Survey Report	Likelihood of occurrence within the Survey Area	
	EPBC Act	*BC Act*					Pre-survey	Post-survey
Philotheca coateana		P3	Red sand	August to September	4.0	Recon Environmental (2008a)	**Likely:** This species has been recorded in very close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey. In addition, the survey was conducted during the known flowering period for this species.
Verticordia mitodes		P3	Yellow sand. Undulating plains	October to December or January	8.1	WAHerb TPFL NatureMap	**Possible**: The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Verticordia stenopetala		P3	Yellow sand, sometimes with gravel. Undulating plains	October to December or January	6.7	WAHerb TPFL NatureMap	**Possible**: The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Banksia shanklandiorum		P4	White/yellow sand with lateritic gravel.	June to August	5.75	Stantec (2019)	**Likely:** This species has been recorded in very close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Unlikely:** The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this large (up to 2.5 m high and 3 m wide) perennial shrub would have been detectable at the time of the survey.
Calamphoreus inflatus		P4	Clay loam with ironstone gravel. Flats, disturbed sites.	October to December or February to March	Within the Survey Area	WAHerb TPFL Recon Environmental (2008a) MWH (2014)	**Confirmed:** Previously recorded within the Survey Area.	**Confirmed:** Previously recorded within the Survey Area.
Eremophila caerulea subsp. *merrallii*		P4	Sand, clay or loam. Undulating plains.	October to December	6.3	WAHerb NatureMap Recon Environmental (2008a) Recon Environmental (2007)	**Possible**: The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely**: The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey.
Grevillea neodissecta		P4	Lateritic gravel to ironstone, red to yellow loamy sand.	January, February, September, October, November December	5.3	Stantec (2019)	**Possible**: The Survey Area is within the distribution range of this species and the Survey Area may contain suitable habitat, although it has been recorded infrequently in the area.	**Unlikely**: The Survey Area is within the range of this species and does contain some suitable habitat, however if present in the Survey Area, it is likely that this perennial shrub would have been detectable at the time of the survey. In addition, the survey was conducted during the known flowering period for this species.
Stenanthemum bremerense		P4	Orange-brown sandy loam, skeletal red loam, orange-red gravelly loam, laterite, ironstone. Outcrops, breakaways	May, June, September, November	3.9	WAHerb TPFL NatureMap Stantec (2019) Stantec (2020b) Recon Environmental (2008b)	**Likely:** This species has been recorded in very close proximity to the Survey Area and the Survey Area may contain suitable habitat.	**Confirmed:** Recorded within the Survey Area during the current survey.

Appendix E Sample Site Data

Site Type	Site Name	Date
Quadrat	LoM8	22-04-2020 & 25-09-20
Dimensions	20m x 20 m	
Described by	Scott Pansini, Jeni Alford and Julijanna Hantzis	
Location (UTM)		
Easting	743392	mE
Northing	6510186	mN
Site Characteristics		
Landform	Sandy/Stony Plain	
Slope	Flat (0°)	
Aspect	None	
Condition		
Vegetation Condition	Excellent	
Disturbance Type	Mining exploration	
Disturbance Fauna	None discernible	
Fire Age	Old (6+yrs)	
Fire Notes	Bare ground	
Water Presence	None	
Soils		
Soil Texture	Loamy sand	
Soil Colour	Red/Brown	
Rock Type	Quartz	
Coarse Surface Particles		
Maximum Size (mm)	Gravel (1-4 cm)	
Abundance (%)	Common	
Exposed Bedrock (%)	Negligible (<5%)	
Vegetation Description	*Eucalyptus salmonophloia, Eucalyptus longicornis* open forest over *Eucalyptus yilgarnensis, Eucalyptus celastroides* subsp. *celastroides* low woodland over *Dodonaea stenozyga* open shrubland over *Acacia intricata, Acacia merrallii* scattered low shrubs over *Olearia muelleri* scattered herbs.	

Site Photograph

Species List

Species	Height (m)	Cover (%)
Acacia erinacea	0.3	0.5
Acacia intricata	0.5	1
Acacia merrallii	0.2	1
Alyxia buxifolia	0.7	0.1
Austrostipa elegantissima	0.5	0.1
Dodonaea stenozyga	1.4	8
Eremophila interstans subsp. *interstans*	5	1
Eremophila scoparia	1.3	0.1
Eucalyptus celastroides subsp. *celastroides*	7	10
Eucalyptus longicornis	15	8
Eucalyptus salmonophloia	20	30
Eucalyptus yilgarnensis	9	2
Lysiana sp. indet.	0	0.5
Olearia muelleri	0.3	2
Santalum acuminatum	0.4	0.1
Scaevola spinescens	0.8	0.1
Templetonia ceracea	0.6	15

Site Type	Site Name	Date	Site Photograph
Quadrat	LoM12	22-04-20 & 25-09-20	
Dimensions	20m x 20 m		
Described by	Scott Pansini, Jeni Alford and Julijanna Hantzis		
Location (UTM)			
Easting	742399	mE	
Northing	6509807	mN	
Site Characteristics			
Landform	Hillslope		
Slope	South-west		
Aspect	Low (1-20°)		
Condition			
Vegetation Condition	Excellent		
Disturbance Type	Mining exploration		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches		
Water Presence	None		
Soils			
Soil Texture	Sandy loam		
Soil Colour	Orange		
Rock Type	Laterite		
Coarse Surface Particles			
Maximum Size (mm)	Gravel (1-4 cm)		
Abundance (%)	Very common		
Exposed Bedrock (%)	Negligible (<5%)		
Vegetation Description	*Eucalyptus capillosa* low open woodland over *Allocasuarina acutivalvis* subsp. *acutivalvis, Allocasuarina campestris* and *Melaleuca hamata* tall open scrub over *Melaleuca radula* and *Styphelia serratifolia* shrubland over *Melaleuca radula* and *Cryptandra wilsonii* low open shrubland.		

Species List

Species	Height (m)	Cover (%)
Acacia colletioides	0.3	0.1
Acrotriche lancifolia	0.2	0.1
Allocasuarina acutivalvis subsp. *acutivalvis*	3	25
Allocasuarina campestris	2.5	15
Alyxia buxifolia	0.15	0.1
Cassytha nodiflora	0	0.1
Cryptandra wilsonii	0.4	4
Dodonaea microzyga var. *acrolobata*	0.9	0.5
Eucalyptus capillosa	8	3
Euryomyrtus maidenii	0.3	1
Grevillea paradoxa	1.7	0.5
Hibbertia eatoniae	0.6	25
Hybanthus floribundus subsp. *curvifolius*	0.3	0.1
Lepidosperma sp. indet.	0.3	0.1
Melaleuca hamata	2.2	10
Melaleuca radula	1.3	7
Phebalium lepidotum	0.9	0.5
Phebalium tuberculosum	0.9	2
Styphelia serratifolia	1.1	1
Stenanthemum bremerense (P4)	0.1	0.1

Site Type	Site Name	Date	Site Photograph
Quadrat	LoM19	22-04-20 & 25-09-2020	
Dimensions	20m x 20 m		
Described by	Scott Pansini, Jeni Alford and Julijanna Hantzis		
Location (UTM)			
Easting	740995	mE	
Northing	6511426	mN	
Site Characteristics			
Landform	Sandy/Stony Plain		
Slope	Low (1-20°)		
Aspect	South-east		
Condition			
Vegetation Condition	Pristine		
Disturbance Type	None discernible		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches		
Water Presence	None		
Soils			
Soil Texture	Sandy loam		
Soil Colour	Orange		
Rock Type	Laterite		
Coarse Surface Particles			
Maximum Size (mm)	Gravel (1-4 cm)		
Abundance (%)	Common		
Exposed Bedrock (%)	Negligible (<5%)		
Vegetation Description	*Eucalyptus ? rigidula* scattered low trees over *Acacia assimilis subsp. Assimilis, Acacia beauverdiana, Melaleuca hamata* tall shrubland over *Thryptomene kochii, Baeckea elderiana, Leptospermum fastigiatum* shrubland over *Euryomyrtus maidenii* low open shrubland.		

Species List

Species	Height (m)	Cover (%)
Acacia assimilis subsp. *assimilis*	5	2
Acacia beauverdiana	4	5
Allocasuarina ?spinosissima	1.4	0.1
Baeckea elderiana	1.3	3
Cassytha nodiflora	0	0.1
Drosera macrantha	vine	0.1
Eucalyptus ?rigidula	7	1
Euryomyrtus maidenii	0.4	3
Grevillea obliquistigma subsp. *obliquistigma*	1.1	0.1
Hibbertia eatoniae	0.15	0.1
Lepidosperma sp. indet.	0.4	0.5
Leptospermum fastigiatum	1.4	2
Leucopogon sp. outer wheatbelt (M. Hislop 30)	1.1	0.1
Melaleuca hamata	3	4
Prostanthera semiteres subsp. *semiteres*	0.2	0.1
Santalum acuminatum	2.1	1
Thryptomene kochii	1.2	20
Thysanotus manglesianus	0	0.1
Trachymene ornata	0.1	0.1
Waitzia acuminata	0.1	0.1

Site Type	Site Name	Date	Site Photograph
Quadrat	LoM20	22-04-2020 & 25-09-2020	
Dimensions	20m x 20 m		
Described by	Scott Pansini, Jeni Alford and Julijanna Hantzis		
Location (UTM)			
Easting	740987	mE	
Northing	6510957	mN	
Site Characteristics			
Landform	Sandy/Stony Plain		
Slope	Flat (0°)		
Aspect	None		
Condition			
Vegetation Condition	Excellent		
Disturbance Type	Rubbish/ Litter		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches		
Water Presence	None		
Soils			
Soil Texture	Sandy loam		
Soil Colour	Orange		
Rock Type	Laterite		
Coarse Surface Particles			
Maximum Size (mm)	Gravel (1-4 cm)		
Abundance (%)	Moderate		
Exposed Bedrock (%)	Negligible (<5%)		
Vegetation Description	*Eucalyptus horistes* scattered low trees over *Acacia beauverdiana, Melaleuca hamata* tall open scrub over *Thryptomene kochii, Leptospermum fastigiatum shrubland* over *Euryomyrtus maidenii* low open shrubland.		

Species List

Species	Height (m)	Cover (%)
Acacia beauverdiana	4	20
Cassytha sp. indet.	0	0.1
Drosera macrantha	0	0.1
Eucalyptus horistes	7	1.5
Euryomyrtus maidenii	0.4	3
Lawrencella rosea	0.01	0.1
Leptospermum fastigiatum	1.3	5
Melaleuca hamata	3	20
Prostanthera semiteres subsp. *semiteres*	0.5	0.1
Thryptomene kochii	1.4	20
Trachymene ornata	0.01	0.1

Site Type	Site Name	Date	Site Photograph
Quadrat	LoM21	18-04-2020 & 25-09-2020	
Dimensions	20m x 20 m		
Described by	Scott Pansini, Jeni Alford and Julijanna Hantzis		
Location (UTM)			
Easting	743611	mE	
Northing	6511535	mN	
Site Characteristics			
Landform	Stony sandplain		
Slope	Low (1-20º)		
Aspect	East		
Condition			
Vegetation Condition	Pristine		
Disturbance Type	None discernible		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches		
Water Presence	None		
Soils			
Soil Texture	Loamy sand		
Soil Colour	Orange		
Rock Type	Sandstone		
Coarse Surface Particles			
Maximum Size (mm)	Gravel (1-4 cm)		
Abundance (%)	Rare		
Exposed Bedrock (%)	Negligible (<5%)		
Vegetation Description	*Eucalyptus loxophleba* subsp. *Lissophloia* low open woodland over *Melaleuca hamata, Santalum acuminatum, Hakea francisiana* tall shrubland over *Baeckea elderiana, Thryptomene kochii* low open shrubland.		

Species List

Species	Height (m)	Cover (%)
Acacia yorkrakinensis subsp. *acrita*	2.3	0.1
Allocasuarina campestris	2.5	0.5
Alyxia buxifolia	1	0.1
Baeckea elderiana	1.8	5
Beyeria sulcata var. *sulcata*	1.3	0.1
Eucalyptus loxophleba subsp. *lissophloia*	9	9
Euryomyrtus maidenii	0.6	0.5
Grevillea obliquistigma subsp. *obliquistigma*	2.1	0.1
Grevillea paradoxa	1.1	0.1
Hakea francisiana	6	2
Hibbertia eatoniae	0.15	0.1
Leucopogon sp. outer wheatbelt (M. Hislop 30)	1.5	0.1
Melaleuca cordata	1.5	0.5
Melaleuca hamata	3	20
Melaleuca sp. indet.	0.3	0.1
Micromyrtus racemosa	0.3	0.1
Santalum acuminatum	4	3
Thryptomene kochii	1.3	5

Site Type	Site Name	Date	Site Photograph
Quadrat	LoM24	22-04-2020 & 25-09-2020	
Dimensions	20m x 20 m		
Described by	Scott Pansini, Jeni Alford and Julijanna Hantzis		
Location (UTM)			
Easting	741403	mE	
Northing	6510937	mN	
Site Characteristics			
Landform	Sandy/Stony Plain		
Slope	Flat (0°)		
Aspect	None		
Condition			
Vegetation Condition	Pristine		
Disturbance Type	None discernible		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches		
Water Presence	None		
Soils			
Soil Texture	Loamy sand		
Soil Colour	Orange		
Rock Type	Laterite		
Coarse Surface Particles			
Maximum Size (mm)	Gravel (1-4 cm)		
Abundance (%)	Moderate		
Exposed Bedrock (%)	Negligible (<5%)		
Vegetation Description	*Eucalyptus capillosa, Eucalyptus horistes* low woodland over *Allocasuarina campestris* tall open scrub over *Grevillea obliquistigma* subsp. *obliquistigma* scattered shrubs over *Hibbertia eatoniae, Euryomyrtus maidenii, Prostanthera semiteres* subsp. *semiteres* scattered low shrubs.		

Species List

Species	Height (m)	Cover (%)
Acacia hemiteles	1.1	0.1
Allocasuarina campestris	2.5	30
Dianella revoluta var. *divaricata*	0.8	.1
Eucalyptus horistes	8	5
Eucalyptus capillosa	8	6
Euryomyrtus maidenii	0.3	1
Grevillea obliquistigma subsp. *obliquistigma*	1.3	1
Grevillea paradoxa	0.3	0.1
Hakea francisiana	4	0.5
Hibbertia eatoniae	0.5	2
Leptospermum fastigiatum	1.7	0.1
Melaleuca hamata	2.3	1
Prostanthera semiteres subsp. *semiteres*	0.8	1
Santalum acuminatum	4.5	2
Stenanthemum bremerense (P4)	0.2	0.1

Site Type	Site Name	Date	Site Photograph
Quadrat	LoM25	22-04-2020 & 25-09-2020	
Dimensions	20m x 20 m		
Described by	Scott Pansini, Jeni Alford and Julijanna Hantzis		
Location (UTM)			
Easting	742108	mE	
Northing	6510805	mN	
Site Characteristics			
Landform	Rocky outcropping		
Slope	Moderately inclined (21-45º)		
Aspect	East		
Condition			
Vegetation Condition	Excellent		
Disturbance Type	Mining exploration, Road access tracks		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches		
Water Presence	None		
Soils			
Soil Texture	Sandy loam		
Soil Colour	Red/Brown		
Rock Type	Laterite		
Coarse Surface Particles			
Maximum Size (mm)	Large rocks (20-50 cm)		
Abundance (%)	Very common		
Exposed Bedrock (%)	Moderate (30-50%)		
Vegetation Description	*Allocasuarina campestris, Calothamnus gilesii, Dodonaea microzyga* var. *acrolobata* tall open scrub over *Hibbertia eatoniae* low shrubland		

Species List

Species	Height (m)	Cover (%)
Acacia colletioides	0.9	0.1
Allocasuarina campestris	2.3	30
Calothamnus gilesii	3	5
Cassytha nodiflora	0	0.1
Dianella revoluta var. *divaricata*	0.7	0.5
Dodonaea microzyga var. *acrolobata*	2.5	3
Grevillea obliquistigma subsp. *obliquistigma*	2.2	2
Grevillea paradoxa	0.9	2
Hakea pendens (P3)	3.5	2
Hibbertia eatoniae	0.7	20
Lepidosperma sanguinolentum	0.6	0.5
Phebalium tuberculosum	1.2	0.1
Poaceae sp. indet.	0.05	0.1
Prostanthera semiteres subsp. *semiteres*	0.5	1
Styphelia serratifolia	0.8	3
Thysanotus manglesianus	0.01	0.1

Site Type	Site Name	Date	Site Photograph
Quadrat	LoM26	23-04-2020 & 25-09-2020	
Dimensions	20m x 20 m		
Described by	Scott Pansini, Jeni Alford and Julijanna Hantzis		
Location (UTM)			
Easting	741628	mE	
Northing	6509607	mN	
Site Characteristics			
Landform	Hillslope		
Slope	Low (1-20°)		
Aspect	South-east		
Condition			
Vegetation Condition	Excellent		
Disturbance Type	Mining exploration		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches		
Water Presence	None		
Soils			
Soil Texture	Sandy loam		
Soil Colour	Orange		
Rock Type	Laterite		
Coarse Surface Particles			
Maximum Size (mm)	Gravel (1-4 cm)		
Abundance (%)	Common		
Exposed Bedrock (%)	Negligible (<5%)		
Vegetation Description	*Eucalyptus capillosa* low open woodland over *Allocasuarina campestris, Thryptomene kochii, Hakea subsulcata* tall shrubland over *Grevillea obliquistigma* subsp. *obliquistigma, Melaleuca cordata, Phebalium canaliculatum* shrubland over *Euryomyrtus maidenii* scattered low shrubs.		

Species List

Species	Height (m)	Cover (%)
Acacia neurophylla	0.5	0.1
Allocasuarina acutivalvis subsp. *acutivalvis*	4	4
Allocasuarina campestris	2.5	30
Alyxia buxifolia	0.1	0.1
Amphipogon caricinus	0.15	0.1
Austrostipa elegantissima	0.7	0.1
Calothamnus gilesii	2.1	2
Cassytha nodiflora	0	0.1
Eucalyptus capillosa	9	4
Euryomyrtus maidenii	0.4	2
Grevillea obliquistigma subsp. *obliquistigma*	1.9	4
Grevillea paradoxa	0.9	0.1
Hakea subsulcata	2.8	5
Hibbertia eatoniae	0.4	0.5
Melaleuca cordata	1.5	3
Phebalium canaliculatum	1.2	5
Thryptomene kochii	2.1	10
Thysanotus manglesianus	0	0.1

Site Type	Site Name	Date	Site Photograph
Relevé	rLoM34	24-04-2020	
Dimensions	Unbounded		
Described by	Scott Pansini, Jeni Alford		
Location (UTM)			
Easting	741690	mE	
Northing	6512343	mN	
Site Characteristics			
Landform	Sandy/Stony Plain		
Slope	N/A		
Aspect	Flat (0°)		
Condition			
Vegetation Condition	Very Good		
Disturbance Type	Historic clearing		
Disturbance Fauna	None discernible		
Fire Age	Unknown (no evidence)		
Fire Notes	None		
Water Presence	None		
Soils			
Soil Texture	Loamy sand		
Soil Colour	Brown/ orange		
Rock Type	quartz		
Coarse Surface Particles			
Maximum Size (mm)	Pebbles (5-10 cm)		
Abundance (%)	Common		
Exposed Bedrock (%)	None		
Vegetation Description	*Atriplex vesicaria, Tecticornia pterygosperma* subsp. *pterygosperma, Tecticornia pergranulata* subsp. *pergranulata* and *Enchylaena tomentosa* low open shrubland.		

Species List

Species	Height (m)	Cover (%)
? *Eriochiton sclerolaenoides*	0.2	0.5
Atriplex vesicaria	0.3	3
Atriplex nummularia subsp. *spathulata*	0.15	0.1
Enchylaena tomentosa	0.3	1
Tecticornia pergranulata subsp. *pergranulata*	0.25	2
Tecticornia pterygosperma subsp. *pterygosperma*	0.2	3

Site Type	Site Name	Date
Quadrat	LoM42	24-04-2020 & 25-09-2020
Dimensions	20m x 20 m	
Described by	Scott Pansini, Jeni Alford and Julijanna Hantzis	
Location (UTM)		
Easting	743881	mE
Northing	6510937	mN
Site Characteristics		
Landform	Sandy/Stony Plain	
Slope	Flat (0°)	
Aspect	None	
Condition		
Vegetation Condition	Excellent	
Disturbance Type	Road access, tracks	
Disturbance Fauna	None discernible	
Fire Age	Old (6+yrs)	
Fire Notes	Bare ground	
Water Presence	None	
Soils		
Soil Texture	Loamy sand	
Soil Colour	Orange	
Rock Type	Sandstone	
Coarse Surface Particles		
Maximum Size (mm)	Gravel (1-4 cm)	
Abundance (%)	Moderate	
Exposed Bedrock (%)	Negligible (<5%)	
Vegetation Description	*Melaleuca hamata, Acacia acuminata, Allocasuarina corniculata* tall shrubland over *Baeckea elderiana* shrubland over *Euryomyrtus maidenii, Hibbertia eatoniae, Prostanthera semiteres* subsp. *Semiteres* low open shrubland.	

Site Photograph

Species List

Species	Height (m)	Cover (%)
?Ericomyrtus serpyllifolia	0.1	0.1
Acacia acuminata	3	5
Allocasuarina corniculata	3	5
Baeckea elderiana	1.8	20
Cassytha nodiflora	0	0.5
Ericomyrtus sp. indet.	0.3	0.1
Euryomyrtus maidenii	0.3	2
Grevillea obliquistigma subsp. *obliquistigma*	1.3	1
Grevillea paradoxa	0.7	0.1
Hibbertia eatoniae	0.2	1
Leptospermum fastigiatum	2.1	0.5
Melaleuca eleuterostachya	2.1	0.1
Melaleuca hamata	3	8
Melaleuca lateriflora	2.1	0.1
Podolepis lessonii	0.01	0.1
Prostanthera semiteres subsp. *semiteres*	0.4	1
Thryptomene kochii	1.1	1
Thysanotus manglesianus	0	0.1
Trachymene ornata	0.01	0.1
Waitzia acuminata	0.01	0.1

Site Type	Site Name	Date	Site Photograph
Quadrat	QLOM51	29-09-2020	
Dimensions	20m x 20 m		
Described by	Scott Pansini and Julijanna Hantzis		
Location (UTM)			
Easting	742946	mE	
Northing	6510959	mN	
Site Characteristics			
Landform	Undulating plain		
Slope	Flat (0º)		
Aspect	None		
Condition			
Vegetation Condition	Excellent		
Disturbance Type	Road access, tracks		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches		
Water Presence	None		
Soils			
Soil Texture	Sandy loam		
Soil Colour	Red/Brown		
Rock Type	Calcrete		
Coarse Surface Particles			
Maximum Size (mm)	Gravel (1-4 cm)		
Abundance (%)	Rare		
Exposed Bedrock (%)	Negligible (<5%)		
Vegetation Description	*Eucalyptus salmonophloia, Eucalyptus longicornis, Eucalyptus salubris* woodland over *Melaleuca pauperiflora, Exocarpos aphyllus, Santalum acuminatum* tall shrubland over *Dodonaea stenozyga, Scaevola spinescens, Acacia merrallii* low shrubland.		

Species List

Species	Height (m)	Cover (%)
Acacia erinacea	0.2	1
Acacia merrallii	0.4	3
Alyxia buxifolia	1.8	5
Austrostipa elegantissima	0.3	0.1
Dodonaea stenozyga	0.9	10
Eremophila ionantha	0.3	0.1
Eucalyptus longicornis	15	7
Eucalyptus salmonophloia	30	15
Eucalyptus salubris	15	5
Exocarpos aphyllus	3	5
Melaleuca pauperiflora	4	7
Olearia muelleri	0.3	1
Santalum acuminatum	2.1	4
Scaevola spinescens	0.5	5
Templetonia ceracea	0.5	0.1

Site Type	Site Name	Date	Site Photograph
Quadrat	QLOM52	29-09-2020	
Dimensions	20m x 20 m		
Described by	Scott Pansini and Julijanna Hantzis		
Location (UTM)			
Easting	742025	mE	
Northing	6512459	mN	
Site Characteristics			
Landform	Sandy/Stony Plain		
Slope	Flat (0º)		
Aspect	None		
Condition			
Vegetation Condition	Pristine		
Disturbance Type	None discernible		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches, Bare ground		
Water Presence	None		
Soils			
Soil Texture	Sandy loam		
Soil Colour	Red/Brown		
Rock Type	Laterite		
Coarse Surface Particles			
Maximum Size (mm)	Gravel (1-4 cm)		
Abundance (%)	Rare		
Exposed Bedrock (%)	Negligible (<5%)		
Vegetation Description	*Eucalyptus salmonophloia, Eucalyptus salubris* woodland over *Melaleuca pauperiflora, Exocarpos aphyllus* tall shrubland over *Microcybe multiflora* open shrubland.		

Species List

Species	Height (m)	Cover (%)
Acacia merrallii	0.2	0.5
Alyxia buxifolia	1.2	0.1
Austrostipa elegantissima	0.3	0.1
Eriochiton sclerolaenoides	0.05	0.1
Eucalyptus salmonophloia	20	15
Eucalyptus salubris	15	5
Exocarpos aphyllus	3	2
Melaleuca pauperiflora	5	10
Microcybe multiflora	1.1	5
Olearia muelleri	0.4	0.5
Roepera ovata	0.05	0.1
Sclerolaena diacantha	0.05	0.1

Site Type	Site Name	Date	Site Photograph
Quadrat	QLOM53	29-09-2020	
Dimensions	20m x 20m		
Described by	Scott Pansini and Julijanna Hantzis		
Location (UTM)			
Easting	742768	mE	
Northing	6511785	mN	
Site Characteristics			
Landform	Undulating plain		
Slope	Flat (0º)		
Aspect	None		
Condition			
Vegetation Condition	Excellent		
Disturbance Type	Road access, tracks		
Disturbance Fauna	None discernible		
Fire Age	Old (6+yrs)		
Fire Notes	Dead branches, Bare ground		
Water Presence	None		
Soils			
Soil Texture	Sandy loam		
Soil Colour	Brown		
Rock Type	Quartz		
Coarse Surface Particles			
Maximum Size (mm)	Gravel (1-4 cm)		
Abundance (%)	Very common		
Exposed Bedrock (%)	Negligible (<5%)		
Vegetation Description	*Eucalyptus salmonophloia, Eucalyptus salubris* woodland over *Santalum acuminatum, Exocarpos aphyllus* tall open shrubland over *Dodonaea stenozyga* open shrubland over *Acacia merrallii, Grevillea acuaria, Acacia ?camptoclada* low shrubland.		

Species List

Species	Height (m)	Cover (%)
Acacia ?camptoclada	0.4	2
Acacia intricata	0.2	0.5
Acacia merrallii	0.3	5
Alyxia buxifolia	0.8	0.1
Daviesia argillacea	0.7	1
Dodonaea stenozyga	1.1	2
Eremophila ionantha	0.5	0.1
Eremophila scoparia	0.6	0.1
Eriochiton sclerolaenoides	0.02	0.1
Eucalyptus salmonophloia	30	15
Eucalyptus salubris	15	14
Exocarpos aphyllus	2.1	5
Grevillea acuaria	0.2	3
Maireana carnosa	0.05	0.1
Maireana marginata	0.05	0.1
Olearia muelleri	0.5	0.1
Podolepis lessonii	0.05	0.1
Santalum acuminatum	4	3
Scaevola spinescens	0.8	1
Templetonia ceracea	0.5	5
Wilsonia humilis	0.15	0.1

Site Type	Site Name	Date
Relevé	rLoM34	24-04-2020
Dimensions	Unbounded	
Described by	Scott Pansini, Jeni Alford	
Location (UTM)		
Easting	741690	mE
Northing	6512343	mN
Site Characteristics		
Landform	Sandy/Stony Plain	
Slope	N/A	
Aspect	Flat (0º)	
Condition		
Vegetation Condition	Very Good	
Disturbance Type	Historic clearing	
Disturbance Fauna	None discernible	
Fire Age	Unknown (no evidence)	
Fire Notes	None	
Water Presence	None	
Soils		
Soil Texture	Loamy sand	
Soil Colour	Brown/ orange	
Rock Type	quartz	
Coarse Surface Particles		
Maximum Size (mm)	Pebbles (5-10 cm)	
Abundance (%)	Common	
Exposed Bedrock (%)	None	

Site Photograph

Vegetation Description	*Atriplex vesicaria, Tecticornia pterygosperma* subsp. *pterygosperma, Tecticornia pergranulata* subsp. *pergranulata* and *Enchylaena tomentosa* low open shrubland.

Species List

Species	Height (m)	Cover (%)
? *Eriochiton sclerolaenoides*	0.2	0.5
Atriplex vesicaria	0.3	3
Atriplex nummularia subsp. *spathulata*	0.15	0.1
Enchylaena tomentosa	0.3	1
Tecticornia pergranulata subsp. *pergranulata*	0.25	2
Tecticornia pterygosperma subsp. *pterygosperma*	0.2	3

Appendix F Inventory of Vascular Flora Recorded

Family	Species
Apocynaceae	*Alyxia buxifolia*
Araliaceae	*Trachymene ornata*
Asparagaceae	*Thysanotus manglesianus*
Asteraceae	**Sonchus* sp. indet.
	Isoetopsis graminifolia
	Lawrencella rosea
	Olearia muelleri
	Podolepis lessonii
	Waitzia acuminata
Casuarinaceae	*Allocasuarina ?spinosissima*
	Allocasuarina acutivalvis subsp. *acutivalvis*
	Allocasuarina campestris
	Allocasuarina corniculata
	Allocasuarina sp. indet.
Chenopodiaceae	*?Eriochiton sclerolaenoides*
	Enchylaena tomentosa
	Eriochiton sclerolaenoides
	Maireana carnosa
	Maireana marginata
	Sclerolaena diacantha
	Tecticornia pergranulata subsp. *pergranulata*
	Tecticornia pterygosperma subsp. *pterygosperma*
Convolvulaceae	*Wilsonia humilis*
Cyperaceae	*Lepidosperma sanguinolentum*
	Lepidosperma sp. indet.
Dilleniaceae	*Hibbertia eatoniae*
Droseraceae	*Drosera macrantha*
Ericaceae	*Acrotriche lancifolia*
	Leucopogon sp. outer wheatbelt (M. Hislop 30)
	Styphelia serratifolia
Euphorbiaceae	*Beyeria sulcata* var. *sulcata*
Fabaceae	**Medicago minima*
	Acacia ?camptoclada
	Acacia ?nigripilosa subsp. *nigripilosa*
	Acacia acuminata
	Acacia assimilis subsp. *assimilis*
	Acacia beauverdiana
	Acacia camptoclada
	Acacia colletioides
	Acacia erinacea
	Acacia hemiteles
	Acacia intricata
	Acacia merrallii
	Acacia neurophylla

Family	Species
	Acacia steedmanii subsp. *steedmanii*
	Acacia yorkrakinensis subsp. *acrita*
	Daviesia argillacea
	Gastrolobium parviflorum
	Templetonia ceracea
Geraniaceae	**Erodium cicutarium*
Goodeniaceae	*Goodenia pinifolia*
	Scaevola spinescens
Hemerocallidaceae	*Dianella revoluta* var. *divaricata*
Lamiaceae	*Hemigenia pedunculata*
	Prostanthera semiteres subsp. *semiteres*
Lauraceae	*Cassytha nodiflora*
	Cassytha sp. indet.
Loranthaceae	*Lysiana* sp. indet.
Myrtaceae	*?Ericomyrtus serpyllifolia*
	Baeckea elderiana
	Calothamnus gilesii
	Ericomyrtus sp. indet.
	Eucalyptus ?rigidula
	Eucalyptus capillosa
	Eucalyptus celastroides subsp. *celastroides*
	Eucalyptus horistes
	Eucalyptus longicornis
	Eucalyptus loxophleba subsp. *lissophloia*
	Eucalyptus moderata
	Eucalyptus salmonophloia
	Eucalyptus salubris
	Eucalyptus sheathiana
	Eucalyptus sp. indet.
	Eucalyptus yilgarnensis
	Euryomyrtus maidenii
	Leptospermum fastigiatum
	Melaleuca cordata
	Melaleuca eleuterostachya
	Melaleuca hamata
	Melaleuca lateriflora
	Melaleuca pauperiflora
	Melaleuca radula
	Melaleuca sp. indet.
	Micromyrtus racemosa
	Rinzia fimbriolata (P1)
	Rhodanthe pygmaea
	Thryptomene kochii
Poaceae	**Pentameris airoides*

Family	Species
	**Pentameris airoides* subsp. *airoides*
	**Rostraria pumila*
	Amphipogon caricinus
	Austrostipa elegantissima
	Poaceae sp. indet.
Primulaceae	**Lysimachia arvensis*
Proteaceae	*Grevillea acuaria*
	Grevillea obliquistigma subsp. *obliquistigma*
	Grevillea paradoxa
	Hakea francisiana
	Hakea pendens (P3)
	Hakea subsulcata
Rhamnaceae	*Cryptandra wilsonii*
	Stenanthemum bremerense (P4)
Rutaceae	*Microcybe multiflora*
	Phebalium canaliculatum
	Phebalium lepidotum
	Phebalium tuberculosum
Santalaceae	*Exocarpos aphyllus*
	Santalum acuminatum
Sapindaceae	*Dodonaea microzyga* var. *acrolobata*
	Dodonaea stenozyga
Scrophulariaceae	*Eremophila interstans* subsp. *Interstans*
	Eremophila ionantha
	Eremophila scoparia
Solanaceae	*Solanum hoplopetalum*
Violaceae	*Hybanthus floribundus* subsp. *curvifolius*
Zygophyllaceae	*Roepera ovata*

Appendix G Vertebrate Fauna Identified in the Desktop Assessment

Legend:

Database Searches:

A	Birdata: Custom Atlas Bird List (Birdlife Australia 2019)
B	Threatened and Priority Fauna Search (DBCA 2020b)
C	NatureMap Database (DBCA 2020a)
D	Protected Matters Search Tool (DotEE 2020)

Literature Review:

E	Parker Range PEC, Flora and Fauna Reconnaissance Survey and Priority Flora Search (Stantec 2019)
F	Level 2 Flora & Fauna Survey: Redwing Project For Hanking Gold Mining Pty Ltd (Botanica 2016b)
G	Yilgarn Star North Prospect Biological Assessment (GHD 2016)
H	Southern Cross Operations: Baseline Fauna Survey; Spring 2007 & Autumn 2008 (Western Wildlife 2008)

Current Survey:

I	Windmills Flora, Vegetation and Fauna Survey

Species	Common name	WA	EPBC	A	B	C	D	E	F	G	H	I
Amphibia												
Myobatrachidae												
Pseudophryne guentheri	Crawling Toadlet					x						
Pseudophryne occidentalis	Western Toadlet					x					x	
Limnodynastidae												
Heleioporus albopunctatus	Western Spotted Frog					x					x	
Neobatrachus albipes	White-footed Trilling Frog					x					x	
Neobatrachus kunapalari	Kunapalari Frog					x					x	
Aves												
Acanthizidae												
Acanthiza apicalis	Inland Thornbill			x		x			x		x	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill			x		x				x	x	
Acanthiza uropygialis	Chestnut-rumped Thornbill			x		x					x	
Aphelocephala leucopsis	Southern Whiteface			x								
Calamanthus campestris	Rufous Fieldwren			x								
Calamanthus cauta	Shy Heathwren			x		x			x		x	
Gerygone fusca	Western Gerygone			x		x				x	x	
Pyrrholaemus brunneus	Redthroat			x		x			x		x	
Sericornis frontalis	White-browed Scrubwren			x								
Smicrornis brevirostris	Weebill			x		x			x	x	x	
Accipitridae												
Elanus caeruleus axillaris	Australian Black-shouldered Kite			x								
Hieraaetus morphnoides	Little Eagle			x								
Accipiter cirrocephalus	Collared Sparrowhawk			x								
Accipiter fasciatus	Brown Goshawk			x							x	
Aquila audax	Wedge-tailed Eagle			x		x		x	x		x	
Circus assimilis	Spotted Harrier			x								
Haliastur sphenurus	Whistling Kite			x								
Hamirostra isura	Square-tailed Kite			x		x					x	
Milvus migrans	Black Kite			x								
Aegothelidae												
Aegotheles cristatus	Australian Owlet-nightjar			x		x					x	
Alcedinidae												
Todiramphus pyrrhopygius	Red-backed Kingfisher			x								
Todiramphus sanctus	Sacred Kingfisher			x								
Anatidae												
Anas gracilis	Grey Teal			x								
Anas superciliosa	Pacific Black Duck			x								
Aythya australis	Hardhead			x								
Chenonetta jubata	Australian Wood Duck			x		x						

Species	Common name	WA	EPBC	A	B	C	D	E	F	G	H	I
Malacorhynchus membranaceus	Pink-eared Duck			x								
Tadorna tadornoides	Australian Shelduck			x								
Apodidae												
Apus pacificus	Fork-tailed Swift	IA	Mi				x					
Ardeidae												
Ardea ibis	Cattle Egret						x					
Ardea modesta	Eastern Great Egret						x					
Ardea novaehollandiae	White-faced Heron			x								
Ardea pacifica	White-necked Heron			x								
Artamidae												
Artamus cinereus	Black-faced Woodswallow			x		x			x		x	
Artamus cyanopterus	Dusky Woodswallow			x		x					x	
Artamus personatus	Masked Woodswallow			x		x						
Cacatuidae												
Cacatua leadbeateri	Major Mitchell's Cockatoo			x								
Cacatua roseicapilla	Galah			x		x		x	x		x	x
Cacatua sanguinea	Little Corella			x								
Calyptorhynchus banksii	Red-Tailed Black Cockatoo			x								
Nymphicus hollandicus	Cockatiel			x								
Campephagidae												
Coracina maxima	Ground Cuckoo-shrike										x	
Coracina novaehollandiae	Black-faced Cuckoo-shrike			x		x		x	x		x	
Lalage tricolor	White-winged Triller			x							x	
Caprimulgidae												
Eurostopodus argus	Spotted Nightjar			x		x						
Charadriidae												
Charadrius melanops	Black-fronted Dotterel			x								
Thinornis cucullatus	Hooded Plover	P4					x					
Vanellus tricolor	Banded Lapwing			x								
Climacteridae												
Climacteris rufa	Rufous Treecreeper			x							x	
Columbidae												
Columba livia	*Domestic Pigeon			x			x					
Ocyphaps lophotes	Crested Pigeon			x		x		x			x	x
Phaps chalcoptera	Common Bronzewing			x		x		x	x		x	
Phaps elegans	Brush Bronzewing									x		
Streptopelia senegalensis	*Laughing Turtle-Dove			x			x					
Corvidae												
Corvus bennetti	Little Crow			x		x				x		
Corvus coronoides	Australian Raven			x		x		x	x		x	x

Species	Common name	WA	EPBC	A	B	C	D	E	F	G	H	I
Corvus orru	Torresian Crow			x							x	
Cracticidae												
Cracticus nigrogularis	Pied Butcherbird			x		x		x			x	
Cracticus tibicen	Australian Magpie			x		x		x		x	x	
Cracticus torquatus	Grey Butcherbird			x		x			x		x	
Strepera versicolor	Grey Currawong			x		x		x	x	x	x	
Cuculidae												
Cacomantis flabelliformis	Fan-tailed Cuckoo			x		x					x	
Cacomantis pallidus	Pallid Cuckoo			x								
Chrysococcyx basalis	Horsfield's Bronze Cuckoo			x							x	
Chrysococcyx lucidus	Shining Bronze Cuckoo			x								
Chrysococcyx osculans	Black-eared Cuckoo			x			x				x	
Dicaeidae												
Dicaeum hirundinaceum	Mistletoebird			x							x	
Dromaiidae												
Dromaius novaehollandiae	Emu			x		x		x	x	x	x	
Estrildidae												
Taeniopygia guttata	Zebra Finch			x								
Falconidae												
Falco berigora	Brown Falcon			x		x		x			x	
Falco cenchroides	Australian Kestrel			x		x		x	x		x	
Falco longipennis	Australian Hobby			x								
Falco peregrinus	Peregrine Falcon	OS		x	x						x	
Hirundinidae												
Cheramoeca leucosternus	White-backed Swallow			x		x					x	
Hirundo neoxena	Welcome Swallow			x		x						
Petrochelidon ariel	Fairy Martin			x								
Petrochelidon nigricans	Tree Martin			x		x			x		x	
Locustellidae												
Megalurus cruralis	Brown Songlark			x								
Megalurus mathewsi	Rufous Songlark			x								
Maluridae												
Malurus lamberti	Variegated Fairy-wren			x					x			
Malurus leucopterus	White-winged Fairy-wren			x							x	
Malurus pulcherrimus	Blue-breasted Fairy-wren			x		x					x	
Malurus splendens	Splendid Fairy-wren			x								
Stipiturus malachurus	Southern Emu-wren			x								
Meliphagidae												
Acanthagenys rufogularis	Spiny-cheeked Honeyeater			x		x					x	
Acanthorhynchus superciliosus	Western Spinebill									x		

Species	Common name	WA	EPBC	A	B	C	D	E	F	G	H	I
Anthochaera carunculata	Red Wattlebird			x		x		x	x	x	x	
Certhionyx variegatus	Pied Honeyeater			x								
Epthianura albifrons	White-fronted Chat			x							x	
Epthianura tricolor	Crimson Chat			x								
Gavicalis virescens	Singing Honeyeater			x							x	
Glyciphila melanops	Tawny-crowned Honeyeater			x		x			x			
Lichenostomus cratitius	Purple-gaped Honeyeater			x								
Lichenostomus leucotis	White-eared Honeyeater			x		x			x		x	
Lichmera indistincta	Brown Honeyeater			x		x					x	
Manorina flavigula	Yellow-throated Miner			x		x					x	
Melithreptus brevirostris	Brown-headed Honeyeater			x		x				x	x	
Phylidonyris nigra	White-cheeked Honeyeater			x								
Ptilotula ornatus	Yellow-plumed Honeyeater			x							x	
Purnella albifrons	White-fronted Honeyeater			x		x			x			
Sugomel niger	Black Honeyeater			x								
Meropidae												
Merops ornatus	Rainbow Bee-eater			x		x	x				x	
Monarchidae												
Grallina cyanoleuca	Magpie-lark			x				x			x	
Motacillidae												
Anthus australis	Australian Pipit			x							x	
Motacilla cinerea	Grey Wagtail	IA	Mi				x					
Neosittidae												
Daphoenositta chrysoptera	Varied Sittella			x		x			x		x	
Oreoicidae												
Oreoica gutturalis	Crested Bellbird			x		x			x		x	x
Otididae												
Ardeotis australis	Australian Bustard			x								
Pachycephalidae												
Colluricincla harmonica	Grey Shrike-thrush			x		x			x		x	
Falcunculus frontatus	Crested Shrike-tit			x								
Pachycephala inornata	Gilbert's Whistler			x		x					x	
Pachycephala occidentalis	Western Whistler			x					x		x	x
Pachycephala rufiventris	Rufous Whistler			x		x				x	x	
Pardalotidae												
Pardalotus punctatus	Spotted Pardalote			x		x						
Pardalotus striatus	Striated Pardalote			x		x			x		x	
Petroicidae												
Drymodes brunneopygia	Southern Scrub-robin			x		x			x		x	

Species	Common name	WA	EPBC	A	B	C	D	E	F	G	H	I
Eopsaltria australis griseogularis	Western Yellow Robin			x		x			x		x	
Melanodryas cucullata	Hooded Robin			x						x		
Microeca fascinans	Jacky Winter			x		x					x	
Petroica boodang	Scarlet Robin			x								
Petroica goodenovii	Red-capped Robin			x		x				x	x	
Phalacrocoracidae												
Phalacrocorax melanoleucos	Little Pied Cormorant			x								
Phasianidae												
Coturnix pectoralis	Stubble Quail			x								
Podargidae												
Podargus strigoides	Tawny Frogmouth			x								
Podicipedidae												
Poliocephalus poliocephalus	Hoary-headed Grebe			x								
Tachybaptus novaehollandiae	Australasian Grebe			x								
Pomatostomidae												
Pomatostomus superciliosus	White-browed Babbler			x		x			x		x	
Psittacidae												
Melopsittacus undulatus	Budgerigar			x								
Neophema elegans	Elegant Parrot			x							x	
Parvipsitta porphyrocephala	Purple-crowned Lorikeet			x				x	x		x	
Pezoporus occidentalis	Night Parrot	Cr	En				x					
Platycercus icterotis xanthogenys	Western Rosella (inland)	P4		x	x	x					x	
Platycercus varius	Mulga Parrot			x								
Platycercus zonarius	Australian Ringneck			x		x		x			x	x
Polytelis anthopeplus	Regent Parrot			x		x		x			x	
Psophodidae												
Cinclosoma clarum	Copper-backed Quail-thrush			x					x			
Rallidae												
Fulica atra	Eurasian Coot			x								
Tribonyx ventralis	Black-tailed Native-hen			x								
Rhipiduridae												
Rhipidura albiscapa	Grey Fantail			x		x					x	
Rhipidura leucophrys	Willie Wagtail			x		x		x	x		x	x
Scolopacidae												
Calidris acuminata	Sharp-tailed Sandpiper	IA	Mi				x					
Calidris ferruginea	Curlew Sandpiper	Cr	Cr; Mi				x					
Calidris melanotos	Pectoral Sandpiper	IA	Mi				x					
Tringa hypoleucos	Common Sandpiper	IA	Mi	x			x					
Tringa nebularia	Common Greenshank	IA	Mi	x	x							

Species	Common name	WA	EPBC	A	B	C	D	E	F	G	H	I
Strigidae												
Ninox boobook	Boobook Owl			x							x	
Threskiornithidae												
Threskiornis molucca	Australian White Ibis			x								
Turnicidae												
Turnix varia	Painted Button-quail			x								
Turnix velox	Little Button-quail			x								
Tytonidae												
Tyto alba	Barn Owl			x								
Megapodiidae												
Leipoa ocellata	Malleefowl	Vu	Vu	x	x	x	x	x	x			x
Recurvirostridae												
Himantopus himantopus	Black-winged Stilt			x								
Cladorhynchus leucocephalus	Banded Stilt			x								
Recurvirostra novaehollandiae	Red-necked Avocet			x								
Laridae												
Larus novaehollandiae	Silver Gull			x								
Zosteropidae												
Zosterops lateralis	Silvereye			x		x						
Mammalia												
Bovidae												
Capra hircus	*Goat						x					
Ovis aries	*Sheep							x				
Canidae												
Canis lupus	*Dog						x			x		
Vulpes vulpes	*Red Fox						x	x	x		x	
Dasyuridae												
Dasyurus geoffroii	Chuditch	Vu	Vu		x		x					
Phascogale calura	Red-tailed Phascogale	CD	Vu			x						
Sminthopsis crassicaudata	Fat-tailed Dunnart										x	
Sminthopsis dolichura	Little long-tailed Dunnart					x						
Sminthopsis granulipes	White-tailed Dunnart					x						
Equidae												
Equus asinus	*Donkey						x					
Equus caballus	*Horse						x					
Felidae												
Felis catus	*Cat						x		x		x	
Leporidae												
Oryctolagus cuniculus	*Rabbit						x	x	x	x	x	x
Macropodidae												
Macropus fuliginosus	Western Grey Kangaroo							x	x	x	x	
Notamacropus irma	Western Brush Wallaby	P4			x							

Species	Common name	WA	EPBC	A	B	C	D	E	F	G	H	I
Osphranter robustus	Euro					x					x	
Petrogale lateralis lateralis	Black-footed Rock-wallaby	En	En		x							
Molossidae												
Austronomus australis	White-striped Freetail-bat								x		x	
Ozimops kitcheneri	Western Free-tailed Bat								x			
Muridae												
Leporillus conditor	Greater Stick-nest Rat	CD	Vu		x							
Mus musculus	*House Mouse					x	x			x	x	
Notomys mitchellii	Mitchell's Hopping-mouse					x			x		x	
Tachyglossidae												
Tachyglossus aculeatus	Short-beaked Echidna							x		x	x	
Thylacomyidae												
Macrotis lagotis	Bilby	Vu	Vu			x						
Vespertilionidae												
Chalinolobus gouldii	Gould's Wattled Bat					x			x		x	
Chalinolobus morio	Chocolate Wattled Bat								x			
Nyctophilus geoffroyi	Lesser Long-eared Bat					x			x			
Scotorepens balstoni	Inland Broad-nosed Bat										x	
Vespadelus regulus	Southern Forest Bat								x		x	
Burramyidae												
Cercartetus concinnus	Western Pygmy-possum					x					x	
Suidae												
Sus scrofa	*Pig						x					
Camelidae												
Camelus dromedarius	*Camel								x			
Reptilia												
Agamidae												
Ctenophorus cristatus	Bicycle Dragon					x					x	x
Ctenophorus maculatus griseus	Spotted Military Dragon					x						
Ctenophorus reticulatus	Western Netted Dragon					x						
Ctenophorus salinarum	Salt Pan Dragon										x	
Ctenophorus scutulatus	Lozenge-marked Dragon					x					x	
Moloch horridus	Thorny Devil					x					x	
Pogona minor	Dwarf Bearded Dragon					x					x	
Tympanocryptis cephalus	Coastal Pebble-mimic dragons					x					x	
Carphodactylidae												
Underwoodisaurus milii	Southern Barking Gecko					x					x	

Species	Common name	WA	EPBC	A	B	C	D	E	F	G	H	I
Diplodactylidae												
Crenadactylus ocellatus	Clawless Gecko					x					x	
Diplodactylus granariensis	Western Stone Gecko					x					x	
Diplodactylus pulcher	Pretty Gecko					x					x	
Hesperoedura reticulata	Reticulated Velvet Gecko					x					x	
Lucasium maini	Main's Ground Gecko					x					x	
Elapidae												
Brachyurophis semifasciatus	Southern Shovel-nosed Snake					x					x	
Parasuta gouldii	Gould's Hooded Snake					x					x	
Paroplocephalus atriceps	Lake Cronin Snake	P3			x							
Pseudechis australis	Mulga Snake					x						
Pseudonaja affinis	Dugite					x		x			x	
Pseudonaja mengdeni	Western Brown Snake					x						
Pseudonaja modesta	Ringed Brown Snake					x						
Pseudonaja nuchalis	Gwardar; Northern Brown Snake										x	
Simoselaps bertholdi	Jan's Banded Snake					x					x	
Suta fasciata	Rosen's Snake					x						
Gekkonidae												
Christinus marmoratus	Marbled Gecko					x						
Gehyra variegata	Variegated Dtella					x					x	
Heteronotia binoei	Bynoe's Gecko					x					x	
Pygopodidae												
Delma fraseri	Fraser's Delma					x					x	
Lialis burtonis	Burton's Legless Lizard					x						
Pygopus lepidopodus	Common Scaly Foot					x		x			x	
Pythonidae												
Aspidites ramsayi	Woma (south west pop)	P1			x	x						
Morelia spilota	Carpet Python					x					x	
Scincidae												
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink					x						
Cryptoblepharus plagiocephalus	Peron's Snake-eyed Skink					x					x	
Ctenotus leonhardii	Common Desert Ctenotus					x						
Ctenotus schomburgkii	Barred Wedge-snouted Ctenotus					x						
Ctenotus uber	Western Spotted Ctenotus					x					x	
Egernia depressa	Southern Pygmy Spiny-tailed Skink					x						
Egernia richardi	Richard's Crevice Skink					x						
Hemiergis initialis	Western Earless Skink										x	

Species	Common name	WA	EPBC	A	B	C	D	E	F	G	H	I
Lerista gerrardii	Bold-striped Robust Slider										x	
Lerista kingi	King's Three-toed Slider					x						
Lerista muelleri	Mueller's Three-toed Slider										x	
Liopholis inornata	Desert Skink					x						
Liopholis multiscutata	Bull Skink					x			x		x	
Menetia greyii	Common Dwarf Skink					x					x	
Morethia butleri	Butler's Snake-eyed Skink					x					x	
Tiliqua multifasciata	Central Blue-tongue							x				
Tiliqua occipitalis	Western Bluetongue							x			x	x
Tiliqua rugosa	Shingleback/Bobtail					x					x	
Typhlopidae												
Anilios australis	Southern Blind Snake										x	
Anilios bicolor	Dark-spined Blind Snake										x	
Varanidae												
Varanus gouldii	Sand Monitor					x						
Varanus tristis	Racehorse Monitor					x					x	

Appendix H Likelihood of Occurrence of Significant Fauna in the Survey Area

Common name (*Scientific name*)	Conservation status		Habitat Preferences	Likelihood of occurrence and justification
	EPBC	WA		
Mammalia				
Chuditch (*Dasyurus geoffroii*)	Vu	Vu	Inhabits a range of forest, shrub and desert habitats, currently inhabits sclerophyll forest, dry woodland, heath and Mallee shrubland in southwest Australia (van Dyck and Strahan 2008). Den in hollow logs, burrows or rock crevices (DEC 2012a).	**Likely** While the Survey Area sits on the edge of the species current distribution (DEC 2012a, Woinarski *et al.* 2014), the species was recorded recently nearby. Three records from within the Phoenix, Bronco, Brumby Zeus Survey Area approximately 3.5 km south of the Survey Area (Stantec unpublished data).140 records from 2017 and 2016 were detected in an area >40km south of the Survey Area (DBCA 2020a). Remaining records of the species, located near Southern Cross and the Great Eastern highway, are over 20 years old (DBCA 2020a). Furthermore the range of *Eucalyptus* woodlands and Mallee shrubland found within the Survey Area would provide suitable habitat. Trees in the Survey Area may form hollows, and this together with areas supporting large woody debris or burrows may provide denning habitat. As such, the species is considered likely to occur.
Western Brush Wallaby (*Notamacropus irma*)		P4	Inhabits open woodland and forest, mallee and heath (DEC 2012b). The species also preferentially utilise open seasonally wet flats and scrub thickets (DEC 2012b).	**Likely** The Survey Area contains suitable habitat and occurs within the species range. The species was recorded approximately 3.5 km south of the Survey Area within the Phoenix, Bronco, Brumby Zeus Survey Area. 27 records from 2017 and 2016 were detected in one area >40km south of the Survey Area (DBCA 2020a). As such, the species is considered likely to occur.
Black-footed Rock-wallaby (*Petrogale lateralis lateralis*)	En	En	Species is largely confined to granitic outcrops in mallee scrub (van Dyck and Strahan 2008).	**Unlikely** The Survey Area does not contain large areas of granite outcropping suitable for supporting the species, and the species was only recorded once ~28km southwest of the Study Area during 2007 (DBCA 2020a). As such, the species is considered unlikely to occur.

Common name (*Scientific name*)	Conservation status		Habitat Preferences	Likelihood of occurrence and justification
	EPBC	WA		
Red-tailed Phascogale (*Phascogale calura*)	Vu	CD	Inhabits dense, tall forests, with a preference for Rock Sheoak (*Allocasuarina huegeliana*) and Wandoo woodlands with hollows for nesting sites (van Dyck and Strahan 2008).	**Unlikely** A single record of the species occurs in the immediate surrounds, however this dates back to 1998 (DBCA 2020a). The Survey Area contains suitable habitat such as *Eucalyptus* Woodlands, however falls on the edge of the species known distribution (Short and Hide 2012). Consequently, the species is considered unlikely to occur.
Numbat (*Myrmecobius fasciatus*)	En	En	Habitat dominated by Eucalypts providing hollow logs and woody debris for shelter and termites for foraging (van Dyck and Strahan 2008).	**Unlikely** While the Survey Area may contain suitable habitat, the species is restricted to isolated known populations that do not occur in the Survey Area (van Dyck and Strahan 2008). The species was only recorded at one undated location (DBCA 2020a).
Bilby (*Macrotis lagotis*)	Vu	Vu	Occupies a range of habitats including sandplains and dune fields with spinifex, acacia shrubland on red soils and stony downs and Mitchell Grass near cracking clay (van Dyck and Strahan 2008).	**Unlikely** While the Survey Area contains suitable habitat, the species is considered extinct from the Coolgardie and Avon Wheatbelt bioregions (Woinarski *et al.* 2014) and was not recorded recently. The current known range of the species is from the Tanami Desert west to Broome and south to Warburton in Western Australia (van Dyck and Strahan 2008). Consequently, the species is considered unlikely to occur within the Survey Area.
Aves				
Malleefowl (*Leipoa ocellata*)	Vu	Vu	Mainly scrubs and thickets of Mallee, Boree and Bowgada, but also other litter forming shrublands (Johnstone and Storr 1998). Sandy substrates and an abundance of leaf litter are required for the construction incubator mounds (Benshemesh 2007).	**Confirmed** Malleefowl were recorded from one active and one inactive mound in the Survey Area. Two pairs of Mallefowl and 10 mounds (five active) were recorded approximately 3.5 km from the Survey Area by Stantec (2021b) and numerous records occur in the surrounds. See **Section 5.3.3** for details.

Common name (*Scientific name*)	Conservation status		Habitat Preferences	Likelihood of occurrence and justification
	EPBC	WA		
Western Rosella (inland pop.) (*Platycercus icterotis xanthogenys*)		P4	Open forest and woodlands of Eucalypt and Sheoak with scrub, particularly those containing Wandoo, Flooded Gum, Salmon Gum, tall Mallee and *Allocasuarina huegeliana* (DEC 2009*)*. The species nests in hollows of Mallee, Wandoo, York Gum, Flooded Gum and Salmon Gum trees(DEC 2009).	**Likely** The Western Rosella (inland pop.) occurs in the wheatbelt region east of Northam of Southwest WA, whilst the south-west population is found towards the south-west coast (DEC 2009, Menkhorst *et al.* 2017). Therefore all records near the Survey Area are that of the Western Rosella (inland pop.). The subspecies was recorded over 10 km south of the Survey Area in 2008 (Western Wildlife 2008) and regularly in the surrounds between 2013 and 2019 (Birdlife Australia 2019, DBCA 2020a). The species may utilise hollows in the *Eucalyptus* woodland habitat (DEC 2009) within the Survey Area for breeding and feed in surrounding areas. As such, the species is Likely to occur within the Survey Area.
Peregrine Falcon (*Falco peregrinus*)		OS	The species occurs along cliffs, gorges, wooded rivers, wetlands, plains and open woodlands, as well as in association with pylons and buildings. Nests on cliffs, in crevices, large tree hollows or on building ledges (Pizzey and Knight 2007).	**Likely** The species was recorded in the surrounds, including records in 2013 - 2015 and 2017 >40km from the Survey Area (Birdlife Australia 2019, DBCA 2020a). Areas of mature Eucalypt trees may provide nesting habitat for the species however the species preferentially nests in cliff faces (Menkhorst *et al.* 2017). As such, the species is considered likely to forage within the Survey Area and may possibly nest within the Survey Area.
Fork-tailed Swift (*Apus pacificus*)	Mi	IA	An aerial species, which forages high above the tree canopy and rarely lower (Johnstone and Storr 1998). Occurs over a range of habitats including islands, open country, coasts, semi-deserts, urban, forests (Pizzey and Knight 2007).	**Unlikely** This species is identified as occurring outside of the Survey Area using the protected matters search tool (DotEE 2020), however was not recorded recently nearby. The species forages over a range of habitats including those in the Survey Area, however is unlikely to rely on particular areas. As such, the species is considered unlikely to occur.

Common name (*Scientific name*)	Conservation status		Habitat Preferences	Likelihood of occurrence and justification
	EPBC	WA		
Curlew Sandpiper (*Calidris ferruginea)*	Cr; Mi	Cr	Small to large sized shore birds. Inhabit shallow aquatic areas on coasts, mudflats, saltmarshes, estuaries, lake margins and other inland waters and bore or grassy plains (Johnstone and Storr 1998, Menkhorst *et al.* 2017).	**Unlikely** The species was flagged by the PMST (DotEE 2020) but was not recorded nearby. Furthermore, while the species may use saline depressions and claypan habitat, the Survey Area occurs outside the species regular range (Menkhorst *et al.* 2017). As such the species is considered unlikely to occur within the Survey Area.
Sharp-tailed Sandpiper (*Calidris acuminata)* Pectoral Sandpiper (*Calidris melanotos)*	Mi	IA		**Unlikely** The Sharp-tailed Sandpiper and Pectoral Sandpiper have no records within or near the Survey Area, but were flagged by the PMST (DotEE 2020). Furthermore, the Survey Area occurs in the irregular range of the Sharp-tailed Sandpiper and outside of the range of the Pectoral Sandpiper (Menkhorst *et al.* 2017). As such, these species are considered unlikely to occur.
Common Greenshank (*Tringa nebularia)*				**Likely** The species was recorded in 2007 and 2011 at Southern Cross, >35km northwest of the Survey Area (Birdlife Australia 2019, DBCA 2020a). The Survey Area would be suitable in the saline depressions and claypan habitat and occurs within the species range. As such, the species is considered likely to occur.
Common Sandpiper (*Tringa hypoleucos)*				**Possible** The species was recorded at Southern Cross >35km northwest of the Survey Area (Birdlife Australia 2019). While there is more optimal habitat in the surrounds (e.g. chains of depressions), the Survey Area contains suitable habitat in the saline depressions and claypan area and occurs within the species range. As the species was only recorded once 13 years ago it is considered to possibly occur.

Common name (*Scientific name*)	Conservation status		Habitat Preferences	Likelihood of occurrence and justification
	EPBC	WA		
Hooded Plover (*Thinornis cucullatus)*		P4	A small shore bird species, inhabiting coastal beaches and lakes, and the margins of inland salt lake sin the southwest of Australia (Menkhorst *et al.* 2017)	**Unlikely** While the species may use saline depressions and claypan habitat within the Survey Area, the species was only flagged by the PMST (DotEE 2020) but was not recorded nearby. As such the species is considered unlikely to occur within the Survey Area.
Night Parrot (*Pezoporus occidentalis*)	En	Cr	Known to inhabit treeless or sparsely wooded long unburnt spinifex hummock plains often interspersed with chenopods (Pyke and Ehrlich 2014).	**Unlikely** This species, or its habitats were identified as potentially occurring within the Survey Area using the PMST (DotEE 2020). However, the Survey Area does not contain spinifex, or other suitable roosting vegetation associated with drainage/ low lying areas that promote foraging (DPaW 2017, Murphy *et al.* 2017). While there are no records of the species nearby, there is limited information available regarding the species range and the species is elusive and seldomly recorded. However the Survey Area occurs outside priority areas for species surveys and the species range (DPaW 2017, Menkhorst *et al.* 2017).
Grey Wagtail (*Motacilla cinerea*)	Mi	IA	Grey Wagtails are listed as rare vagrants to the Australian continent from the North. Inhabit areas associated with water including running water/ streams, sewage ponds, swamp margins and saltmarshes and lawns, ploughed fields and airfields (Pizzey and Knight 2007).	**Unlikely** This species, or its habitats were identified as potentially occurring within the Survey Area using the PMST (DotEE 2020). No records of the species exist near the Survey Area and there is minimal habitat suitable for the species. As such, the species is considered unlikely to occur.
Reptilia				
Woma Python (southwest pop) (*Aspidites ramsayi*)		P1	Woodlands, heaths and shrublands, often with spinifex. Shelters mainly in abandoned monitor and mammal burrows and in soil cracks (Wilson and Swan 2013), with evidence of arboreal behaviour identified (Bruton 2013).	**Likely** Database searches returned six records for the species occurring within approximately 40 km of the Survey Area, however, all records are undated vouchered specimens (DBCA 2020a, d). Despite this, as the Survey Area contains suitable habitat and occurs within the species range, the species is considered likely to occur.

Common name (*Scientific name*)	Conservation status		Habitat Preferences	Likelihood of occurrence and justification
	EPBC	WA		
Lake Cronin Snake (*Paroplocephalus atriceps*)		P3	Occurs in a relatively restricted area, found in the vicinity of Lake Cronin and on a granite outcrop called Peak Eleonora	**Possible** The species was recorded on one occasion in the surrounds in 2007, >30km south of the Survey Area (DBCA 2020a). As the Survey Area occurs just north of the species predicted range, which is relatively restricted, the species is considered to possibly occur.
Invertebrates				
Brine shrimp (*Parartemia contracta*)		P1	Inland acidic salt lakes to pH 3.5 in the northern, central and southern Wheatbelt of Western Australia (Timms 2014).	**Unlikely** The species was recorded in the Threatened and Priority Fauna database four times between 1997 and 2007 at Moorine South Lake over 40km from the Survey Area (DBCA 2020a). While the Survey Area contains saline depressions and claypan habitat, this comprises a small, isolated samphire shrubland rather than areas of salt lake playa or a chain of depressions similar to where the previous records occur (DBCA 2020a). As such, the species is considered unlikely to occur.
Water flea (*Daphnia jollyi*)		P1	Restricted to shallow, soft-water, granite-rock domes in the wheatbelt region of Western Australia (Colbourne *et al.* 2006).	**Unlikely** This species was recorded from 1990 to 2007 over 20km from the Survey Area (DBCA 2020a). No areas of granite rock occur within the Survey Area; thus the species is considered unlikely to occur.
Tree-stem trapdoor spider (*Aganippe castellum*)		P4	Flood-prone depressions and flats which support myrtaceous shrub communities. areas with Broombush (*Melaleuca uncinata*) and Sheoaks (such as *Allocasuarina acutivalvis*) in sandy loam soils are important habitat for the species (Inglis 2008).	**Likely** This species was recently recorded ~3km southeast of the Survey Area in 2007 and from two locations >40km south of the Survey Area in 2009 (DBCA 2020a). Based on the proximity of records and similar habitat to the current Survey Area, this species is considered likely to occur.

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Stantec

24 August 2021
Senior Environmental Advisor
Barto Gold Pty Ltd

Dear Haydn,

This memorandum comprises the results of the Targeted Chuditch survey (the Survey) undertaken for Barto Gold Pty Ltd (Barto) on their Southern Cross Operations tenements (the Survey Area). The Chuditch (also referred to as Western Quoll) (*Dasyurus geoffroii*) is listed as Vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Vulnerable under the Biodiversity Conservation Act 2016. The purpose of this Survey was to determine the presence of Chuditch (Vu; Vu) across the Survey Area to support environmental approvals for the Project. The Survey was conducted by Stantec zoologists Steph Williams and Melissa Jensen using 60 Reconyx Hyperfire-2 motion cameras over two deployments: 20th to 26th March 2021 (deployment 1) and 22nd June to the 25th July 2021 (deployment 2). After Chuditch were initially detected on a motion camera deployed in March, the Survey 2 scope increased to incorporate a wider survey area to specifically target Chuditch.

A total of 13 cameras were set up during deployment 1 for a period of up to 31 consecutive nights. While an additional 47 cameras were deployed during deployment 2 for a period of up to 32 nights, resulting in a total of 60 motion cameras deployed throughout the cumulative survey period for a total of 1,783 camera trap nights. Universal bait (a mixture of sardines, rolled oats and peanut butter) was used to attract animals and cameras were deployed in habitats likely to support or be used by Chuditch (**Table 1**). Motion cameras were deployed with an emphasis on directing cameras towards fallen trees, hollow logs or rock piles with the potential to contain shelter sites (Rayner *et al.* 2012).

All images were analysed by Stantec zoologists, with a total of 79 detections of Chuditch recorded across 13 cameras, with all of the detections grouped in the southern portion of the Survey Area (**Table 1**, **Figure 1**). Of the 13 cameras on which Chuditch were detected, nine were within *Eucalyptus* Woodland habitats and the remaining four located within Shrubland habitat (**Table 1**). This indicates that both *Eucalyptus* Woodlands and Shrublands are important habitats for Chuditch within the Survey Area, with both habitat types ideal for foraging and sheltering purposes.

The density of *Eucalyptus* Woodland and Shrubland within the southern portion of the Survey Area coupled with the lack of clearing and habitat fragmentation, could support several individuals and give an indication as to why there was a higher number of Chuditch detected here. Cameras were also deployed towards the end of the mating season, so increases in activity could be contributed to males looking for mates and the increased dietary demands of females with pouch young. Chuditch have large home ranges (males approximately 15 km^2 and females ~4 km^2) so they are likely to roam through and between these habitats naturally (DEC 2012a, Soderquist 1988).

A known Chuditch population exists approximately 50 km to the south of the Survey Area at Mt Holland Mine (DBCA 2021, Western Wildlife 2017). Male Chuditch have home ranges that overlap those of several females, and in cases where females are distributed in less density males may have an increased home range (Serena and Soderquist 1989). Additionally, juvenile males have been recorded travelling more than 10 km whilst dispersing (Soderquist and Serena 2000). It is possible that there may be an overlap between the populations at Mt Holland Mine and those in the southern half of the Survey Area.

The Western Brush Wallaby (*Macropus irma)* which is listed as a Priority 4 (P4) species by the Department of Biodiversity Conservation and Attractions (DBCA), was recorded on motion cameras at two locations. The two records were within the southern half of the Survey Area within Shrubland habitat. The Western Brush Wallaby notably favours more open Shrubland, which occurs across the Survey Area (DEC 2012b)(**Table 2**).

Table 1: Summary of Chuditch (*Dasyurus geoffroii*) individuals recorded during the Survey.

Figure Reference	Coordinates (50J)		Habitat Type	Camera Trap Nights	Nights with Chuditch Activity (Distinct Visits*)	Photograph
	Easting	Northing				
REC65	*736064 mE*	*6500907 mN*	*Eucalyptus Woodland*	*32*	*1(1)*	
REC70	*741409 mE*	*6514981 mN*	*Shrubland*	*31*	*6(10)*	
REC61	*743412 mE*	*6504712 mN*	*Eucalyptus Woodland*	*30*	*4(12)*	

Figure Reference	Coordinates (50J)		Habitat Type	Camera Trap Nights	Nights with Chuditch Activity (Distinct Visits*)	Photograph
	Easting	Northing				
REC98	*743092 mE*	*6506189 mN*	*Eucalyptus Woodland*	*32*	*3(4)*	
REC99	*743275 mE*	*6505569*	*Shrubland*	*32*	*1(1)*	
REC68	*742717 mE*	*6503994 mN*	*Eucalyptus Woodland*	*30*	*7(14)*	

Figure Reference	Coordinates (50J)		Habitat Type	Camera Trap Nights	Nights with Chuditch Activity (Distinct Visits*)	Photograph
	Easting	Northing				
REC85	*742717 mE*	*6503994 mN*	*Shrubland*	*3*	*4(13)*	
REC59	*743532 mE*	*6502352 mN*	*Eucalyptus Woodland*	*30*	*5(11)*	
REC75	*744238 mE*	*6503465 mN*	*Eucalyptus Woodland*	*30*	*4(8)*	

Figure Reference	Coordinates (50J)		Habitat Type	Camera Trap Nights	Nights with Chuditch Activity (Distinct Visits*)	Photograph
	Easting	Northing				
REC02	*749025 mE*	*6503340 mN*	*Eucalyptus Woodland*	*31*	*2(2)*	
REC86	*743670 mE*	*6512520 mN*	*Eucalyptus Woodland*	*31*	*1(1)*	
REC123	*740992 mE*	*6511029 mN*	*Shrubland*	*31*	*1(1)*	

Figure Reference	Coordinates (50J)		Habitat Type	Camera Trap Nights	Nights with Chuditch Activity (Distinct Visits*)	Photograph
	Easting	Northing				
REC101A	*743164 mE*	*6506243 mN*	*Eucalyptus Woodland*	*32*	*1(1)*	

***** Distinct visits: Detections separated by a period of 30 minutes were considered as a new detection and distinct visit.

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Table 2: Summary of Western Brush Wallaby (*Macropus Irma;* P4) individuals recorded during the Survey

Figure Reference	Coordinates (50J)		Habitat Type	Camera Trap Nights	Nights with Western Brush Wallaby Activity (Distinct Visits*)	Photograph
	Easting	Northing				
REC85	*742717 mE*	*6503994 mN*	*Shrubland*	*3*	*1(1)*	
REC99	*743275 mE*	*6505569 mN*	*Shrubland*	*32*	*1(1)*	

***** Distinct Visits: Detections separated by a period of 30 minutes were considered as a new detection and distinct visit.

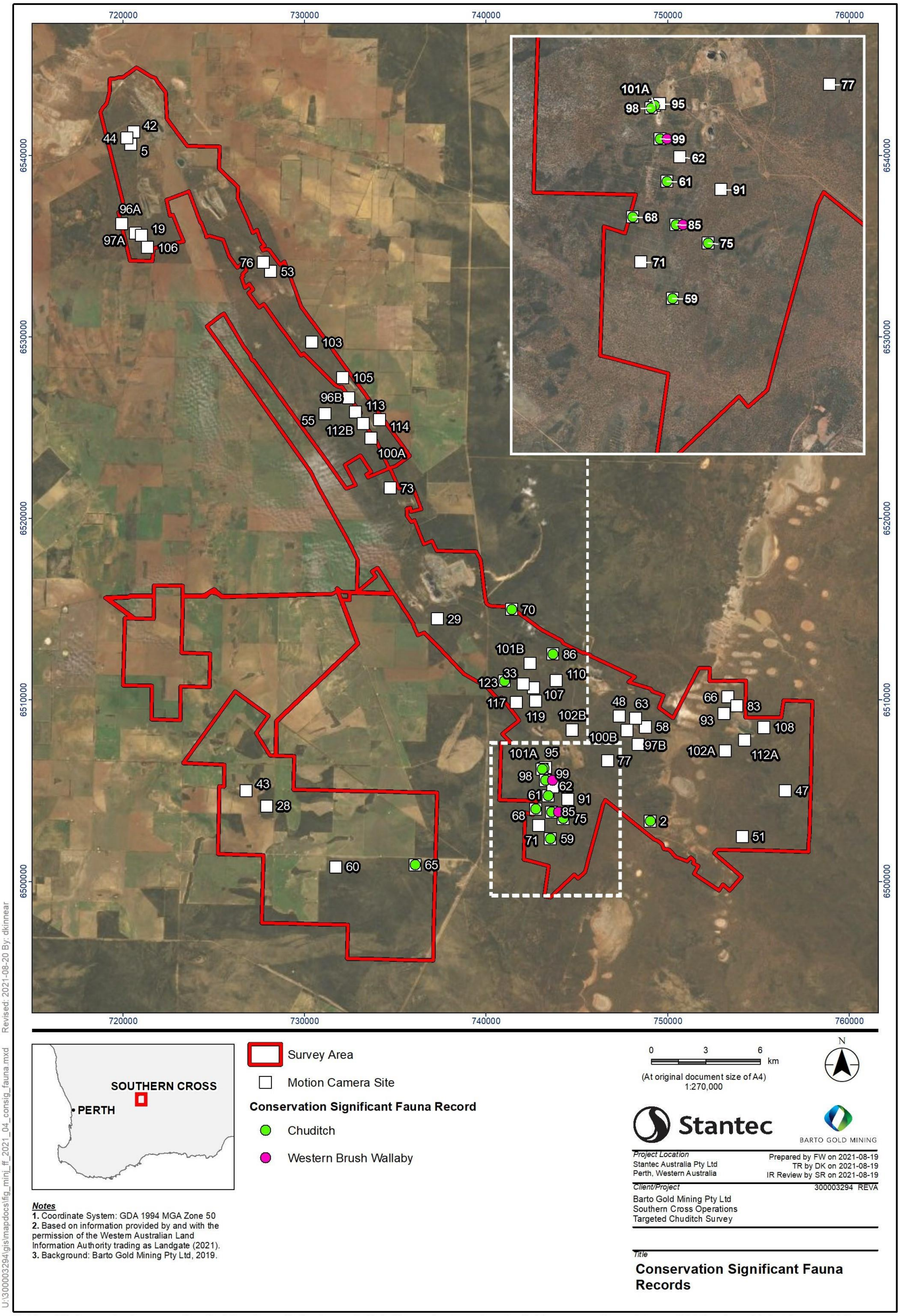

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Figure 1: Conservation Significant Fauna records within the Survey Area. Individual cameras units deployed twice are labelled with an 'A' suffix for deployments in March, and 'B' for deployments in June/July.

Chuditch once ranged across 70% of the Australian mainland but are now restricted to the south-west of Western Australia and a small number of reintroduced populations in Western Australia and South Australia (Morris 2003, Moseby *et al.* 2021). A major threat to remaining Chuditch populations is the clearing of land, particularly the destruction or removal of log hollows and denning sites (DEC 2012a). The majority of the Survey Area lies within the boundary of the Coolgardie Interim Biogeographic Regionalisation for Australia (IBRA) bioregion, with a small portion within the highly fragmented and intensive agricultural Avon Wheatbelt IBRA region. The lack of habitat fragmentation within the Coolgardie bioregion and within the southern half of the Survey Area may provide important shelter and foraging habitat for Chuditch populations.

Future mining development including clearing and/or disturbance of Chuditch habitat should aim to minimize habitat loss and prevent further fragmentation of habitat within the Survey Area. Removal and/or disturbance of dense Shrubland and *Eucalyptus* Woodland habitats within the Survey Area should be limited wherever practicable.

Yours sincerely,

Reviewed by:

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References

DBCA, Department of Biodiversity Conservation and Attractions. (2021) *Threatened and Priority Fauna Database (custom search)*.

DEC, Department of Environment and Conservation. (2012a) *Chuditch (Dasyurus geoffroii) Recovery Plan: Wildlife Management Program No. 54*, Perth, Western Australia.

DEC, Department of Environment and Conservation. (2012b) *Fauna Profiles: Western Brush Wallaby Macropus irma (Jourdan, 1837)*.

Morris, K., Johnson, B., Orell, P., Gaikhorst, G., Wayne, A. & Moro, D. (2003) Recovery of the threatened Chuditch (Dasyurus Geoffroii): A case study. *In M. Jones. (Ed.) Predators with pouches, The biology of carnivorous marsupials* CSIRO.

Moseby, K. E., Hodgens, P., Peacock, D., Mooney, P., Brandle, R., Lynch, C., West, R., Young, C. M., Bannister, H., Copley, P. and Jensen, M. A. (2021) Intensive monitoring, the key to identifying cat predation as a major threat to native carnivore (Dasyurus geoffroii) reintroduction. *Biodiversity and Conservation* 30(5): 1547-1571.

Rayner, K., Chambers, B., Johnson, B., Morris, K. D. and Mills, H. R. (2012) Spatial and dietary requirements of the chuditch (Dasyurus geoffroii) in a semiarid climatic zone. *Australian Mammalogy* 34(1): 59-67.

Serena, M. and Soderquist, T. R. (1989) Spatial organization of a riparian population of the carnivorous marsupial Dasyurus geoffroii. *Journal of Zoology* 219(3): 373-383.

Soderquist, T. R. (1988) The ecology of Chuditch (Dasyurus geoffroii) in the Jarrah forest: a summary of facts relevant to management. *Unpublished document*.

Soderquist, T. R. and Serena, M. (2000) Juvenile behaviour and dispersal of chuditch (Dasyurus geoffroii) (Marsupialia : Dasyuridae). *Australian Journal of Zoology* 48(5): 551-560.

Western Wildlife. (2017) Earl Grey Lithium Project: Level 2 vertebrate fauna survey with targeted Chuditch and Malleefowl surveys.